Agilio OVS 2.2
General Availability Release

Build 4603 - 2016-08-02

Release Notes
Document version 1.1

Notable New Features and Fixes

This release offers the following new features and capabilities.

New Platforms and Modes

1. This release introduces support for 2x10GbE Agilio-CX low profile Intelligent Server Adapters.
2. This release introduces support for 1x40GbE / 2x40GbE Agilio-CX low profile Intelligent Server Adapters.
3. This release introduces the experimental Conntrack mode of the Agilio OVS software.
4. This release introduces the Trivial NIC mode used for very basic communication while OVS is not running.
5. This release introduces Debian/RPM package installation options.

New Dataplane and Controlplane Features

6. Checksum offloading on egress can be enabled or disabled for DPDK applications.
7. Generic VLAN offloading
    a. Linux VLAN subinterfaces can now be configured for physical port representative netdevs.
    b. This feature can be configured with any Linux utility capable to do so normally, e.g. the `ip` utility.
8. Load Balance with Group Select
    a. Supports accelerated load balance for group select operations.
    b. Supports up to 1k groups and a cumulative total of 16k buckets.
9. Link Aggregation/Bonding with LACP
    a. Introduces support for accelerated tcp-balance bond mode.
    b. Supports the ability to enable LACP in a bond.
    c. Supports Active/Active and Active/Passive modes.
    d. Supports up to 128 ports on a bond (accelerated, up to 8 tested).
10. Tunnels in Combination with Link Aggregation
    a. Supports accelerated tunnels over link aggregated ports in tcp balanced mode.
    b. Supports NVGRE, VXLAN and VXLAN-GPE tunnels over link aggregated ports.
11. OVS version 2.5
    a. Supports OVS 2.5.1 LTS.
    b. Supports accelerated masked actions, which may result in a significant reduction of datapath flow and repeated hash entries when using set action rules.
12. PXE Boot
    a. This release of Agilio OVS supports 64bit UEFI boot mode PXE booting via the Agilio Intelligent Server Adapter ports.
    b. Agilio OVS conforms the latest PXE and UNDI specifications.
13. Openstack – VM + Networking Provisioning
    a. This release introduces low-level support for OpenStack Liberty, with compatibility expected for earlier and later versions of OpenStack. Important:

Security groups must be disabled on the OpenStack integration bridges.

b. Two new interfaces are available to manage SR-IOV Virtual Functions:
   i. /sys/module/nfp_fallback/control/vf_netdevs_pcie is available to describe the mapping between fallback netdevs and PCIe addresses.
   ii. The relevant netdev ops have been exposed to set and query the virtual function (VF) mac address from the host on the next functional level reset (FLR). The following command is an example of how to access these using standard tools:
   ip link set dev sdn_v0.0 vf 0 mac 0e:0d:0e:0f:01:02
c. Added agilio-ovs-*-extras.tar.gz package containing the following:
   i. Updated libvirt to allow the use of a PCIe VF pool using the two new interfaces mentioned in 9(b).
   ii. An example patch to modify OpenStack Nova to use the extended libvirt interface.
d. For further information and technical details, consult the README.extras file in the agilio-ovs-*-extras.tar.gz package.
e. Added agilio-ovs-*-fuel.tar.gz package containing the Openstack Fuel deployment packages and information.
f. For further information and technical details, consult the agilio-fuel-README.txt in the agilio-ovs-*-fuel.tar.gz package.

VirtIO Relay

An optional VirtIO Relay daemon has now been added to Agilio OVS 2.2. This daemon can relay packets between selected SR-IOV VFs on the host, and VirtIO devices in QEMU virtual machine guests. The benefit of this is that any guest OS supporting VirtIO can be used. See Section 3.7 in the User's Guide for additional information on the configuration and usage of the VirtIO Relay.

DPDK 16.04

DPDK version 16.04 is now also bundled with Agilio OVS 2.2, in addition to DPDK 1.8 and DPDK 2.2. The DPDK 2.2 version is built by default and symlinked from `/opt/netronome/srcpkg/dpdk-ns` . However one may build any of the other DPDK versions by executing one of the following commands in the `/opt/netronome/srcpkg/` directory:

- `make build_dpdk1.8`
- `make build_dpdk2.2`
- `make build_dpdk16.04`

Supported Platforms

The following platforms are supported in this build.

1. 2x40GbE and 1x100GbE Agilio-LX Intelligent Server Adapters, with 8GB DRAM, are fully supported.
    - These can optionally be combined with a PCIe expansion card, enabling a second PCIe bus to be used with the Agilio-LX adapter.
    - Only one PCIe expansion card may be connected to each Agilio-LX card.
    - The PCIe expansion card must be connected using two cables.
    - 2x40GbE Intelligent Server Adapters are supported in 2x40GbE, 8x10GbE and 1x40GbE + 4x10GbE mode.
    - 1x100GbE Intelligent Server Adapters are supported in 1x100GbE, 2x40GbE or 10x10GbE mode.
2. 1x40GbE Agilio-CX Intelligent Server Adapters, with 2GB DRAM, are fully supported, in 1x40GbE or 4x10GbE mode.
3. 2x10GbE Agilio-CX Intelligent Server Adapters, with 2GB DRAM, are fully supported.
4. 2x40GbE Agilio-CX Intelligent Server Adapters, with 2GB DRAM, are fully supported, in 2x40GbE, 8x10GbE and 1x40GbE + 4x10GbE mode.

The following platforms are NOT supported in this build:

1. NFP-3xxx (“Yeldham”) based hardware.

Installation and Usage

1. For installation instructions, refer to `README.installation` in the distribution archive.
    - All the required dependencies must be installed on the target platform (host OS) before attempting to install the software.
    - Kernel source code must be available on the host OS and the guest OS. Ensure it is available before attempting to install the software.
    - Agilio OVS 2.2 must be reinstalled when upgrading or downgrading the kernel version on the host OS. This is only required on guest OS that make use of the `nfp_uio.ko` kernel module for DPDK usage.
    - Linux kernels exhibit undesired behavior in PCIe configuration code. Netronome submitted a fix to the kernel maintainers for this issue. This has been accepted into kernel version 4.5. As you will probably be using an older kernel at this stage, a patch needs to be applied to the kernel source code, or an already patched kernel needs to be installed. For your convenience, packages containing patched versions of the default kernels for various Ubuntu 14.04 LTS and RHEL/CentOS 7 variants are available on Netronome’s support site (http://support.netronome.com). To install these, transfer the package files to a subdirectory on your system, change to that subdirectory, and enter:

      `dpkg -i *.deb` (on Ubuntu systems), or:

      `rpm -Uvh *.rpm` (on RHEL/CentOS systems).

      Contact Netronome support if you require assistance.
2. For usage instructions, refer to the Getting Started Guide, as well as the Open vSwitch (OVS) manuals, obtainable at: http://openvswitch.org/support/dist-docs/

    - To start or stop the system, enter "`ovs-ctl start`" or "`ovs-ctl stop`".
    - For system configuration usage instructions, enter "`ovs-ctl --help`".
3. API documentation can be found in the Agilio OVS 2.2 Programmer's Reference Manual.
4. In many Linux distributions, the iproute2 package's default receive netlink buffer size is insufficient to contain the netlink responses generated by the kernel. This causes the error "`Message Truncated`" to be printed when doing operations such as "`ip link show`". A patch with a workaround is available in the `sdn-2.2/extras/iproute2` directory in the installation sources.
5. For the experimental Conntrack Agilio OVS installation instructions refer to `README.installation` in the distribution archive or the Getting Started Guide.

Debian package based installation

1. Included in this package are scripts that will build installable `.deb` packages for Agilio OVS to aid deployment. For this release, Ubuntu 14.04 is supported. Refer to the `README.package` guide for building requirements. It is recommended to have a clean reference setup to build packages for deployment. Previous installations of Agilio OVS, extra kernel modules, and libraries installed in `/usr/local` will lead to undefined behaviour and must be uninstalled prior to attempting the installation of the Debian packages.
2. To bootstrap the package build, the following steps are recommended:
   ```
   dpkg -i sdn-2.2/nfp-bsp/nfp-bsp-release-2015.11*.deb
   make -f Makefile.package bootstrap
   dpkg -i _build_deb/agilio-ovs-common*.deb
   apt-get -f install
   ```
3. After the above steps, packages can be prepared by using:
   ```
   make -f Makefile.package
   ```
4. The following `/etc/netronome.conf` settings are recommended for `.deb` based installs:
   ```
   SDN_VERBOSE="y"
   SDN_VIRTIORELAY_ENABLE="n"
   SDN_BIND_VF_DRIVER="none"
   ```
5. Note that DPDK is not installed for the `.deb` based install. A source-based solution is in development for future release.

OpenStack Fuel deployment

1. Packages are available to aid in deployment in an OpenStack Fuel based install. Consult `agilio-fuel-README.txt` in the agilio-ovs-*-fuel.tar.gz package for detailed installation instructions.
2. Currently, only Ubuntu 14.04 slave nodes are supported, with other distributions in development.
3. A heterogenous environment is supported, where some nodes have Agilio adapters and some do not.

4. Security Groups need to be disabled globally on the OpenStack cloud deployed if acceleration is desired.

Intelligent Server Adapter Port Configuration - mx10GbE vs nx40GbE vs 1x100GbE

1. Each physical port can be configured to operate either in mx10GbE mode (i.e. breakout mode) or in nx40GbE / 1x100GbE mode (i.e. native single port mode).
2. Appropriate fiber cables need to be attached - in the nx40GbE or 1x100GbE configuration, regular MTP fiber needs to be attached, and in the mx10GbE configuration, MTP to 10GbE LC breakout fiber needs to be attached.
3. The non-breakout mode (nx40GbE or 1x100GbE depending on the card model) is the default. Should you wish to reconfigure your card for mx10GbE operation, use the following procedure. All commands should be entered while logged in as user `root`.
    - Before attempting the following, ensure that the software has been installed.
    - Configure the card to operate in mx10GbE mode by entering a command like the following. (This example configures a 2x40GbE card for 8x10GbE operation. The procedure is analogous to configure a 1x40GbE card for 4x10GbE operation.)
      `/opt/netronome/bin/nfp-media phy0=4x10G phy1=4x10G`
    - Configure the card to operate in 2x40GbE mode again by entering:
      `/opt/netronome/bin/nfp-media phy0=40G phy1=40G`
    - When using mixed configurations (40GbE on one port, 4x10GbE on another port), the highest numbered port must be the 40GbE port.
    - After configuring or reconfiguring the card, reboot the host platform.
    - Re-installing the software should preserve the selected configuration.
    - To display the current setting, enter:
      `/opt/netronome/bin/nfp-media -L`

Intelligent Server Adapter PXE Boot Port Configuration

1. Depending on the port configuration of the Intelligent Server Adapter, multiple ports may be configured for PXE boot purposes.
2. After Agilio OVS 2.2 installation, only port 0 will be configured for PXE boot.
3. Additional bootable ports may be configured with the following procedure:
    - Before attempting the following, ensure that the software has been installed.
    - To display the current bootable ports, enter:
      `/opt/netronome/bin/ nfp-hwinfo | grep eth.*boot`
    - The bootable state of each port will be displayed with 1 indicating the port is bootable and 0 indicating the port is not bootable.
    - To modify the bootable state of a port, enter:
      `/opt/netronome/bin/ nfp-media --set-hwinfo ethN.boot=1`
    - Where N is the ethernet instance as displayed in the output of the `nfp-hwinfo` command above.
    - After configuring or reconfiguring the card, reboot the host platform.

4. Ensure that ports are appropriately enabled in the host system BIOS settings. Refer to the BIOS documentation for more details on this procedure.

Trivial NIC Mode

1. The firmware and kernel modules are added to the initramfs during Agilio OVS installation. On system boot, the Agilio OVS firmware and kernel modules will be loaded to provide very simplistic access to the physical ports of the Intelligent Server Adapter without OVS running.
2. The representative netdevs `sdn_pX` and `sdn_vX.Y` will be available directly after system bootup. Even though VF representative netdevs are available, traffic sent to these netdevs will be dropped.
3. The physical port representative netdevs, i.e. `sdn_pX`, can be used as any other ‘dumb NIC in this mode. For example establishing an IP network connection to a peer. Such connections will be kept active even while OVS is started, granted standard OVS behaviour is taken into account, e.g. if the particular representative netdev is attached to an OVS bridge, the peer connection will not stay active unless OVS is configured appropriately.
4. This mode supports no forwarding or offloading features and will thus not provide any performance benefit.
5. Agilio OVS stop, start or restart operations will not reset the firmware as was the case with previous Agilio OVS versions.
6. Refer to the User Guide for more details on the usage of this feature.

Known Issues and Limitations

This build exhibits the following known issues and has the following limitations:

Note that some of the issues and limitations apply to the upstream version of OVS on which this build is based. These are identified by the text “Upstream OVS limitation” and also apply to the accelerated version.

Installation

1. Ubuntu 16.04 LTS is not supported by this release (Upstream OVS limitation).
2. GCC version 5.x is not supported by this release (Upstream OVS limitation).
3. Host systems running CentOS/RHEL may experience a problem with the OS using older Agilio OVS kernel modules contained in the weak-updates directory when a kernel update has been performed. The installation process will detect and warn the user if this state is detected. To rectify the problem, uninstall the `nfp-bsp-dkms` package with the `yum remove nfp-bsp-dkms` command and remove all remaining `nfp*.ko` kernel modules found in the `/lib/modules/$(uname -r)/` directory. After this has been done, reinstall the Agilio OVS software.
4. If the firewalld service is in use on the server, the ‘`CleanupOnExit=no`’ configuration option is required in `/etc/firewalld/firewalld.conf` file. If this configuration option is not specified, the system may get stuck on reboot due to firewalld unloading the Agilio OVS kernel modules incorrectly.
5. This Agilio OVS release only supports a single Intelligent Server Adapter installed on the host server.

PCIe

6. The host system must support ARI on the PCIe bus(es) to which the NFP is attached. Recent Xeon E5 and E7 based systems typically have the required capabilities.
7. This build supports the use of VFs 0 to 59 on PCIe buses 0 and 1. The corresponding netdev names are `sdn_v0.0` to `sdn_v0.59` for the first PCIe bus, and `sdn_v1.0` to `sdn_v1.59` for the second PCIe bus. The other VFs / netdevs are reserved. VFs bound to netdevs (in the host OS or the OS running in the VM) will acquire OS-specific names.

Networking

1. Fragmented traffic is processed according to the configured mode, but not all modes are supported. Refer to the OVS documentation for details. (Upstream OVS limitation.)
2. VLAN operations only cater for a single VLAN tag. Matching or creating “q-in-q” traffic is not supported. (Upstream OVS limitation.)
3. Some OpenFlow fields are supported by OVS for matching, but not for action processing: these fields are read-only as far as action processing is concerned. Refer to the OVS documentation for details. (Upstream OVS limitation.)

4. Sending malformed IPv6 packets with IPv6 flow rules in place could result in incorrect OpenFlow flow statistics being observed. (Upstream OVS limitation.)
5. This build supports an MTU of up to 9000 (corresponding to an Ethernet frame size of 9014 bytes, excluding the FCS, and excluding a VLAN tag). The MTU can be reduced or increased as needed (by reconfiguring netdev or DPDK poll mode drivers).
6. Checksum offloading on ingress (i.e. checksum validation) is not supported for MPLS traffic.
7. The Supported/Advertised link modes shown by `ethtool` on the physical port representative netdevs (e.g. sdn_p0) does not reflect the true state of the populated QSFP.
8. Up to a total of 4096 VLAN subinterfaces can be offloaded, spread over any number of physical ports. These VLAN subinterfaces are independent of OVS configuration.
9. Note that all standard OS limits apply to configuring many netdevs on the host system, e.g. open file descriptor limits etc. Refer to the applicable distribution documentation to modify the system configuration if any of these limits are reached.
10. Only single tagged VLAN configurations are supported for offloading. Nested VLAN subinterfaces are not supported.
11. Directing packets to multiple tunnel ports in a single OVS flow rule is not supported.

Flow Table

1. Should the exact match portion of the Flow Cache be full, but a wild card match is found, the wild card entry will be used; this will reduce performance slightly.
2. Although the Programmer's Reference Manual refers to a Flow Cache exact match API, this API is not supported yet. Use the wildcard table (OpenFlow table) API instead. By refraining from supplying any wildcards, it can be used as a replacement for the dedicated exact match API.
3. This build omits the following fields from the flow tracking table (flow cache) key.
    - TCP flags
    - Tunnel header source and destination transport layer (e.g. UDP) ports

   Policies that vary according to specific values of these fields are therefore not supported yet.

Tunnels

1. When matching MPLS tagged traffic, it is not possible to also match headers (e.g. IP headers) located within MPLS. (Upstream OVS limitation.)
2. Various other MPLS related limitations and restrictions apply. Refer to the OVS documentation and release notes for details. (Upstream OVS limitation.)
3. Tunnel termination and origination such that the outer headers consist of VXLAN or NV-GRE within MPLS is not supported.
4. Tunnel configurations with multiple local IP addresses configured to use the same destination address are not supported.

5. Tunnel termination can only be offloaded for the first 32 active IP addresses on the host system. Specific IP addresses can be configured in the NFP for this purpose. Refer to the relevant section in the User Guide for configuration of this feature.
6. When more than 85 IP addresses are configured on the host, the kernel does not provide these configured IP addresses via Netlink to the Agilio OVS process. This results in 'Invalid NetLink response received' warning messages logged in the OVS log. The system IP addresses will then not be available for terminating tunnels on this host. To work around this issue, reduce the number of configured IP addresses, or configure the required IP addresses in OVSDB. Refer to the relevant section in the User Guide for guidance on configuring IP addresses for tunnel termination.

Command Line Usage and Health Checking / Debugging

1. The system cannot be started or stopped (`ovs-ctl start` / `ovs-ctl stop` / `ovs-ctl restart` etc.) while a health checking operation (`ovs-ctl status`) or another start / stop operation (`ovs-ctl start` / `ovs-ctl stop` / `ovs-ctl restart` etc.) are in progress.
2. After an `ovs-ctl troubleshoot` operation has been performed, the host needs to be rebooted, as this operation needs to disturb the internal state of the system in order to capture sufficient system information to enable debugging dataplane issues.

Performance and Capacity

1. Traffic may be reordered, dropped, or forwarded with varying latency. (Upstream OVS limitation.)
    - The system may for example drop packets if a burst of packets destined to a newly configured tunnel or a newly established microflow arrive.
    - While the system's typical / average network to network latency is approx. 10 microseconds, latencies of 10 milliseconds or more can be observed for packets that traverse the host OVS datapath (i.e. require fallback processing).
2. The supported throughput can vary according to the installed flow table entries and the traffic characteristics. (Upstream OVS limitation.)
3. OpenFlow port numbers larger than 65,279 (0xfeff) are reserved. (Upstream OVS limitation.)
4. The flow tracking table (flow cache) tracks up to eight million concurrent microflows on Agilio-LX adapters, and up to two million concurrent microflows on Agilio-CX adapters. Packets associated with microflows that could not be stored in the exact match table because it is full will be processed in a stateless manner using the wildcard table. The wildcard table supports up to one million masked flow entries on Agilio-LX adapters, and up to five hundred thousand masked flow entries on Agilio-CX adapters, exceeding which flow processing will be performed on the host. The accelerated datapath supports a maximum of 250 unique masks (match field combinations) with the wildcard matching performance degrading gracefully as more masks are utilized concurrently. Exceeding the number of supported masks will further degrade performance by processing those flows for which a mask cannot be stored on the host.

5. The IP stack neighbor table (i.e. ARP table) is only guaranteed to support up to 16,000 entries. It may be able to accommodate more entries though - this limit is not strictly enforced. If this table is full, traffic associated with entries that could not be stored is sent via the slow path until an older entry times out to make room for the applicable new entry.
    - The Linux neighbor table has a default capacity of 1,024.
6. Classifying the first few packets of each microflow could involve the OVS software running on the host (so-called fallback processing). The host datapath exhibits higher latencies and lower throughput than the NFP datapath.
7. For optimum performance, and/or to avoid forwarding ceasing due to buffer starvation, ensure that DPDK applications are configured to use enough buffers. In many sample DPDK applications, the following line can for example be amended to increase the number of buffers:
   ```
   #define NB_MBUF 8192
   ```
   Increase the value (e.g. double it) repeatedly until performance reaches a plateau or until error indications are returned by the application. This is especially important when assigning multiple virtual functions (VFs) to a single DPDK application instance.
8. For optimum performance, ensure that DPDK applications process packets in batches or bursts. Consider configuring applications to process 32 or 64 packets at a time for example.
9. Performance optimization is still in progress.

Hypervisor and Virtual Machine Configuration

1. Incorrect memory mappings that might lead to system instability have been observed when the following three conditions occur on an untrusted VM:
    - VF passthrough using an IOMMU with vfio has been enabled,
    - dynamic memory allocation has been enabled (such as ballooning or shared memory pages), and
    - the OS on the VM issues a reboot.

   This has been observed with multiple versions of KVM/QEMU and the Linux kernel. This problem is not specific to Netronome hardware. Two possible workarounds exist: disabling dynamic memory allocation (e.g. pre-allocating the maximum amount of memory), or removing the guest's permission to reboot. While the issue has been reported to upstream providers, the root cause of the problem has not been found and the impact of this is still uncertain.
2. Incorrect memory mappings that might lead to system instability have been observed when:
    - iommu=pt is enabled on the kernel command-line,
    - Ubuntu kernel 3.13 is used, and
    - a VM runs with VF passthrough using vfio.

   This has been identified as an upstream kernel bug that has already been fixed in later kernels: Ubuntu kernels 3.16, 3.19 and 4.4, and CentOS 7 kernel 3.10.0-229.el7 do not exhibit this behavior.

The suggested workaround is to remove iommu=pt from the kernel command-line (this disables DPDK usage in the host), or to upgrade to an unaffected kernel.

Link Aggregation

1. Turning LACP off whilst using tcp-balance mode results in packet loss. (Upstream OVS limitation.)
2. It is required to add a "no-forward" option for the LOCAL port on the bond bridge. Failure to do so leads to un-accelerated flows as all the bonding rules contain a LOCAL port as an output.
3. LACP fails under heavy traffic load and many datapath flow entries; this results in packet loss and unstable LACP. 40G with up to 10k flows works as expected, but failure occurs at 40G with 64k flows.

Trivial NIC

1. When using the 1x100GbE Agilio-LX Intelligent Server Adapters, it has been observed that the Trivial NIC does not startup when the server boots up. This issue could affect PXE booting on this device.

PXE Boot

1. When using the 1x100GbE Agilio-LX Intelligent Server Adapters in 10x10GbE breakout mode, ports 9 and 10 cannot be used for PXE booting at this stage.
2. When using the 1x100GbE Agilio-LX Intelligent Server Adapters, occasionally the Trivial NIC mode does not load during server boot up. This will affect PXE booting (especially with a NFS filesystem configuration) over the Intelligent Server Adapter.
3. Only 64bit UEFI boot mode is supported by the Agilio Intelligent Server Adapters.

Load Balancing

1. Load balancing is achieved based on layer 3 and 4, source and destination address information. Traffic that does not contain layer 3 or 4 will not be spread over multiple buckets. Examples of such traffic include MPLS and ARP. This behaviour differs from previous versions of Agilio OVS, which would have balanced on Layer 2.
2. Configuring load balance group select in Agilio OVS 2.2 differs from the methods used in Agilio OVS 2.1. Users can no longer configure tuples and salts outside of OVS; methods used to achieve this in Agilio OVS 2.1 are no longer applicable to Agilio OVS 2.2.
3. Checksum errors could be observed with set UDP actions in buckets.

Flow statistics

1. An individual packet will be counted twice in the flow statistics when all of the following are true:
    a. The actions for the flow contain one or more of:
        i. Entunnel action
        ii. Group Select
        iii. Link Aggregation output

b. The flow itself has been offloaded to the NFP
c. All of the required data has not yet been provided to the NFP; upper bounds on the time that this can take are:
    i. Neighbour entry available for entunnel action: 1 s
    ii. Group Select: 80 ms
    iii. Link Aggregation: 4 ms

VirtIO Relay

1. It is recommended to use QEMU version 2.5 or newer. Version 2.3 is known to have a memory leak with shared hugepages (see https://lists.gnu.org/archive/html/qemu-devel/2014-10/msg01812.html), we have not established which exact version after 2.3 fixes this issue, but 2.5 does not exhibit the issue. VM live migration with VirtIO Relay has only been successfully tested using QEMU 2.5.
2. Restarting the VirtIO relay while connected QEMU VMs are running is not yet supported. QEMU currently cannot re-connect the vhost-user socket to the relay daemon, and therefore VirtIO connectivity in the VM will only be restored once QEMU is restarted. A future version of QEMU may support this feature (as of May 2016, some patches have been seen on QEMU mailing lists in this regard), or VirtIO relay may change to become a vhost-user client and use QEMU as a vhost-user server, allowing reconnections in the other direction.
3. Forwarding between VFs on host and VirtIO instances in VMs is currently only supported for 1:1 pairs, where each VirtIO instance required will need a host VF connected to the relay.
4. Multiqueue VirtIO is not supported.
5. Jumbo frames are not supported.

DPDK and CONFIG_RTE_MAX_ETHPORTS > 32

1. By default, DPDK enables support for 32 ports. In order to allow a single VirtIO Relay process to service the available ports on an Agilio NIC, this configuration value has been increased to 64 for the bundled DPDK 16.04. The majority of sample applications bundled with DPDK uses a 32-bit port mask to identify ports, resulting in undesired behavior.
2. The configuration of DPDK 2.2 and 1.8 has been left to default. DPDK 16.04 may also be recompiled with other settings if so desired.

