1.112.1 Fundamentals of TCP/IP Weight 4

Linux Professional Institute Certification — 102

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Outline

Topic 112 Networking Fundamentals [14]

Where we are up to

1.112.1 **Fundamentals of TCP/IP [4]**

1.112.3 TCP/IP configuration and troubleshooting [7]

1.112.4 Configure Linux as a PPP client [3]

Description of Objective

1.112.1 Fundamentals of TCP/IP

Candidates should demonstrate a proper understanding of network fundamentals. This objective includes the understanding of IP-addresses, network masks and what they mean (i.e. determine a network and broadcast address for a host based on its subnet mask in “dotted quad” or abbreviated notation or determine the network address, broadcast address and netmask when given an IP-address and number of bits). It also covers the understanding of the network classes and classless subnets (CIDR) and the reserved addresses for private network use. It includes the understanding of the function and application of a default route. It also includes the understanding of basic internet protocols (IP, ICMP, TCP, UDP) and the more common TCP and UDP ports (20, 21, 23, 25, 53, 80, 110, 119, 139, 143, 161).

Key files, terms, and utilities include:
1.112.1 Fundamentals of TCP/IP

`/etc/services` — file mapping port numbers to names

`ftp` — FTP client program

`telnet` — telnet client program

`host` — program to test DNS servers

`ping` — program to test connectivity to other machines via ICMP

`dig` — program to test DNS servers

`traceroute` — program to test the path to a remote machine, showing routers along the way

`whois` — queries information about the owner of a domain

(2.2) Networking Fundamentals [14]

1.112.1 **Fundamentals of TCP/IP [4]**

1.112.3 TCP/IP configuration and troubleshooting [7]

1.112.4 Configure Linux as a PPP client [3]

Fundamentals of TCP/IP [4]
Resources of interest

W. Richard Stevens.
TCP/IP Illustrated, Volume 1: The Protocols
Addison Wesley

Olaf Kirch and Terry Dawson.
Linux Network Administrator's Guide
O'Reilly 2000.
`http://tldp.org/LDP/nag2/`

Angie Nash and Jason Nash.
LPIC 1 Certification Bible
Hungry Minds

IP addressing

This objective includes the understanding of:

- IP-addresses, network masks and what they mean, i.e.,
  - determine a network and broadcast address for a host based on its subnet mask in “dotted quad” or abbreviated notation or
  - determine the network address, broadcast address and netmask when given an IP-address and number of bits.

IP Address Classes (Classic)

Class A — 255.0.0.0

0xxxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 0.0.0.0
0xxxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 127.255.255.255

Class B — 255.255.0.0

10xxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 128.0.0.0
10xxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 191.255.255.255

Class C — 255.255.255.0

110xxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 192.0.0.0
110xxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 223.255.255.255

IP Address Classes (Classic)

Class A — 255.0.0.0

0xxxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 0.0.0.0
01111111.11111111.11111111.11111111 - 127.255.255.255

Class B — 255.255.0.0

10xxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 128.0.0.0
10111111.11111111.11111111.11111111 - 191.255.255.255

Class C — 255.255.255.0

110xxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx - 192.0.0.0
11011111.11111111.11111111.11111111 - 223.255.255.255

IP Address Classes (Classic)

Class A — 255.0.0.0

```
00000000.00000000.00000000.00000000 - 0.0.0.0
01111111.11111111.11111111.11111111 - 127.255.255.255
```

Class B — 255.255.0.0

```
10000000.00000000.00000000.00000000 - 128.0.0.0
10111111.11111111.11111111.11111111 - 191.255.255.255
```

Class C — 255.255.255.0

```
11000000.00000000.00000000.00000000 - 192.0.0.0
11011111.11111111.11111111.11111111 - 223.255.255.255
```

IP Address Classes (Classic)

Class A — 255.0.0.0

```
00000000.00000000.00000000.00000000 - 0.0.0.0
01111111.11111111.11111111.11111111 - 127.255.255.255
```

Class B — 255.255.0.0

```
10000000.00000000.00000000.00000000 - 128.0.0.0
10111111.11111111.11111111.11111111 - 191.255.255.255
```

Class C — 255.255.255.0

```
11000000.00000000.00000000.00000000 - 192.0.0.0
11011111.11111111.11111111.11111111 - 223.255.255.255
```

IP Address - Loopback

Reserved Space 127.0.0.0 — 127.255.255.255
127.0.0.1 localhost

IP Address - Private Networks

There are IP ranges set aside for privite address spaces. These should not be made visible on the internet.

Class A

```
10.0.0.0 -- 10.255.255.255
```

Class B

```
172.16.0.0 -- 172.32.255.255
```

Class C

```
192.168.0.0 -- 192.168.255.255
```

IP Address — Subneting

```
Network: 192.168.192.0
Subnet:  255.255.255.224
```

IP Address - Default Route

```
$ sudo route add default gw 192.168.1.1 ↩
```

DoD Layer Model

Application	ftp, telnet, mail, http protocols
Transport	TCP , UDP protocols
Network	IP, ICMP, IGMP protocols
Link	Ethernet, Token Ring, FDDI

Basic Internet Protocols

IP

ICMP

TCP

UDP

Outline

Ports and Port Numbers

Listing the Ports

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```
$ less /etc/services
ftp             21/tcp
ftp             21/udp          fsp fspd
ssh             22/tcp          # SSH Remote Login Protocol
ssh             22/udp          # SSH Remote Login Protocol
telnet          23/tcp
telnet          23/udp
# 24 - private mail system
smtp            25/tcp          mail
smtp            25/udp          mail
time            37/tcp          timserver
```

Outline

Ports and Port Numbers

FTP	20, 21
Telnet	23
SSH	22
smtp	25
DNS	53
http	80
pop3	110
nntp	119
netbios	137, 138, 139
imap2	143
snmp	161

Port Number vRanges

1–255	Original reserved ports (till 1992) (256-1023 UNIX)
1–1023	Well Known or Famous Port Numbers - Reserved
1024–65535	Unprivileged

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