

DPDK 高性能处理框架 VPP

VPP 环境安装

\$ git clone -b stable/1801 <https://github.com/FDio/vpp.git>

```
king@ubuntu:~/share$ git clone -b stable/1801 https://github.com/FDio/vpp.git
Cloning into 'vpp'...
remote: Enumerating objects: 121933, done.
remote: Counting objects: 100% (6928/6928), done.
remote: Compressing objects: 100% (2715/2715), done.
remote: Total 121933 (delta 4800), reused 6227 (delta 4171), pack-reused 115005
Receiving objects: 100% (121933/121933), 102.20 MiB | 773.00 KiB/s, done.
Resolving deltas: 100% (92173/92173), done.
Checking connectivity... done.
king@ubuntu:~/share$
```

\$./extras/vagrant/build.sh && make

```
king@ubuntu:~/share/dpdk-linuxapp/vpp$ ls build-root/
autowank      config.site      path_setup      vpp-api-java_18.01.2-1~g9b554f3_amd64.deb
bootstrap.sh  copying         platforms.mk    vpp-api-lua_18.01.2-1~g9b554f3_amd64.deb
build-config.mk  deb            scripts        vpp-api-python_18.01.2-1~g9b554f3_amd64.deb
build-config.mk.README  install-vpp-debug-native  tools          vpp-dbg_18.01.2-1~g9b554f3_amd64.deb
build-tool-native  install-vpp-native  vagrant        vpp-dev_18.01.2-1~g9b554f3_amd64.deb
build-vpp-debug-native  Makefile          vpp_18.01.2-1~g9b554f3_amd64.changes  vpp-lib_18.01.2-1~g9b554f3_amd64.deb
build-vpp-native  packages         vpp_18.01.2-1~g9b554f3_amd64.deb      vpp-plugins_18.01.2-1~g9b554f3_amd64.deb
king@ubuntu:~/share/dpdk-linuxapp/vpp$
```

在编译成功以后，会生成上图红色的 deb 表

\$ dpkg -i vpp-lib_18.01.2-1~g9b554f3_amd64.deb

\$ dpkg -i vpp_18.01.2-1~g9b554f3_amd64.deb

\$ dpkg -i vpp-dev_18.01.2-1~g9b554f3_amd64.deb

\$ dpkg -i vpp-plugins_18.01.2-1~g9b554f3_amd64.deb

执行完成以后，在 /etc/vpp/startup.conf

```
king@ubuntu:~/share/dpdk-linuxapp/vpp$ ls /etc/vpp/startup.conf
/etc/vpp/startup.conf
king@ubuntu:~/share/dpdk-linuxapp/vpp$
```

在 /usr/lib/vpp_plugins/

```
king@ubuntu:~/share/dpdk-linuxapp/vpp$ ls /usr/lib/vpp_plugins/
acl_plugin.so      gtpu_plugin.so  ixge_plugin.so  lb_plugin.so      nat_plugin.so
dpdk_plugin.so     ila_plugin.so  kubeproxy_plugin.so  libsixrd_plugin.so  pppoe_plugin.so
flowprobe_plugin.so  ioam_plugin.so  l2e_plugin.so  memif_plugin.so  stn_plugin.so
king@ubuntu:~/share/dpdk-linuxapp/vpp$
```

在 conf 文件里面添加了三个 dev 网卡

```

root@ubuntu:/home/king/share# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:0c:29:85:2e:88
          inet addr:192.168.0.120  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe85:2e88/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:295 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:41851 (41.8 KB)  TX bytes:1332 (1.3 KB)

eth1      Link encap:Ethernet  HWaddr 00:0c:29:85:2e:92
          inet addr:192.168.0.109  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe85:2e92/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:222 errors:0 dropped:0 overruns:0 frame:0
          TX packets:101 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:31827 (31.8 KB)  TX bytes:12708 (12.7 KB)

eth2      Link encap:Ethernet  HWaddr 00:0c:29:85:2e:9c
          inet addr:192.168.0.118  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe85:2e9c/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:295 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:41851 (41.8 KB)  TX bytes:1332 (1.3 KB)

eth3      Link encap:Ethernet  HWaddr 00:0c:29:85:2e:7e
          inet addr:192.168.232.133  Bcast:192.168.232.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe85:2e7e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:1026 errors:0 dropped:0 overruns:0 frame:0
          TX packets:733 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:87706 (87.7 KB)  TX bytes:112831 (112.8 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:164 errors:0 dropped:0 overruns:0 frame:0
          TX packets:164 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:12080 (12.0 KB)  TX bytes:12080 (12.0 KB)

```

Startup.conf 里面的 pci 地址

```

root@ubuntu:/home/king/share# lspci | grep Ethernet
02:01.0 Ethernet controller: Intel Corporation 82545EM Gigabit Ethernet Controller (Copper) (rev 01)
03:00.0 Ethernet controller: VMware VMXNET3 Ethernet Controller (rev 01)
0b:00.0 Ethernet controller: VMware VMXNET3 Ethernet Controller (rev 01)
13:00.0 Ethernet controller: VMware VMXNET3 Ethernet Controller (rev 01)
root@ubuntu:/home/king/share#

```

编写 Startup.conf

```

king@ubuntu:~/share/dpdk-linuxapp/vpp$ cat /etc/vpp/startup.conf

cpu {
    main-core 0
}

unix {
    interactive cli-listen 127.0.0.1:5002
    log /tmp/vpp.log
    full-coredump
}

dpdk {
    uio-driver igb_uio
    dev 0000:03:00.0
    dev 0000:0b:00.0
    dev 0000:13:00.0
#    vdev eth_bond0, mode=2, slave=0000:0b:00.0, slave=0000:13:00.0, xmit_policy=134
#    socket-mem 512, 512
}

api-trace {
    on
}

```

如果需要使用 vppctl, 需要 cli-listen /run/vpp/cli.sock

```
unix {  
    interactive cli-listen /run/vpp/cli.sock  
    log /tmp/vpp.log  
    full-coredump  
}
```

再 dpdk 的运行环境准备就绪,

```
root@ubuntu:/home/king/share# modprobe uio  
root@ubuntu:/home/king/share# modprobe igb_uio  
root@ubuntu:/home/king/share#  
root@ubuntu:/home/king/share#  
root@ubuntu:/home/king/share# echo 4 > /sys/devices/system/node/node0/hugepages/hugepages-1048576kB/nr_hugepages  
root@ubuntu:/home/king/share# echo 1024 > /sys/devices/system/node/node0/hugepages/hugepages-2048kB/nr_hugepages  
root@ubuntu:/home/king/share#
```

将 eth0/eth1/eth2 关闭

```
$ ifconfig eth0 down
```

```
$ ifconfig eth1 down
```

```
$ ifconfig eth2 down
```

启动 vpp,

```
$ vpp -c /etc/vpp/startup.conf
```

```
root@ubuntu:/home/king/share/dpdk-linuxapp/vpp# vpp -c /etc/vpp/startup.conf  
vlib_plugin_early_init:356: plugin path /usr/lib/vpp_plugins  
load_one_plugin:184: Loaded plugin: acl_plugin.so (Access Control Lists)  
load_one_plugin:184: Loaded plugin: dpdk_plugin.so (Data Plane Development Kit (DPDK))  
load_one_plugin:184: Loaded plugin: flowprobe_plugin.so (Flow per Packet)  
load_one_plugin:184: Loaded plugin: gtpu_plugin.so (GTPv1-U)  
load_one_plugin:184: Loaded plugin: ila_plugin.so (Identifier-locator addressing for IPv6)  
load_one_plugin:184: Loaded plugin: ioam_plugin.so (Inbound OAM)  
load_one_plugin:114: Plugin disabled (default): ixge_plugin.so  
load_one_plugin:184: Loaded plugin: kubeproxy_plugin.so (kube-proxy data plane)  
load_one_plugin:184: Loaded plugin: l2e_plugin.so (L2 Emulation)  
load_one_plugin:184: Loaded plugin: lb_plugin.so (Load Balancer)  
load_one_plugin:184: Loaded plugin: libsixrd_plugin.so (IPv6 Rapid Deployment on IPv4 Infrastructure (RFC5969))  
load_one_plugin:184: Loaded plugin: memif_plugin.so (Packet Memory Interface (experimental))  
load_one_plugin:184: Loaded plugin: nat_plugin.so (Network Address Translation)  
load_one_plugin:184: Loaded plugin: pppoe_plugin.so (PPPoE)  
load_one_plugin:184: Loaded plugin: stn_plugin.so (VPP Steals the NIC for Container integration)  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/dpdk_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_vxlan_gpe_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/nat_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/udp_ping_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/gtpu_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/vxlan_gpe_ioam_export_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_pot_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/stn_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/kubeproxy_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_trace_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/lb_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/pppoe_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_export_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/acl_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/memif_test_plugin.so  
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/flowprobe_test_plugin.so  
dpdk_config:1240: EAL init args: -c 1 -n 4 --huge-dir /run/vpp/hugepages --file-prefix vpp -w 0000:03:00.0 -w 0000:0b:00.0 -w 0000:13:00.0 --master-lcore 0 --socket-mem 64  
EAL: 1024 hugepages of size 2097152 reserved, but no mounted hugetlbfs found for that size  
EAL: VFIO support initialized  
EAL: Invalid NUMA socket, default to 0  
EAL: Invalid NUMA socket, default to 0  
EAL: Invalid NUMA socket, default to 0  
DPDK physical memory layout:  
Segment 0: IOVA:0x40000000, len:1073741824, virt:0x7f800000000, socket_id:0, hugepage_sz:1073741824, nchannel:0, nrank:0  
unix_physmem_region_iommu_register: ioctl (VFIO_IOMMU_MAP_DMA): Invalid argument  
0: dpdk_ipsec_process:1011: not enough DPDK crypto resources, default to OpenSSL
```



vpp#

```
vpp# show int
```

Name	Idx	State	Counter	Count
GigabitEthernet13/0/0	3	down		
GigabitEthernet3/0/0	1	down		
GigabitEthernetb/0/0	2	down		
local0	0	down		

```
vpp#
```

停止 vpp

\$ service vpp stop

```
root@ubuntu:/home/king/share# service vpp stop
root@ubuntu:/home/king/share#
```

Vpp 命令操作

vpp# show int

```
load_one_plugin:63: Loaded plugin: /usr/lib/vpp/api_test_plugins/flowprobe_test_plugin.so
dpdk_config:1240: EAL init args: -c 1 -n 4 --huge-dir /run/vpp/hugepages --file-prefix vp
p -w 0000:03:00.0 -w 0000:0b:00.0 -w 0000:13:00.0 --master-lcore 0 --socket-mem 64
EAL: 1024 hugepages of size 2097152 reserved, but no mounted hugetlbfs found for that siz
e
EAL: VFIO support initialized
EAL: Invalid NUMA socket, default to 0
EAL: Invalid NUMA socket, default to 0
EAL: Invalid NUMA socket, default to 0
DPDK physical memory layout:
Segment 0: IOVA:0x40000000, len:1073741824, virt:0x7f69c0000000, socket_id:0, hugepage_sz
:1073741824, nchannel:0, nrank:0
unix_physmem_region_iommu_register: ioctl (VFIO_IOMMU_MAP_DMA): Invalid argument
0: dpdk_ipsec_process:1011: not enough DPDK crypto resources, default to OpenSSL
```



vpp# show int

Name	Idx	State	Counter	Count
GigabitEthernet13/0/0	3	down		
GigabitEthernet3/0/0	1	down		
GigabitEthernetb/0/0	2	down		
local0	0	down		

vpp# set interface state GigabitEthernet13/0/0 up

Name	Idx	State	Counter	Count
GigabitEthernet13/0/0	3	up	rx packets	3
			rx bytes	624
			drops	3
			ip6	3
GigabitEthernet3/0/0	1	down		
GigabitEthernetb/0/0	2	down		
local0	0	down		

```
vpp#
```

vpp# set interface state GigabitEthernet13/0/0 up

```
vpp# set interface state GigabitEthernet13/0/0 up
vpp# show int
```

Name	Idx	State	Counter	Count
GigabitEthernet13/0/0	3	up	rx packets	3
			rx bytes	624
			drops	3
			ip6	3
GigabitEthernet3/0/0	1	down		
GigabitEthernetb/0/0	2	down		
local0	0	down		

```
vpp#
```

vpp# set interface ip address GigabitEthernet13/0/0 192.168.0.119/24

```
vpp# set interface ip address GigabitEthernet3/0/0 192.168.0.119/32
vpp#
vpp# show int
```

Name	Idx	State	Counter	Count
GigabitEthernet3/0/0	3	up	rx packets	749
			rx bytes	209004
			drops	749
			ip4	517
			ip6	222
GigabitEthernet3/0/0	1	down		
GigabitEthernet3/0/0	2	down		
local0	0	down		

配置 vlan

```
vpp# create bridge-domain 10
```

```
vpp# set interface l2 bridge GigabitEthernet3/0/0 10
```

```
vpp# create sub-interface GigabitEthernet3/0/0 10 dot1q 10
```

```
vpp# show bridge-domain 10 detail
```

```
vpp# create sub-interface GigabitEthernet3/0/0 10 dot1q 10
GigabitEthernet3/0/0.10
vpp# show int
```

Name	Idx	State	Counter	Count
GigabitEthernet3/0/0	3	down		
GigabitEthernet3/0/0.10	4	down		
GigabitEthernet3/0/0	1	up	rx packets	2057
			rx bytes	963054
			tx packets	10
			tx bytes	866
			drops	2052
			ip4	506
			ip6	222
GigabitEthernet3/0/0.10	5	down		
GigabitEthernet3/0/0	2	up	rx packets	738
			rx bytes	209532
			drops	738
			ip4	488
			ip6	228
local0	0	down		

```
vpp# set interface l2 bridge GigabitEthernet3/0/0.10 10
vpp#
vpp#
vpp# set interface l2 tag-rewrite GigabitEthernet3/0/0.10 pop 1
vpp#
vpp# show bridge-domain 10 detail
```

BD-ID	Index	BSN	Age(min)	Learning	U-Forwrd	UU-Flood	Flooding	ARP-Term	BVI-Intf
10	1	0	off	on	on	on	on	off	N/A

Interface	If-idx	ISN	SHG	BVI	TxFlood	VLAN-Tag-Rewrite
GigabitEthernet3/0/0	1	1	0	-	*	none
GigabitEthernet3/0/0.10	5	1	0	-	*	pop-1

```
vpp#
```

配置 veth

```
$ ip link add name vpp1out type veth peer name vpp1host
```

```
$ ip addr show vpp1host
```

```
$ ip link set dev vpp1out up
```

```
$ ip link set dev vpp1host up
```



```

root@ubuntu:/home/king# ip link add name vpp1out type veth peer name vpp1host
root@ubuntu:/home/king#
root@ubuntu:/home/king# ip addr show vpp1host
6: vpp1host@vpp1out: <BROADCAST,MULTICAST,M-DOWN> mtu 1500 qdisc noop state DOWN group default qlen 1000
    link/ether 36:fb:a2:c5:b7:60 brd ff:ff:ff:ff:ff:ff
root@ubuntu:/home/king#
root@ubuntu:/home/king# ip link set dev vpp1out up
root@ubuntu:/home/king# ip link set dev vpp1host up
root@ubuntu:/home/king#
root@ubuntu:/home/king# ifconfig
eth3      Link encap:Ethernet  HWaddr 00:0c:29:85:2e:7e
          inet addr:192.168.232.133  Bcast:192.168.232.255  Mask:255.255.255.0
          inet6 addr: fe80::20c:29ff:fe85:2e7e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:256387 errors:0 dropped:0 overruns:0 frame:0
          TX packets:333858 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:47129193 (47.1 MB)  TX bytes:547739230 (547.7 MB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:202 errors:0 dropped:0 overruns:0 frame:0
          TX packets:202 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:14318 (14.3 KB)  TX bytes:14318 (14.3 KB)

vpp1host  Link encap:Ethernet  HWaddr 36:fb:a2:c5:b7:60
          inet6 addr: fe80::34fb:a2ff:fec5:b760/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:7 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:578 (578.0 B)  TX bytes:578 (578.0 B)

vpp1out   Link encap:Ethernet  HWaddr 36:5a:4c:2e:51:d3
          inet6 addr: fe80::345a:4cff:fe2e:51d3/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:7 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:578 (578.0 B)  TX bytes:578 (578.0 B)

```

配置 vpp1host ip 地址

```
$ ip addr add 192.168.3.128/24 dev vpp1host
```

```
$ ip addr show vpp1host
```

```

root@ubuntu:/home/king# ip addr add 192.168.3.128/24 dev vpp1host
root@ubuntu:/home/king# ip addr show vpp1host
6: vpp1host@vpp1out: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP group default qlen 1000
    link/ether 36:fb:a2:c5:b7:60 brd ff:ff:ff:ff:ff:ff
    inet 192.168.3.128/24 scope global vpp1host
        valid_lft forever preferred_lft forever
    inet6 fe80::34fb:a2ff:fec5:b760/64 scope link
        valid_lft forever preferred_lft forever
root@ubuntu:/home/king#

```

VPP 添加插件 plugin

实现一个打印包头信息的插件，源代码如下：

```

root@ubuntu:/home/king/share/dpdk-linuxapp/vpp# ls src/plugins/pktdump
pktdump.c  pktdump.h  pktdump_node.c
root@ubuntu:/home/king/share/dpdk-linuxapp/vpp#

```

修改 src/configure.ac

```

##### Update By King
PLUGIN_ENABLED(kingsample)
PLUGIN_ENABLED(pktdump)

```

修改 `src/plugins/Makefile.am`

```
#### Update By King
if ENABLE_KINGSAMPLE_PLUGIN
include kingsample.am
endif

if ENABLE_PKT_DUMP_PLUGIN
include pktdump.am
endif
```

```
# make wipe
# make build
# make run
```

```
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_pot_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/stn_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/kubeproxy_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_trace_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/lb_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/pppoe_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/ioam_export_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/acl_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/memif_test_plugin.so
load_one_plugin:63: Loaded plugin: /usr/lib/vpp_api_test_plugins/flowprobe_test_plugin.so
vlib_pci_bind_to_uio: Skipping PCI device 0000:02:01.0 as host interface eth3 is up
dpdk_config:1240: EAL init args: -c 1 -n 4 --huge-dir /run/vpp/hugepages --file-prefix vpp -b 0000:02:01.0 --master-locre 0 --socket-mem 64
EAL: 1024 hugepages of size 2097152 reserved, but no mounted hugetlbfs found for that size
EAL: VFIO support initialized
EAL: Invalid NUMA socket, default to 0
EAL: Invalid NUMA socket, default to 0
EAL: Invalid NUMA socket, default to 0
DPDK physical memory layout:
Segment 0: IOVA:0x40000000, len:1073741824, virt:0x7fbf80000000, socket_id:0, hugepage_sz:1073741824, nchannel:0, nrank:0
unix_physmem_region_iommu_register: ioctl (VFIO_IOMMU_MAP_DMA): Invalid argument
0: dpdk_ipsec_process:1011: not enough DPDK crypto resources, default to OpenSSL
0: dpdk_lib_init:225: DPDK drivers found 3 ports...
0: svm_client_scan_this_region_nolock:1181: /vpe-api: cleanup ghost pid 4367
0: svm_client_scan_this_region_nolock:1181: /global vm: cleanup ghost pid 4367
```

DBGvpp#

```
DBGvpp# set int ip address GigabitEthernet3/0/0 192.168.0.120/24
DBGvpp#
DBGvpp#
DBGvpp# show int

```

Name	Idx	State	Counter	Count
GigabitEthernet13/0/0	3	down		
GigabitEthernet3/0/0	1	up	rx packets	117
			rx bytes	31608
			drops	117
			ip4	76
			ip6	39
GigabitEthernetb/0/0	2	down		
local0	0	down		

```

DBGvpp# show int address
GigabitEthernet13/0/0 (dn):
GigabitEthernet3/0/0 (up):
    192.168.0.120/24
GigabitEthernetb/0/0 (dn):
local0 (dn):
DBGvpp#

```

执行结果:

Windows 物理机 ping 192.168.0.120

```
GigabitEthernet0/0      2      down
local0                  0      down
DBGvpp# show int address
GigabitEthernet13/0/0 (dn):
GigabitEthernet3/0/0 (up):
  192.168.0.120/24
GigabitEthernet0/0 (dn):
local0 (dn):
DBGvpp# pkt_dump GigabitEthernet3/0/0
DBGvpp# 45 00 00 3c 07 bf 00 00 80 01 b0 c8 c0 a8 00 71 c0 a8 00 78
45 00 00 3c 07 c0 00 00 80 01 b0 c7 c0 a8 00 71 c0 a8 00 78
45 00 00 3c 07 c1 00 00 80 01 b0 c6 c0 a8 00 71 c0 a8 00 78
45 00 00 95 00 00 40 00 40 11 79 af c0 a8 00 01 ff ff ff ff
45 00 00 95 00 00 40 00 40 11 79 af c0 a8 00 01 ff ff ff ff
45 00 00 3c 07 c2 00 00 80 01 b0 c5 c0 a8 00 71 c0 a8 00 78

C:\Users\WangBoJing> ping 192.168.0.120

Pinging 192.168.0.120 with 32 bytes of data:
Reply from 192.168.0.120: bytes=32 time=1272ms TTL=64
Reply from 192.168.0.120: bytes=32 time=43ms TTL=64
Reply from 192.168.0.120: bytes=32 time=1264ms TTL=64
Reply from 192.168.0.120: bytes=32 time=43ms TTL=64

Ping statistics for 192.168.0.120:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 43ms, Maximum = 1272ms, Average = 655ms

C:\Users\WangBoJing>
```

插件 plugin 的原理

VNET

VPP networking source

- Devices
- Layer [2, 3, 4]
- Session Management
- Overlays
- Control Plane
- Traffic Management

Plugins

- Plugins can be in-tree:
 - SNAT,
 - Policy ACL,
 - Flow Per Packet,
 - ILA,
 - IOAM,
 - LB,
 - SIXRD,
 - VCGN
- Separate fd.io project:
 - NSH_SFC

VLIB

VPP application management

- buffer, buffer management
- graph node, node management
- tracing, counters
- threading
- CLI
- and most importantly ...
- main()

VPP INFRA

Library of function primitives, for

- memory management
- memory operations
- vectors
- rings
- hashing
- timers

