1.112.1
Fundamentals of TCP/IP
Weight 4
Linux Professional Institute Certification — 102

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Outline

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Objective
Context
Resources
IP Addressing
Classful Addressing (Obsolete)
Loopback address
Private addresses

Subnetting
Adding a Default Route
Model of network layers
Basic Internet Protocols
Ports and Port Numbers
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Main port numbers
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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

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:

/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]
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/](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

\[ 00000000.00000000.00000000.00000000 - 0.0.0.0 \]
\[ 01111111.11111111.11111111.11111111 - 127.255.255.255 \]

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

\[0000000.0000000.0000000.0000000 - 0.0.0.0\]
\[0111111.1111111.1111111.1111111 - 127.255.255.255\]

Class B — 255.255.0.0

\[1000000.0000000.0000000.0000000 - 128.0.0.0\]
\[1011111.1111111.1111111.1111111 - 191.255.255.255\]

Class C — 255.255.255.0

\[1100000.0000000.0000000.0000000 - 192.0.0.0\]
\[1101111.1111111.1111111.1111111 - 223.255.255.255\]
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)

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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 private 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 — Subnetting

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
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Ports and Port Numbers
Listing the Ports


$ 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
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**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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