QuCPE-7012
Network Virtualization Premise Equipment
Supports hardware acceleration SR-IOV technology
<table>
<thead>
<tr>
<th>Model</th>
<th>CPU</th>
<th>Memory</th>
<th>Port</th>
<th>Network Module</th>
<th>PCIe Slot</th>
<th>HDD Slot</th>
<th>M.2 SSD Slot</th>
<th>SR-IOV support</th>
</tr>
</thead>
<tbody>
<tr>
<td>QuCPE-7012-D2166NT-64GB</td>
<td>Intel Xeon D-2166NT 12 cores, 24 threads 2.0GHz (Max 3.0GHz)</td>
<td>64GB DDR4 ECC (4x16GB)</td>
<td>10GbE SFP+ x4, 2.5GbE RJ45 x8</td>
<td>1</td>
<td>1x PCIe Gen3 x8</td>
<td>2x 2.5&quot; SATA slots</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>QuCPE-7012-D2146NT-32GB</td>
<td>Intel Xeon D-2146NT 8 cores, 16 threads 2.3GHz (Max 3.0GHz)</td>
<td>32GB DDR4 ECC (2x16GB)</td>
<td>10GbE SFP+ x4, 2.5GbE RJ45 x8</td>
<td>1</td>
<td>1x PCIe Gen3 x8</td>
<td>2x 2.5&quot; SATA slots</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>QuCPE-7012-D2123IT-8GB</td>
<td>Intel Xeon D-2123IT 4 cores, 8 threads 2.2GHz (Max 3.0GHz)</td>
<td>8GB DDR4 ECC (2x4GB)</td>
<td>10GbE SFP+ x4, 2.5GbE RJ45 x8</td>
<td>1</td>
<td>1x PCIe Gen3 x8</td>
<td>2x 2.5&quot; SATA slots</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>QuCPE-3034-C3758R-16G</td>
<td>Intel Atom C3758R 8 cores, 8 threads 2.4GHz</td>
<td>16GB DDR4 (2x8GB)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>2x 2280 M.2 MVMe</td>
<td>V</td>
</tr>
<tr>
<td>QuCPE-3032-C3558R-8G</td>
<td>Intel Atom C3558R 4 cores, 4 threads 2.4GHz</td>
<td>8GB DDR4 (2x4GB)</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>2x 2280 M.2 MVMe</td>
<td>V</td>
</tr>
</tbody>
</table>
Inside the QuCPE

**Intel® Xeon® D**
- Xeon D-2123IT
- Xeon D-2146NT
- Xeon D-2166NT

1 x PCIE Gen3 x 8 FH/HL

1 x Network module
Expansion for 10GbE / 25GbE

8 x 2.5GbE RJ45 ports

Dual 300W Power (Main/Backup)

8 x DDR4 Slots, up to 128GB (U-DIMM) & 256GB (R-DIMM)

2 x 2.5” slots
Support SATA 6Gbps

4 x 10GbE SFP+ Fiber (SR-IOV supported)
# High speed expansion with Network module

<table>
<thead>
<tr>
<th></th>
<th>PulM-10G4SF-XL710</th>
<th>PulM-10G4SF-MLX</th>
<th>PulM-25G2SF-MLX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed</strong></td>
<td>10 GbE</td>
<td>10 GbE</td>
<td>25 GbE</td>
</tr>
<tr>
<td><strong>Ports</strong></td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Interface</strong></td>
<td>SFP+</td>
<td>SFP+</td>
<td>SFP28</td>
</tr>
<tr>
<td><strong>Processor</strong></td>
<td>Intel XL710</td>
<td>Nvidia Mellanox ConnectX-4</td>
<td>Nvidia Mellanox ConnectX-4</td>
</tr>
<tr>
<td><strong>Bus</strong></td>
<td>PCIe 3.0 x8</td>
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<td>PCIe 3.0 x8</td>
</tr>
</tbody>
</table>
What is SR-IOV?

With a smart NIC support SR-IOV. It allow the network adapter can be shared and direct attached to virtual environment. With PF (Physical function) and VF (Virtual function) supported. It give the possibility to VNF (virtual network function) to access the physical interface directly without non-essential packet process on host OS.

The result comes after is to increase the packets forwarding capability and reduce the CPU utilization on the host system.
SR-IOV test Topology
Packet Forwarding Flow

**Guest OS**
- VNF Forwarding Function
- V-NIC
- OVS
- Linux-Kernel Forwarding Process
- Driver
- PCI-e
- NIC
- Hardware

**QNE OS**
- VNF Forwarding Function
- VF
- OVS
- Linux-Kernel Forwarding Process
- PF
- PCI-e
- NIC
- Hardware

**Hardware**
- NIC
- NIC
- NIC
- NIC
PF (Physical Function)

With SR-IOV supported smart network adapter. A single PF (physical function) mapping to a single Ethernet port. Take an example on QuCPE 7012, build in 4 ports 10GbE SFP+ powered by Intel X722 Ethernet controller support 4 PF (physical function) by default. Can be expand up to 4 10GbE SFP+ and 4 PF (physical function) by additional expansion card.

VF (Virtual Function)

VF (virtual function) functioning as a virtual NIC on virtual machine which allow virtual machine access to PF (physical function) directly through SR-IOV technology. A single PF (physical function) can map to multiple VF (virtual function) depending on Ethernet controller. Take an example on QuCPE 7012, with Intel X722 Ethernet controller. One single PF (physical function) can map to 32 VF (virtual function). But the total bandwidth still limited by physical link speed which is up to 10GbE (single direction) maximum for one single PF (physical function).
Each of VF need to mapping to a PF. Which that means the SR-IOV cannot enable on the links between VNFs/VMs when a single chain topology are required as the diagram above. But the VF and virtual NIC can be enable on the same guest OS at the same time. The packets will be process as the diagram shown on the right in this case.
Test Setup – without SR-IOV
Test Setup – without SR-IOV

Client
- OS: QNE 1.0.3.q573
- Tool: Iperf 3.1.3
- Client-A: 192.168.61.1/24, connect to QuCPE 7012 port 9 (10GbE SFP+)
- Client-B: 192.168.62.1/24, connect to QuCPE 7012 port 10 (10GbE SFP+)
- Client-C: 192.168.63.1/24, connect to QuCPE 7012 port 11 (10GbE SFP+)
- Client-D: 192.168.64.1/24, connect to QuCPE 7012 port 12 (10GbE SFP+)

QuCPE-7012
- CPU: Intel Xeon-D 2146NT
- RAM: 32GB
- OS: QNE 1.0.3.573

Pfsense:
- CPU assign: Core 3-8 (Total 12 threads)
- RAM: 1G
- HDD: 100G
- Version: 2.6.0 Release
- WAN: DHCP from system default virtual switch for system update
- LAN: 192.168.60.254/24 to Virtual switch 1 (for pfSense Web GUI access)
- OPT1: 192.168.61.254/24, VirtIO to Native Port 9
- OPT2: 192.168.62.254/24, VirtIO to Native Port 10
- OPT3: 192.168.63.254/24, VirtIO to Native Port 11
- OPT4: 192.168.64.254/24, VirtIO to Native Port 12
Test Setup – With SR-IOV

NIC
Linux - Kernel Forwarding Process
OVS
PCI-e
VF
VNF Forwarding Function
PF
PCI-e
NIC
Test Setup – With SR-IOV
Client-A
Linux
Virtual Switch 1
Client-B
Client-C
Client-D
VF b7:02:0
(Native Port 9)
VF b7:0a:0
(Native Port 11)
VF b7:06:0
(Native Port 10)
VF b7:0e:0
(Native Port 12)
PFsense
System default
Virtual Switch 1
PFsense
System default
Virtual Switch 1
PFsense
System default
Virtual Switch 1
PFsense
System default
Virtual Switch 1
**Test Setup – With SR-IOV**

**Client**
- OS: QNE 1.0.3.q573
- Tool: Iperf 3.1.3
- Client-A: 192.168.61.1/24, connect to QuCPE 7012 port 9 (10GbE SFP+)
- Client-B: 192.168.62.1/24, connect to QuCPE 7012 port 10 (10GbE SFP+)
- Client-C: 192.168.63.1/24, connect to QuCPE 7012 port 11 (10GbE SFP+)
- Client-D: 192.168.64.1/24, connect to QuCPE 7012 port 12 (10GbE SFP+)

**QuCPE-7012**
- CPU: Intel Xeon-D 2146NT
- RAM: 32GB
- OS: QNE 1.0.3.573

**Pfsense**
- CPU assign: Core 3-8 (Total 12 threads)
- RAM: 1G
- HDD: 100G
- Version: 2.6.0 Release
- WAN: DHCP from system default virtual switch for system update
- LAN: 192.168.60.254/24 to Virtual switch 1 (for pfsense Web GUI access)
- OPT1: 192.168.61.254/24, connect to port 9 with SR-IOV VF
- OPT2: 192.168.62.254/24, connect to port 10 with SR-IOV VF
- OPT3: 192.168.63.254/24, connect to port 11 with SR-IOV VF
- OPT4: 192.168.64.254/24, connect to port 12 with SR-IOV VF
QuCPE-7012 is your best choice