Transferring and Copying Files

scp command line utilities:

- $ scp source destination

  - Copy source to destination.

Scenario-1:

- scp /a/abc.txt user@server2:/tmp
- which copies the /a/abc.txt from source to destination /tmp directory

Scenario-2:

- scp user@server2:/a/abc.txt /tmp
- which copies the /a/abc.txt from remote to current system /tmp directory

ssh server communication:

- Use the following commands to connect from the source system to the Remote system

  $ ssh user@ipaddress -p port

  $ ssh -l user ipaddress -p port

Password Less Login:

1) Login to the Src System

2) $ ssh-keygen

→ This utility generates ssh Keys (Public and private) in the ~/.ssh/ folder

  id_rsa(private key) and id_rsa.pub(public key)

3) $ ssh-copy-id user@ipaddress

→ which copies the public key of the src system user to dest system user account

4) test the connection

  $ ssh user@dest_ip

Networking

TCP/IP

What You WillLearn

- TCP/IP

- Classful networks

- Subnet masks

- Broadcast addresses

- CIDR

- Private address space

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TCP/IP:

- TCP/IP
  - Used for network communications
  - TCP = Transmission Control Protocol
  - IP = Internet Protocol
- TCP - controls data exchange
- IP - sends data from one device to another
- Hosts
  - devices on a network that have an IP address

IP Networking:

- IP address
  - Example: 199.83.131.186
- subnet mask
  - Example: 255.255.255.0
- broadcast address
  - Example: 199.83.131.255
- octet.octet.octet.octet
  - octet values can be from 0 to 255

IP Networking:

- Network Address

- Host Address

- Each must be unique for proper routing

- Address Classes

  - Used to determine the network address and host address

Classful Networks:

Class	Network	Hosts Allowed
A	1.0 -> 127.0 *Ex: 17.24.88.9*	16,777,216
B	128.0 -> 191.255 *Ex: 183.194.46.31*	65,536
C	192.0.0 -> 233.255.255 *Ex: 199.83.131.186*	255

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Subnet Masks:

Class	Subnet Mask
A	255.0.0.0
B	255.255.0.0
C	255.255.255.0

255	255	0	0
183	194	46	31

Classless Inter-Domain Routing / CIDR:

- **IP: 121.67.198.94/8**
  - Class A network: 121.0.0.0
  - Class A subnet: 255.0.0.0
  - Class A broadcast: 121.255.255.255

- IP: **121.67.198.94/24** Subnet: 255.255.255.0
  - CIDR network: 121.67.198.0
  - CIDR subnet: 255.255.255.0
  - CIDR broadcast: 121.67.198.255

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Reserved Private Address Space:

Class	Range	Private Address Space
A	1.0.0.0 - 127.255.255.255	10.0.0.0 - 10.255.255.255
B	128.0.0.0 - 191.255.255.255	172.16.0.0 - 172.31.255.255
C	192.0.0.0 - 233.255.255.255	192.168.0.0 - 192.168.255.255

Broadcast Addresses:

Class	Network	Subnet Mask	Broadcast
A	17.0.0.0	255.0.0.0	17.255.255.255
B	183.194.0.0	255.255.0.0	183.194.255.255
C	199.83.131.0	255.255.255.0	199.83.131.255

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Understanding CIDRs Subnet Masks

- The subnet masks basically allows part of the underlying IP to get additional next values from the base IP

  - /32 allows for 1 IP $= 2^0$
  - /31 allows for 2 IP $= 2^1$
  - /30 allows for 4 IP $= 2^2$
  - /29 allows for 8 IP $= 2^3$
  - /28 allows for 16 IP $= 2^4$
  - /27 allows for 32 IP $= 2^5$
  - /26 allows for 64 IP $= 2^6$
  - /25 allows for 128 IP $= 2^7$
  - /24 allows for 256 IP $= 2^8$
  - /16 allows for 65,536 IP $= 2^{16}$
  - /0 allows for all IPs $= 2^{32}$

- Quick memo:
- /32 – no IP number can change
- /24 - last IP number can change
- /16 – last IP two numbers can change
- /8 – last IP three numbers can change
- /0 – all IP numbers can change

Understanding CIDR - IPv4 (Classless Inter-Domain Routing)

Source ⓘ
0.0.0.0/0
122.149.196.85/32

- They help to define an IP address range
  - WW.XX.YY.ZZ/32   == one IP
  - 0.0.0.0/0== all IPs
  - But we can define for ex: 192.168.0.0/26:
          192.168.0.0 – 192.168.0.63 (64 IP)

Understanding CIDR

- A CIDR has two components:
  - The base IP (XX.XX.XX.XX)
  - The Subnet Mask (/26)

- The base IP represents an IP contained in the range

- The subnet masks defines how many bits can change in the IP

- The subnet mask can take two forms. Examples:

  - 255.255.255.0   (less common)

  - /24   (more common)

Understanding CIDRs Little exercise

- 192.168.0.0/24 = … ?
  - 192.168.0.0 – 192.168.0.255 (256 IP)
- 192.168.0.0/16 = … ?
  - 192.168.0.0 – 192.168.255.255 (65,536 IP)
- 134.56.78.123/32 = … ?
  - Just 134.56.78.123
- 0.0.0.0/0
  - All IP!
- When in doubt, use this website: https://www.ipaddressguide.com/cidr

<u>Private vs Public IP (IPv4) Allowed ranges</u>

- The Internet Assigned Numbers Authority (IANA) established certain blocks of IPV4 addresses for the use of private (LAN) and public (Internet) addresses.

- Private IP can only allow certain values
    - 10.0.0.0 – 10.255.255.255   (10.0.0.0/8)   <= in big networks
    - 172.16.0.0 – 172.31.255.255 (172.16.0.0/12) <= default AWS one
    - 192.168.0.0 – 192.168.255.255 (192.168.0.0/16)   <=
       example: home networks

- All the rest of the IP on the internet are public IP

Summary:

- TCP/IP
- Classful networks
- Subnet masks
- Broadcast addresses
- CIDR
- Private Address Space

Networking

What You WillLearn

- Determining your IP address
- ip and ifconfig utilities
- hostnames
- DNS and name resolution
- /etc/hosts
- Network ports
- DHCP
- Static IP addresses

Determining Your IP Address

- ip address
  - ip addr
  - ip a
  - ip address show or ip a s

  - ifconfig

hostnames

- human-readable name for an IP address
  - webprod01 = 10.109.155.174

DNS hostnames

- FQDN = fully qualified domain name
  - webprod01.mycompany.com
- TLD
  - .com, .net, .org, etc.
- Domains
  - below (to the left of) TLD
- sub-domain
  - below (to the left of) the domain
  - webprod01.ny.us.mycompany.com

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Displaying the hostname

$ hostname

webprod01

$ uname -n

webprod01

$ hostname -f

webprod01.mycompany.com

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Setting the hostname

hostnamectl set-hostname webprod1

/etc/hostname

vi /etc/sysconfig/network

   HOSTNAME=webprod01

Resolving DNS Names

- host
- dig

$ host www.mycompany.com

webprod01.mycompany.com has address 1.2.1.6

$ host 1.2.1.6

6.1.2.1.in-addr.arpa domain name pointer www.mycompany.com.

$

The /etc/hosts file

- Format:
  - IP FQDN alias(es)
  - 10.11.12.13 webprod02.mycorp.com webprod02
- Now you can refer to the host by name.
  - webprod02.mycorp.com OR webprod02
- /etc/hosts is local to your linux system. It does not propagate to the rest of the network.

Sample /etc/hosts file

```
127.0.0.1          localhost
1.2.1.6            webprod01.mycompany.com      webprod01
10.11.12.14        webprod02.mycompany.com      webprod02
10.11.12.15        webprod03.mycompany.com      webprod03
10.11.13.7         dbcluster
```

Network Ports

- When a service starts it binds itself to a port.
- Ports 1 - 1,023 are well-known ports.
  - 22 - SSH
  - 25 - SMTP
  - 80 - HTTP
  - 143 - IMAP
  - 389 - LDAP
  - 443 - HTTPS

/etc/services

- Maps port names to port numbers

```
ssh       22/tcp        #  SSH Remote Login Protocol
smtp      25/tcp        #  SMTP
https     80/tcp        #  http
ldap      389/tcp       #  LDAP
https     443/tcp       #  http protocol over TLS/SSL
```

DHCP

- Dynamic Host Configuration Protocol
- DHCP servers assign IP address to DHCP clients
  - IP Address
  - netmask
  - gateway
  - DNS servers

DHCP

- Each IP is "leased" from the pool of IP addresses the DHCP server manages.
    - The lease expiration time is configurable on the DHCP server. (1hr, 1day, 1 week, etc.)
    - The client must renew the lease if it wants to keep

        using the IP address. If no renewal is received, the IP is available to other DHCP clients.

Configuring a DHCP Client - RHEL

ifconfig -a or ip link

/etc/sysconfig/network-scripts/ifcfg-DEVICE

/etc/sysconfig/network-scripts/ifcfg-eth0

/etc/sysconfig/network-scripts/ifcfg-enp5s2

BOOTPROTO=dhcp

Assigning a Static IP Address - RHEL

/etc/sysconfig/network-scripts/ifcfg-eth0

DEVICE=eth0
BOOTPROTO=static
IPADDR=10.109.155.174
NETMASK=255.255.255.0
NETWORK=10.109.155.0
BROADCAST=10.109.155.255
GATEWAY=10.109.155.1
ONBOOT=yes

<u>**Summary**</u>

- Determining your IP address
- ip and ifconfig utilities
- hostnames
- DNS and name resolution
- /etc/hosts

Summary

- Network ports
  - well-known / privileged
  - unprivileged
- DHCP
- Static IP addresses

Network Troubleshooting

What You WillLearn

- ping
- traceroute / tracepath
- netstat
- telnet

Testing Connectivity with Ping

Format:

ping HOST

ping -c COUNT HOST

Example:

ping -c 3 google.com

```
$ ping -c 3 google.com

PING google.com (216.58.2.7) 56 bytes of data.

64 bytes from 216.58.2.7: icmp_seq=1 ttl=53 time=20.1 ms

64 bytes from 216.58.2.7: icmp_seq=2 ttl=53 time=20.2 ms

64 bytes from 216.58.2.7: icmp_seq=3 ttl=53 time=23.9 ms


--- google.com ping statistics ---

3 packets transmitted, 3 received, 0% packet loss, time
2004ms

rtt min/avg/max/mdev = 21.489/22.924/24.154/1.111 ms
```

```
$ ping -c 3 google.com

PING google.com (216.58.2.7) 56 bytes of data.

From 216.58.2.7 icmp_seq=1 Destination Host Unreachable

From 216.58.2.7 icmp_seq=2 Destination Host Unreachable

From 216.58.2.7 icmp_seq=3 Destination Host Unreachable


--- google.com ping statistics ---

3 packets transmitted, 0 received, +3 errors, 100% packet
loss, time 2002ms

pipe 3
```

traceroute -n google.com

traceroute to google.com (216.58.2.7), 30 hops max, 60 byte packets

Diagnosing Network Connections 413

```
 1  10.0.2.2  0.296 ms  0.178 ms  0.220 ms
 2  192.168.1.1  2.529 ms  2.713 ms  2.630 ms
 3  72.14.237.231  23.750 ms  22.087 ms
12.122.132.137  22.701 ms
 4  216.58.216.78  20.549 ms 12.250.16.30  22.904
ms 216.58.216.78  20.724 ms
```

$ tracepath -n google.com

```
 1?:  [LOCALHOST]      pmtu 1500
 1:   10.0.2.2         0.470ms
 1:   10.0.2.2         0.649ms
 2:   192.168.1.1      2.147ms asymm 64
...
```

The netstat Command

-n   Display numerical addresses and ports.

-i   Displays a list of network interfaces.

-r   Displays the route table. (netstat -rn)

-p   Display the PID and program used.

-l   Display listening sockets. (netstat -nlp)

-t   Limit the output to TCP (netstat -ntlp)

-u   Limit the output to UDP (netstat -nulp)

```
$ netstat -i   Kernel Interface
table
Iface     MTU   RX-OK RX-ERR RX-DRP RX-OVR  TX-OK TX-ERR TX-DRP TX-OVR Flg
eth0     1500   3975      0     0 0       2627      0      0      0 BMRU
lo      65536      8      0     0 0          8      0      0      0 LRU
$ netstat -rn   Kernel IP
routing table
Destination Gateway       Genmask         Flags   MSS Window   irtt Iface
0.0.0.0      10.0.2.2     0.0.0.0         UG        0 0           0 eth0
10.0.2.0     0.0.0.0      255.255.255.0   U         0 0           0 eth0
$ sudo netstat -ntlp  Active Internet
connections (only servers)
Proto Recv-Q Send-Q Local Address   Foreign Address    State    PID/Program
name
tcp        0      0 0.0.0.0:22        0.0.0.0:*
tcp        0      0 127.0.0.1:25      0.0.0.0:*
```

telnet HOST_OR_IP PORT_NUMBER

$ telnet google.com 80

Trying 216.58.2.7...

Connected to google.com. Escape

character is '^]'. GET /

HTTP/1.0 200 OK

^]

telnet> quit

closed.

Summary

- ping
- traceroute / tracepath
- netstat
- telnet