Network Diagnostic Tools

Jijesh Kalliyat
Sr.Technical Account Manager, Red Hat
15th Nov 2014

Agenda

- Network Diagnostic Tools Linux
- Tcpdump
- Wireshark
- Tcpdump Analysis

Sources of Network Issues

If a system is unable to connect to a network,

- Physical layer issues
- Bad network card / drivers or configurations
- Firewall preventing computers from seeing each other

Network Slowness,

- NIC duplex and speed incompatibilities
- Network congestion / Packet drops
- Poor routing
- Bad hardware / cabling
- Overloaded servers

1 . Test Network Connectivity

- **Use ping command**
  - Isolate host resolution/DNS issues (/etc/{hosts,resolv.conf})
  - Does 127.0.0.1 / local IP/ another host in same network respond ?

- **Use traceroute / mtr command**
  - Provides information about path to a remote server.
  - **mtr :** real-time data about latency and routing changes

- **Look for default route / gateway**
  #route -n / #ip route

- **Verify the IP address / arp caches**
  #ifconfig (is obsolete !) */ #ip addr list*
  #arp -an / #cat /proc/net/arp

2 . Test Remote Ports

- **telnet**

```
# telnet 192.168.5.5 25
Trying 192.168.5.5...
telnet: Unable to connect to remote host: Connection refused
```

- **nc (netcat)**

```
# nc example.com 81 -v
nc: connect to node1 port 81 (tcp) failed: Connection refused
# nc example.com 80 -v
Connection to node1 80 port [tcp/http] succeeded!
```

- **wget / curl** to check webservers
- **nmap** to scan the ports

3. Check the Link status

dmesg | egrep “eth|em”

e1000: eth0 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: None

ip link show

eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc UP qlen 1000

mii-tool eth0 (deprecated , doesn't work on Gigabit NICs)

eth0: negotiated 100baseTx-FD, link ok

ethtool eth0 (provided by net-tools)

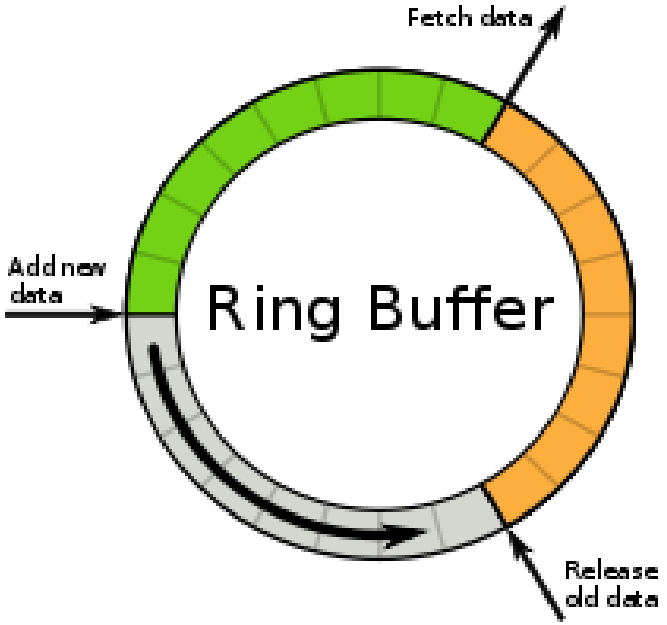
Speed: 1000Mb/s
Duplex: Half
Link detected: yes

cat /sys/class/net/eth0/operstate

up

Monitoring and Diagnosing Performance Problems

How Network Interface Cards (NIC) works internally ?



- If the NIC is faster than the host, there shouldn't be any problem.
- On the other hand, if the host is faster, then the ring can fill up (no gray area left) and the host will be forced to wait.

Packet Loss at Network Interface Cards (NIC)

- Packet errors/drops displayed in #ifconfig

```
eth0   Link encap:Ethernet  HWaddr 00:16:3E:74:7B:63
       UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
       RX packets:40685771 errors:0 dropped:8 overruns:20 frame:0
       TX packets:2649925 errors:10 dropped:0 overruns:0 carrier:10
```

- Firmware Buffer Overflows

ethtool -S

e1000e/e1000	:	rx_missed_errors
tg3	:	rx_discards
bnx2 driver	:	rx_fw_discards

Increase the buffer size , ethtool -g eth0 / ethtool -G eth0 rx 4096

Packet Loss in networking stack (socket / kernel)

- **netstat -s** - Collects infos from the following files: /proc/net/snmp, /proc/net/netstat and /proc/net/sctp/snmp.

```
# netstat -s |egrep -i “error|drop|over”
7 SYNs to LISTEN sockets dropped
6 times the listen queue of a socket overflowed
```

- **dropwatch** - Monitors and records packets that are dropped by the kernel.

```
# dropwatch -l kas  (  /proc/kallsyms are used for function mappings)
dropwatch> start
10 drops at unix_stream_sendmsg+735
5 drops at netlbl_domhsh_def+8349525
dropwatch> stop
#
```

- **sar -n EDEV** tells you how much errors per second is happening

```
iface   rxerr/s   txerr/s    coll/s  rxdrop/s  txdrop/s  txcarr/s  rxfram/s
eth0     5.00     10.00      0.00    0.00       0.00       5.00      0.00
```

TCP Socket Buffers and Tuning

- Flexible buffer that handles incoming and outgoing packets at the kernel level
- Can be tuned in /etc/sysctl.conf file

net.ipv4.tcp_rmem = 4096 87380 4194304
net.ipv4.tcp_wmem = 4096 87380 4194304

- Be careful not to set the buffers too large. Buffers uses Physical Memory.
- Each time data is read/written to the buffers, the entire socket must be read.

Investigate Sockets

➢ **SS** - Command-line utility that prints statistical information about sockets

- Shows information similar to 'netstat'
- Display more TCP and state informations than other tools

ss -t -a : Display all TCP sockets
ss -it : Socket Internal information

```
State      Recv-Q Send-Q  Local Address:Port  Peer Address:Port
ESTAB   967899      0       192.168.1.2:35390  192.168.1.3:imaps   cubic
wscale:11,7 rto:204 rtt:1.875/1 ato:40 mss:1448 cwnd:10 send 61.8Mbps
rcv_rtt:40.875 rcv_space:203340
```

Recv-Q : The count of bytes not copied by the program connected to this socket.
Send-Q : The count of bytes not acknowledged by the remote host.

Other Candidates ?

- Are interrupts balancing? (/proc/interrupts)

```
           CPU0       CPU1       CPU2       CPU3
43:      17704      28952       8866       8027   PCI-MSI-edge      eth1
```

- Multiqueue enabled ? (/proc/interrupts)

```
PCI-MSI-X  eth2-tx-0
PCI-MSI-X  eth2-tx-1
```

- Identify Driver Issues

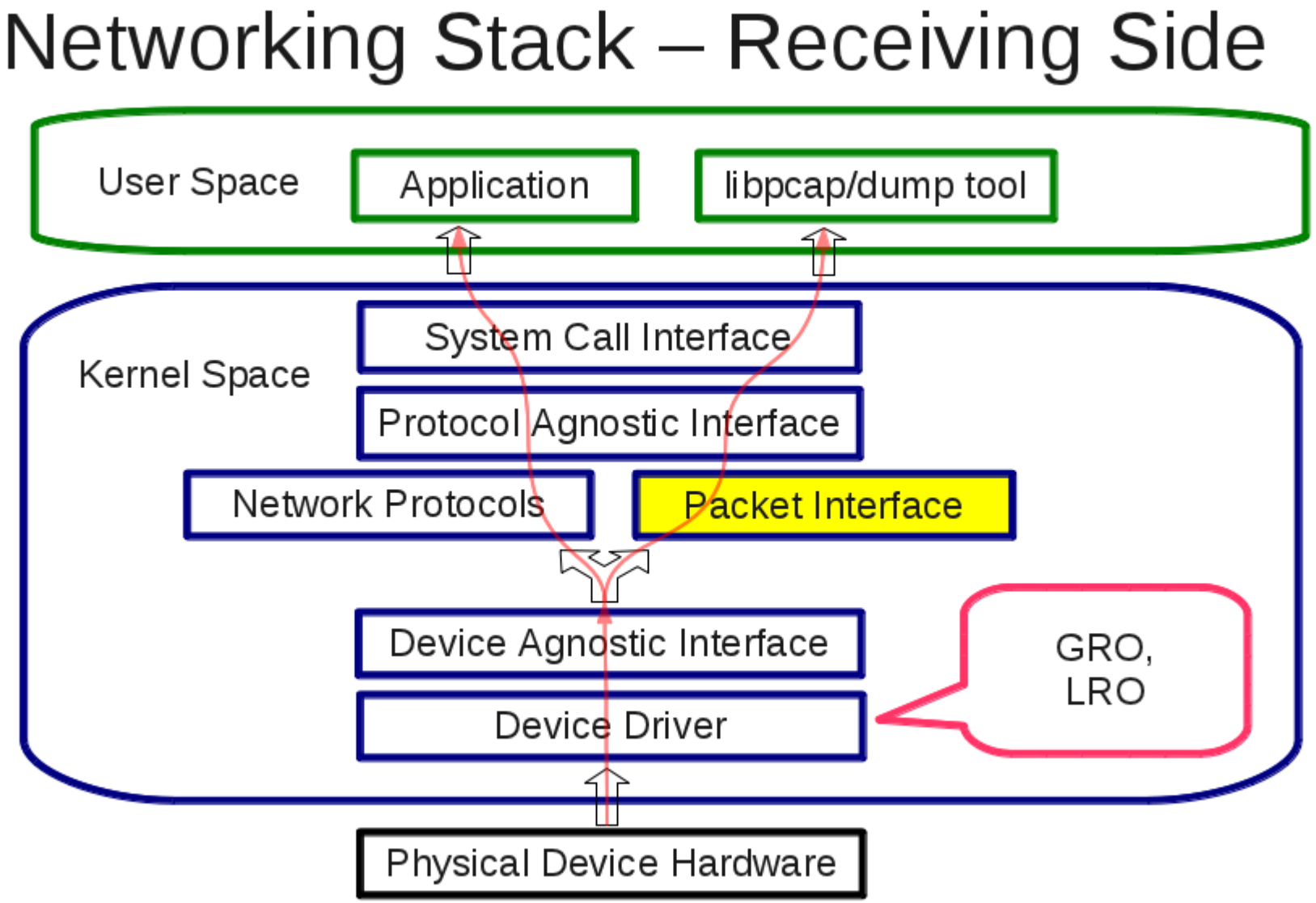
```
# grep eth var/log/messages & var/log/dmesg
# grep <driver name> var/log/messages & var/log/dmesg
```

- Check relevant offloading and apply

```
# ethtool -k eth0
rx-checksumming: off
tx-checksumming: on
```


CentOS
Tcpdump

Where does tcpdump get the packets ?



Tcpdump - Promiscuous Mode

- When you run tcpdump, it will put your NIC into "promiscuous" mode

host1.test.com: [147715] device em1 entered promiscuous mode

- Promiscuous mode makes the Network Card pass all traffic it receives to the central processing unit rather than just frames addressed to it

- If a network device is in promiscuous mode, the kernel will receive all network traffic (i.e., the CPU load will slightly increase).

Tcpdump filters

- Most basic way of using tcpdump

  #tcpdump (captures everything)

- src/dst, port, protocol : combined all three

  # tcpdump src port 1025 and tcp
  # tcpdump udp and src port 53

- Rotating with timestamps – Every 1 hour

  # tcpdump -i eth0 -G 3600 -w 'file.pcap'

- Rotating by size – 100MB of data

  # tcpdump -i eth0 -C 100 -w capture

How to Get a Good Packet Capture ?

tcpdump -s0 -n -i ethX -w /tmp/$(hostname)-$(date +"%Y-%m-%d-%H-%M-%S").pcap host <ip-address>

- **s0** : Capture the whole packet instead of the first 68 bytes.
- **n** : don't resolve hostnames (faster) . Dns lookups can slow down capturing and potentially cause missed packets.
- **i** : listen on a specific interface : tpcdump -i eth0 , tcpdump -i bond0
- **w** : dump packet data to a file, instead of decoding and printing on console
- **host** : Capture only the packets to/from the <host>

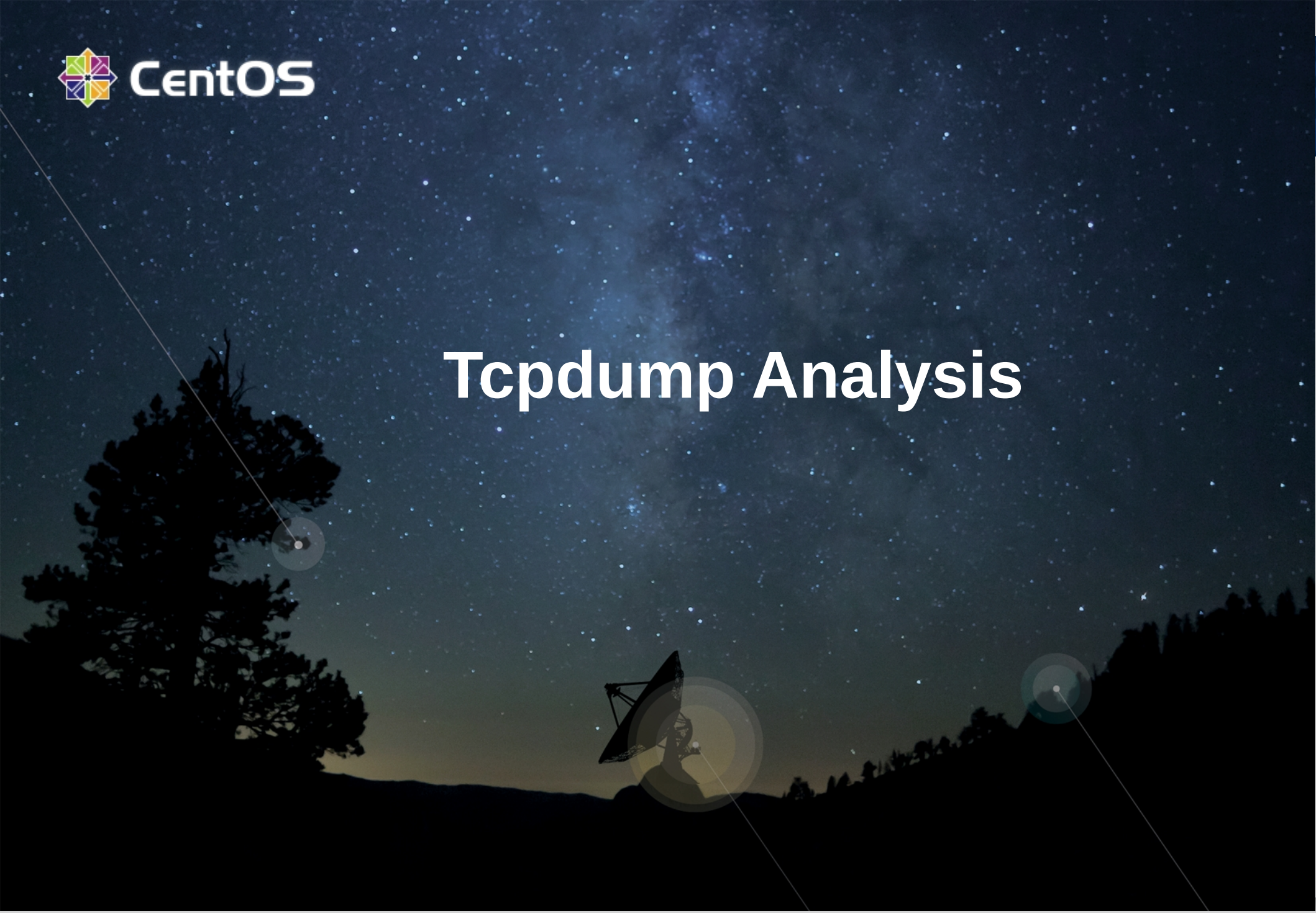
#tcpdump -i bond0 -s0 -n -w /tmp/nfsclient.pcap host <ip-nfs-server>

Wireshark

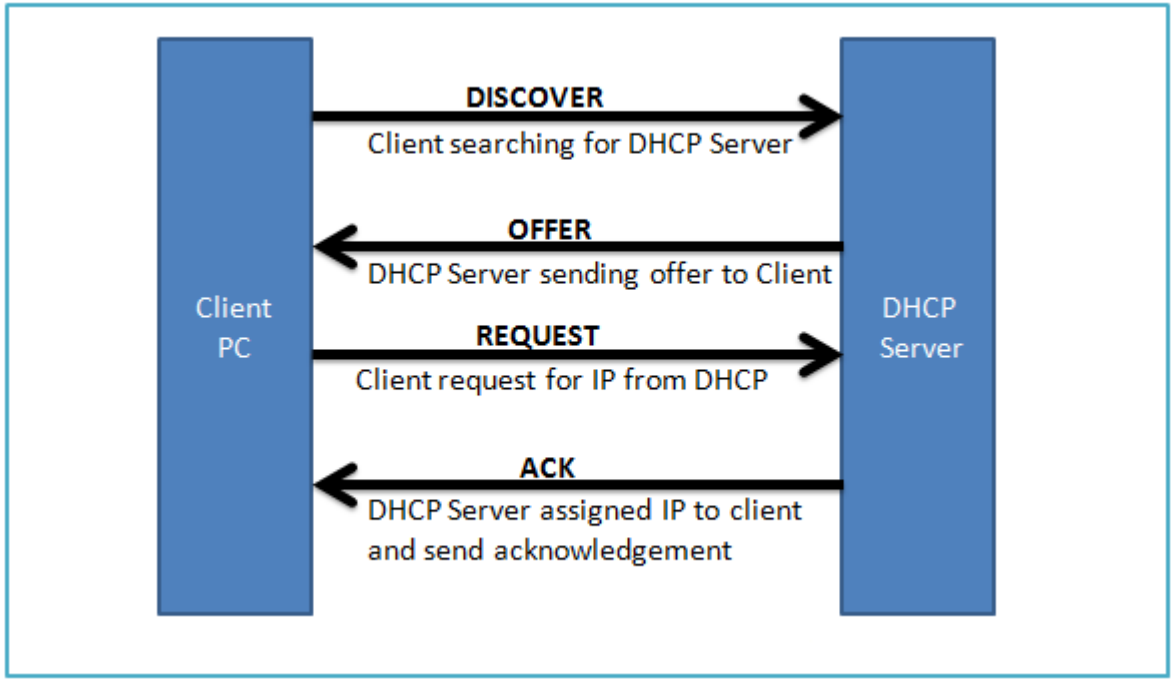
- Captures packets and allows you to examine the packet content.
- Provided by the package wireshark-gnome in CentOS.
- Wireshark and Time Zones

```
# TZ="America/Los_Angeles"  wireshark <file.pcap>
# TZ="Asia/Kolkata" wireshark <file.pcap>
```

- Run Wireshark with the TZ environment variable set to refer to the preferred time zone.


CentOS
Tcpdump Analysis

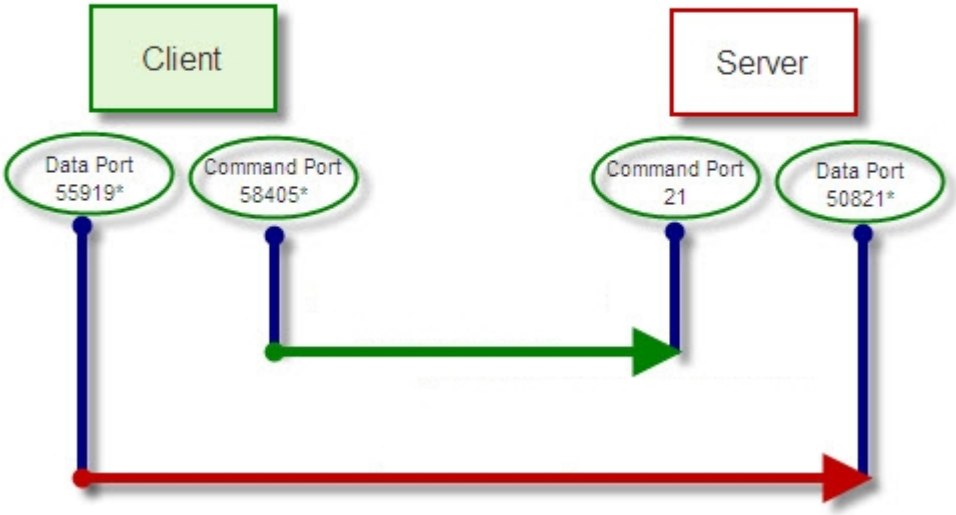
Dynamic Host Configuration Protocol (DHCP)



RFC : https://www.ietf.org/rfc/rfc2131.txt
dhclient.pcap Captured during DHCP IP assignment process

File Transfer Protocol (FTP)

Passive FTP



1) Client uses Random Port to connect to Server's Port 21
2) Client sends a PASV command to Server , requesting a port it wishes to use for the Data Channel
3) The server replies with the port number which the client then uses to initiate an exchange on the Data Channel.

Understanding NFS Protocol

- Understanding the protocol is essential

NFSv3 : http://www.ietf.org/rfc/rfc1813.txt

NFS Server : 10.70.35.111
NFS Client : 10.70.35.80

- NFS Client Capture : tcpdump -i eth0 -s0 -w /tmp/example2.pcap host 10.70.35.11

```
[root@nfsclient ~]# mount 10.70.35.111:/test /mnt
[root@nfsclient ~]# cd /mnt/
[root@nfsclient mnt]# touch t1
touch: cannot touch `t1': Permission denied
```

Network will not start after reboot, says IP address in use

- Getting the following error while restarting network service.

  host1 ifup:Error, some other host already uses address x.x.x.x

- Who throws this error ? /etc/sysconfig/network-scripts/ifup-eth

```
/sbin/arping -q -c 2 -w 3 -D -I ${REALDEVICE} ${ipaddr[$idx]}
if [ $? = 1 ]; then
net_log $"Error, some other host already uses address ${ipaddr[$idx]}."
exit 1
 fi
```

 # tcpdump -i any -w /tmp/tcpdump.pcap arp

- MAC Address Lookup : IEEE OUI (Organizationally Unique Identifier) and Company_id Assignments

  http://standards.ieee.org/regauth/oui/index.shtml

Feedback
Q and A
Thank you!