Basics Of Networking

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Basics Of Networking

Brief History Of Networking (Ethernet)

1968 Norman Abramson

University of Hawaii - ALOHA System

1972 Bob Metcalfe

Xerox Palo Alto Research Center

Turned Ethernet Into Industry Standard

Founded Computer, Communication, and Compatibility Corporation

Seven Layer Open System Interconnection (OSI) Model

- Develop to resolve incompatibility issues and allow hardware from different manufacturers to communicate.
- Important to understand for network troubleshooting
- Modularizes different pieces of the network

Seven Layer Open System Interconnection (OSI) Model

- Structured approach to the transmission of data
- Lower levels (layers 1-4) deal with the interconnection of processors
- Upper levels (layers 5-7) deal with the interconnection of applications

Seven Layer Open System Interconnection (OSI) Model

7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

Seven Layer Open System Interconnection (OSI) Model: *Seven Layers In Detail*

7 Application

Layer at which applications execute

examples: Berkeley & Arpa Services

6 Presentation

Layer for dealing with data representation in applications - responsible for protocol conversion, translation, encryption, and graphic command expansion

example: UNIX to DOS

Seven Layer Open System Interconnection (OSI) Model: *Seven Layers In Detail*

5 Session Layer

Layer that allows connection between inter-process communications

example: Multiple Telnet sessions

4 Transport Layer

Layer that defines the transportation of data

examples: TCP & UDP

Seven Layer Open System Interconnection (OSI) Model: *Seven Layers In Detail*

3 Network Layer

Inter-Network Addressing Scheme

example: IP Address & Routing

2 Data Link Layer

Intra-Network Addressing Scheme

example: Ethernet Address or Link Level Address

1 Physical Layer

Layer that provides standardization of data circuits that connect to physical media, i.e. specifies characteristics of cable. example: Cat 5 Twisted Pair Cable

Seven Layer Open System Interconnection (OSI) Model: *Additional Information*

7	Application	host name
6	Presentation	host name
5	Session	socket address
4	Transport	port address
3	Network	internet address
2	Data Link	intranet address
1	Physical	“no addressing”

Seven Layer Open System Interconnection (OSI) Model:
HP-UX Specific Information

7	Application	hostname
6	Presentation	hostname
5	Session	netstat -an
4	Transport	netstat -an
3	Network	ifconfig
2	Data Link	lanscan
1	Physical	linkbeat lights

Internet Protocol Address: *Definition*

- Unique number representing a node on a network
- Part of the seven layer OSI model
- Used to route packets along a network

Internet Protocol Address: *Two Parts*

- Network Address

  Common to all hosts / devices on same physical network
- Node Address

  Unique to the host on that network

Internet Protocol Address: *Structure*

- 32 bits (four bytes) long
- Written in “dotted decimal” format:

  15.24.190.4

- Includes both network and node address information
- Divided into five major classes:

  A B C D & E

Internet Protocol Address: *Dotted Decimal Format*

- Address in binary:

  01000001 00010010 00001011 10000111

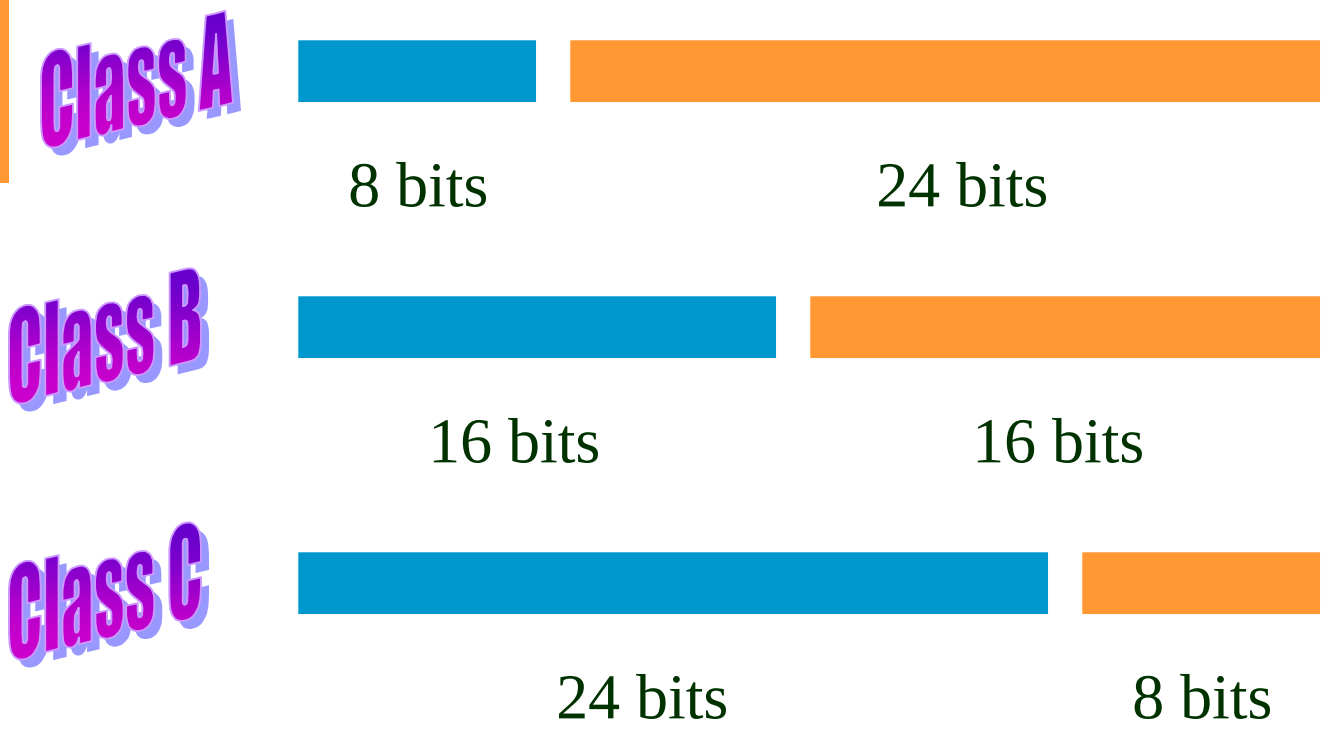
- Written in “dotted decimal” format:

  65.18.11.135

Network Portion

Host Portion

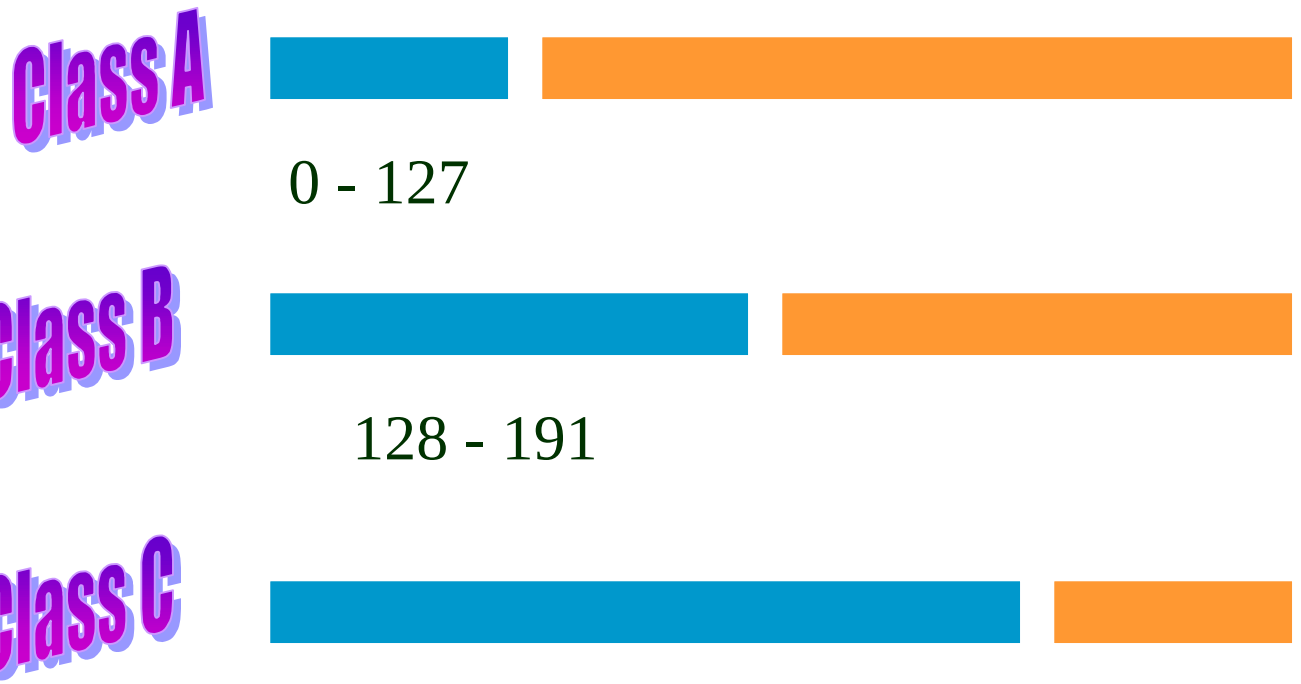
Internet Protocol Address:
Formulation Of IP Address



Network Range

Host Portion

Internet Protocol Address:
Formulation Of IP Address



Internet Protocol Address:
Class D & E

Range: 224 - 239

Multicast Group ID

Range: 240 - 247

Reserved for future use

Internet Protocol Address:
Two Reserved Addresses

Broadcast Address

Network Address

Internet Protocol Address: *Broadcast Address*

- A host uses the broadcast address to send a packet to every host within its same network
- Broadcast address is obtained by setting all bits of the host part to 1

Internet Protocol Address:
Broadcast Address Examples

Class A 15.255.255.255

Class B 148.22.255.255

Class C 192.161.32.255

Internet Protocol Address: *Network Address*

- Network address is used to specify a remote network.
- The *route command* uses the network address to configure routing.
- The network address is obtained by setting all bits of the host address to zero

Internet Protocol Address:
Network Address Examples

Class A 15.000.000.000

Class B 148.22.000.000

Class C 192.161.32.000

Link Level Address: *Definition*

- Unique address of a LAN interface.
- Value is usually set by the manufacturer
- Changing Link Level Address is not recommended

Link Level Address:
Also know as ...

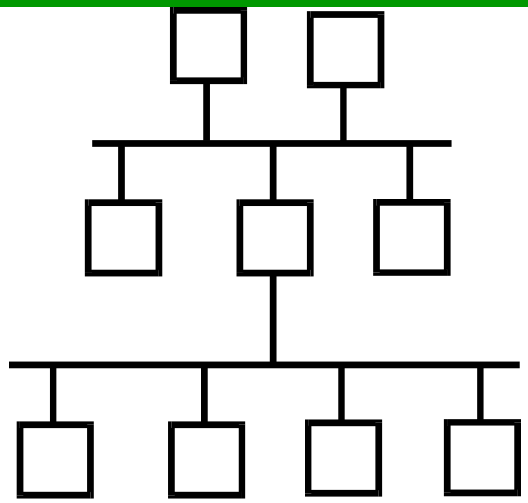
- MAC address
- Ethernet address
- IEEE 802.3 address

Link Level Address: *Example*

- Address is usually provided in hexadecimal form:

  0x0800090012ab

Type your welcome message here. You can make this a long message, or something short. Be sure to include a brief description of the type of things that can be found at this location.



Custom Topic A

Custom Topic B

Vital Statistics

Favorite Sites

Visit

Send E-mail

- Network has exceeded limits of a single LAN and run out of IP Addresses
- Isolate traffic of a specific node or group of nodes
- Divide a network into logical segments
- Improve throughput of network

- An optional addressing scheme that allows you to partition the host address portion of an IP address into discrete subnetworks
- Implemented by the keywords netmask or subnet mask which identifies the bits used to mask out the network portion of the IP Address
- Network portion is always masked out by using binary 1’s

00000001	2^0 = 1
00000010	2^1 = 2
00000100	2^2 = 4
00001000	2^3 = 8
00010000	2^4 = 16
00100000	2^5 = 32
01000000	2^6 = 64
10000000	2^7 = 128

Class A Network

Default netmask = 255.0.0.0

14.23.190.4

network portion

host portion

Class B Network

Default netmask = 255.255.0.0

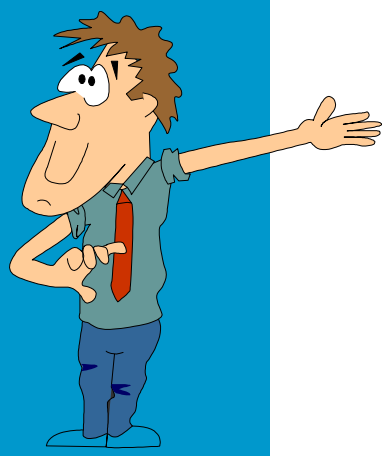
142.23.190.4

network portion

host portion

Class C Network

Default netmask = 255.255.255.0



212.23.190.4

network portion

host portion

- Subnets for a netmask are determined by working with the subnet field bits (those that extend into the node address portion of the IP address)
- The following example illustrates a node in a network with an IP address of 212.23.190.98 and a netmask of 255.255.255.224
- The subnet value field bits are 224

- Convert the 224 subnet field to binary

224 = 1 1 1 0 0 0 0 0

3 subnet field bits 5 node field bits

2^7 + 2^6 + 2^5 = 32 + 64 + 128 = 224

- The subnet field extends into the first three bits of the node potion of the IP address
- Five bits remain for the node portion

224 = 1 1 1 0 0 0 0 0

- All 0's or all 1's are not allowed for the subnet field
- All 0's for the node field is reserved for the subnet (network) address
- All 1's for the node field is reserved for the subnet (broadcast) address

Subnet Field	Value	Subnet Address	Hosts IP Address	Broadcast Address
00000000	0	212.23.190.0	212.23.190.1 - 30	212.23.190.31
00100000	32	212.23.190.32	212.23.190.33 - 62	212.23.190.63
01000000	64	212.23.190.64	212.23.190.65 - 94	212.23.190.95
01100000	96	212.23.190.96	212.23.190.97 - 126	212.23.190.127
10000000	128	212.23.190.128	212.23.190.129 - 158	212.23.190.159
10100000	160	212.23.190.160	212.23.190.161 - 190	212.23.190.191
11000000	192	212.23.190.192	212.23.190.193 - 222	212.23.190.223
11100000	224	212.23.190.224	212.23.190.225 - 254	212.23.190.255

Note: Values in red are not within the valid range

- What are the range and values of the subnets for a node in a network with an IP address of 132.23.190.84 and a netmask of 255.255.192.0
- Let's begin by defining the subnet value field bits => 192

- Convert the 192 subnet field to binary

  192 = 1 1 0 0 0 0 0 0

  2 subnet field bits 6 node field bits

  2^7 + 2^6 = 64 + 128 = 192

- The subnet field extends into the first two bits of the node potion of the IP address
- Six bits remain for the node portion

Subnet Field	Value	Subnet Address	Hosts IP Address	Broadcast Address
00000000	0			
01000000	64			
10000000	128			
11000000	192			

Let's just fill in the subnet field …

Remember: Values in red are not within the valid range

Subnet Field	Value	Subnet Address	Hosts IP Address	Broadcast Address
00000000	0	132.23.0.0	132.23.0.1 - 132.23.63.254	132.23.63.255
01000000	64	132.23.64.0	132.23.64.1 - 132.23.127.254	132.23.127.255
10000000	128	132.23.128.0	132.23.128.1 - 132.23.191.254	132.23.191.255
11000000	192	132.23.192.0	132.23.192.1 - 132.23.255.254	132.23.255.255

Now, let's complete the subnet spreadsheet with the appropriate ranges and values

Subnetting: Quiz

Network: 15.0.0.0 Netmask: 255.255.248.0

xxxxxxxx.xxxxxxxx.xxxxxxxx.xxxxxxxx

network portion *host portion*

Host, Broadcast, or Network Addresses ???

15.7.164.0 15.32.208.0

15.70.93.255 15.101.143.255

Subnetting: Quiz (con't)

255.255.248.0	248 = 11111 000
15.7.164.0	164 = 10100 100
15.32.208.0	208 = 11010 000
15.70.93.255	93 = 01011 101
15.101.143.255	143 = 10001 111

Network Configuration

Lanscan Command:
Definition

- Displays LAN device configuration and status

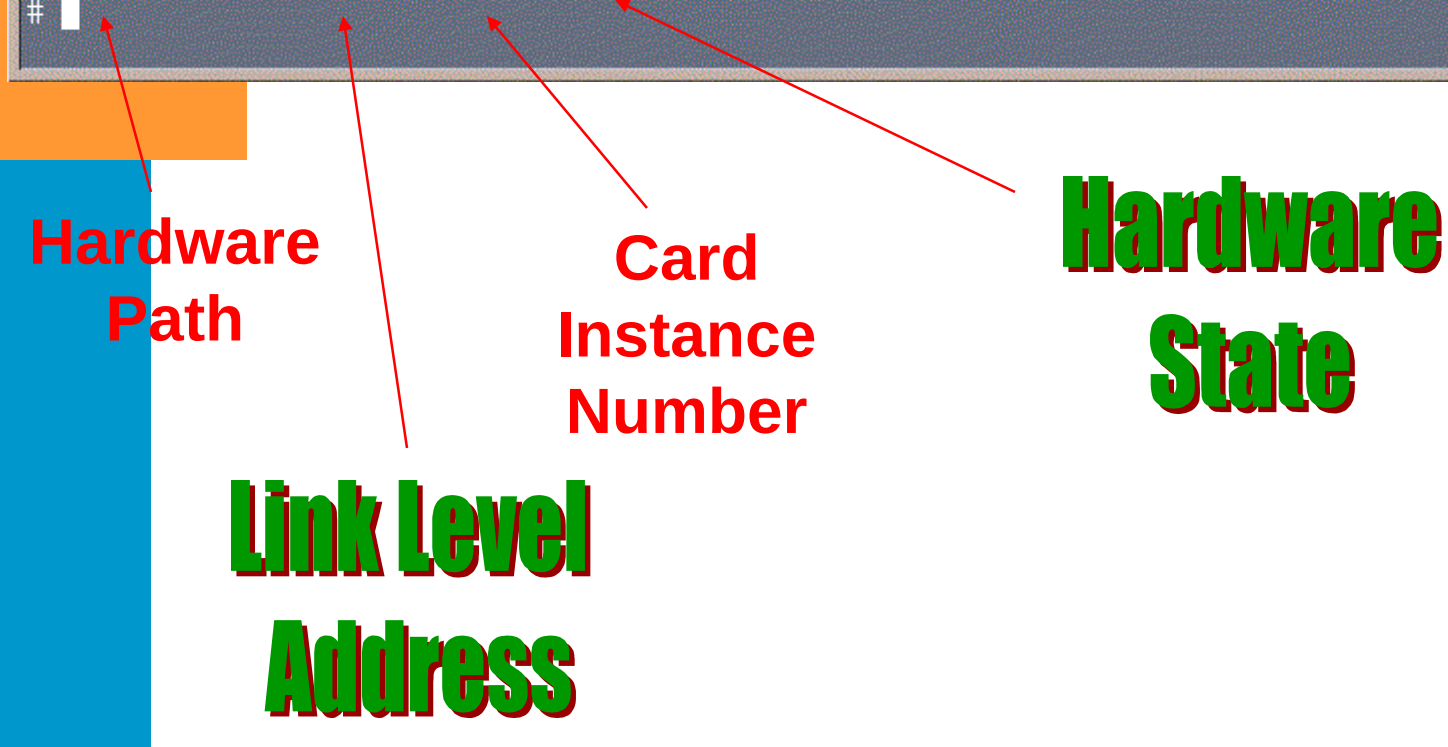
Window Edit Options Help

```
# lanscan
Hardware Station         Crd Hardware Net-Interface   NM  MAC         HP DLPI Mjr
Path     Address         In# State    NameUnit State  ID  Type        Support Num
2/0/2    0x080009783272 0   UP       lan0     UP     4   ETHER       Yes     52
#
```

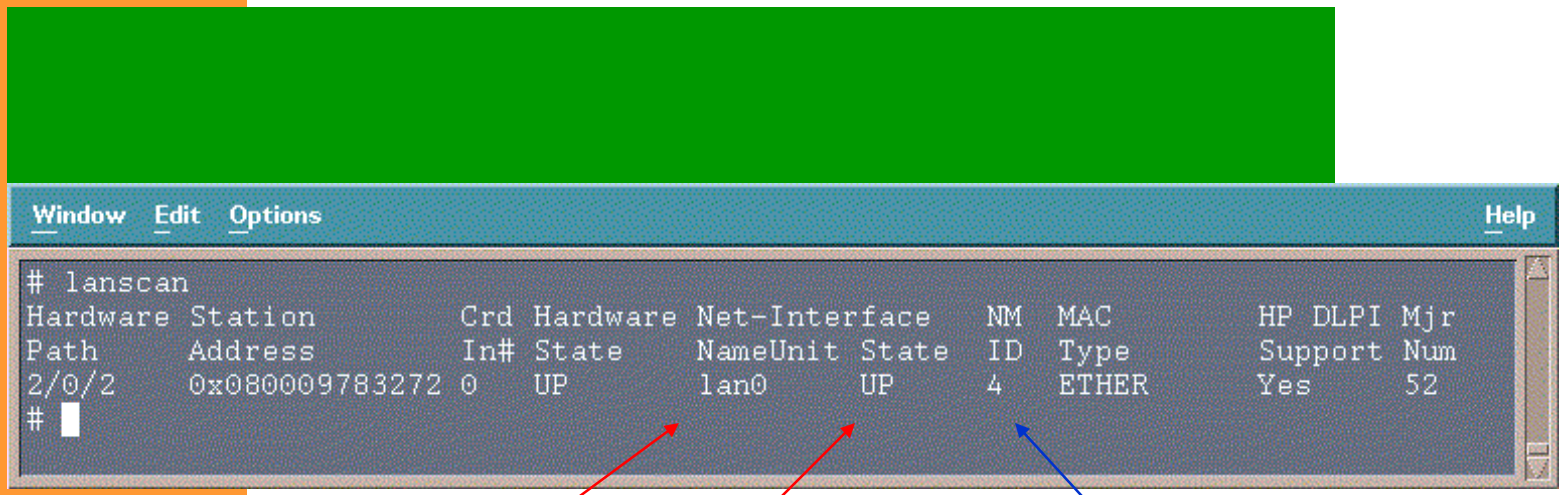
Lanscan Command:
Example

Window Edit Options Help

```
# lanscan
Hardware  Station         Crd Hardware Net-Interface   NM  MAC         HP DLPI Mjr
Path      Address         In# State    NameUnit State  ID  Type        Support Num
2/0/2     0x080009783272  0   UP       lan0     UP     4   ETHER       Yes     52
#
```



Lanscan Command:
Example



Net Interface Name

Net Interface State

Relates to the ifconfig command

Network Management ID

Used by lanadmin diagnostic tool

Lanscan Command:
Example

Window Edit Options Help

```
# lanscan
Hardware  Station         Crd Hardware Net-Interface   NM  MAC         HP DLPI Mjr
Path      Address         In# State    NameUnit State  ID  Type        Support Num
2/0/2     0x080009783272  0   UP       lan0     UP     4   ETHER       Yes     52
#
```

Specifies medium access control (MAC) of LAN link

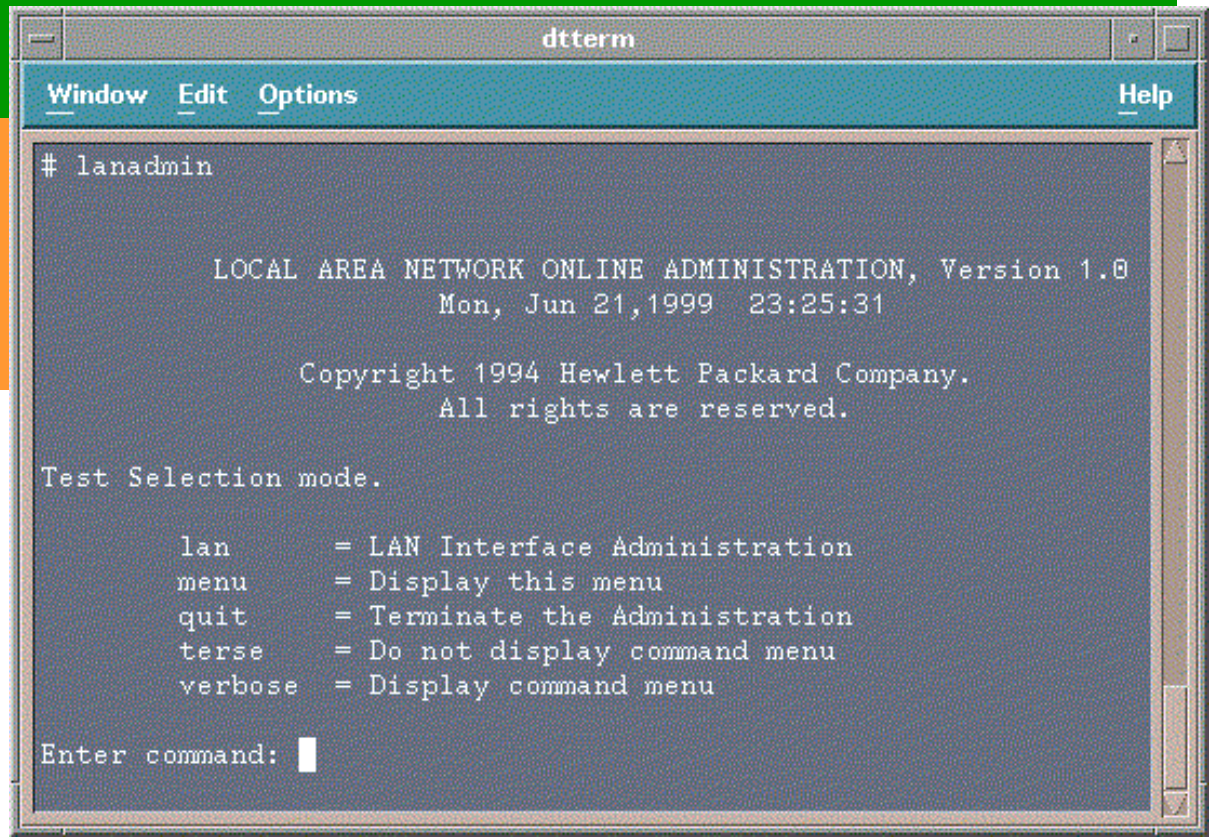
Driver

Indicates whether or not the LAN device drive is compatible with HP's Data Link Provider Interface

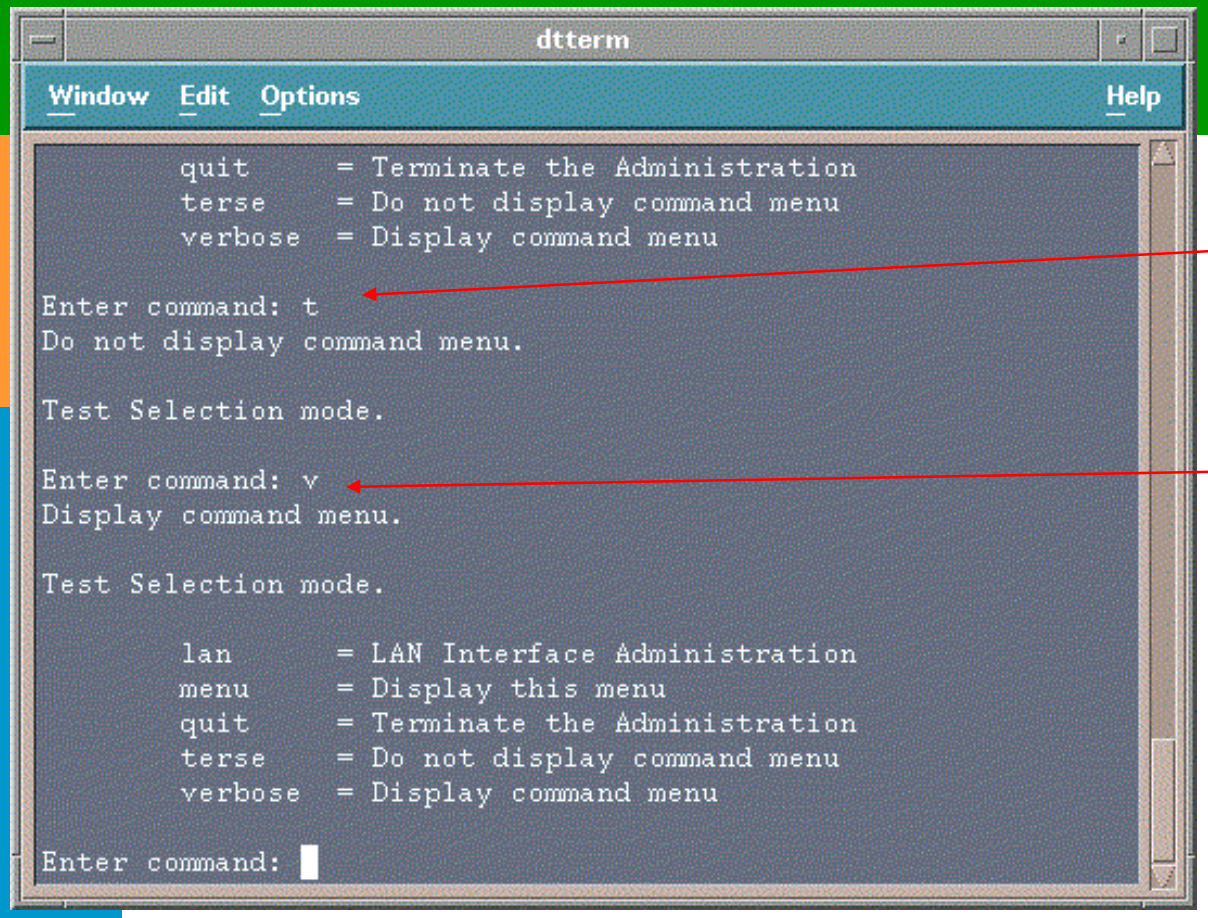
Lanadmin Command: Definition

- LAN diagnostic tool
- Enables reset of LAN interface card
- Checks for faulty network connection
- Reports driver statistics for unusual or unexpected values
- Resets the driver statistics

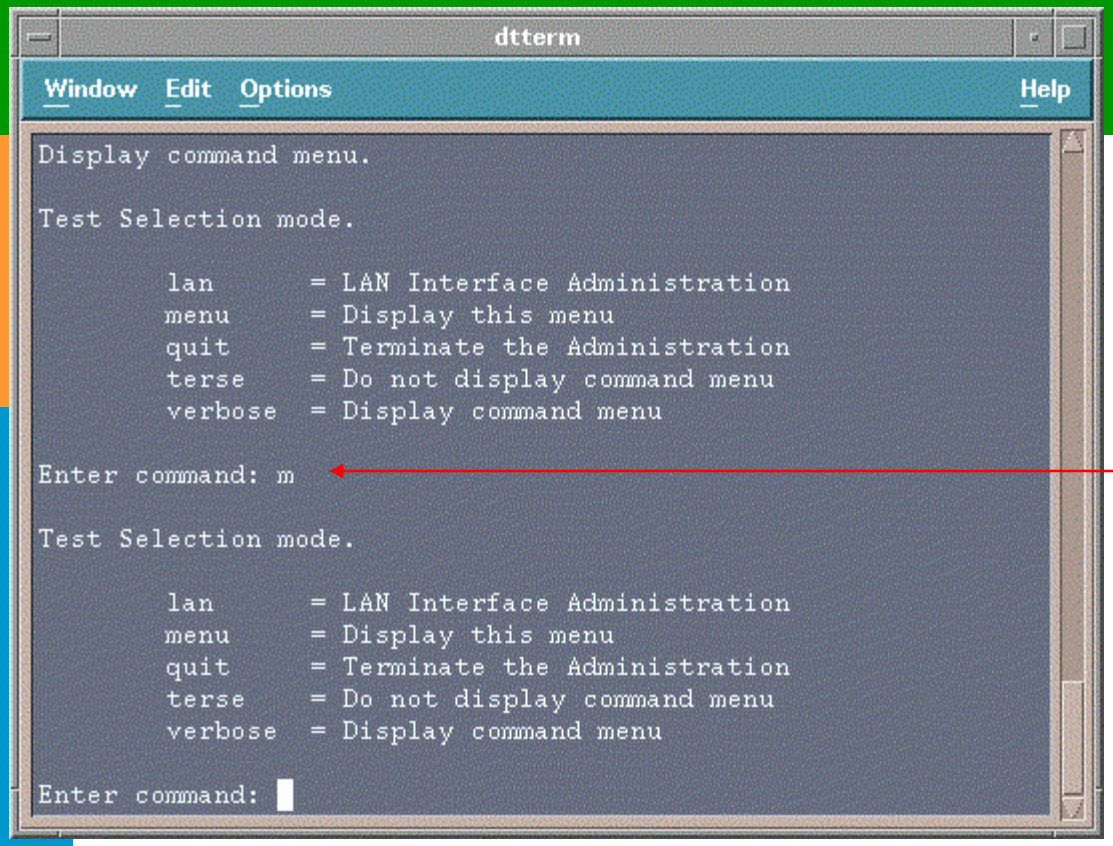
Lanadmin Command Menu: Example



Lanadmin Command Menu: erse & verbose

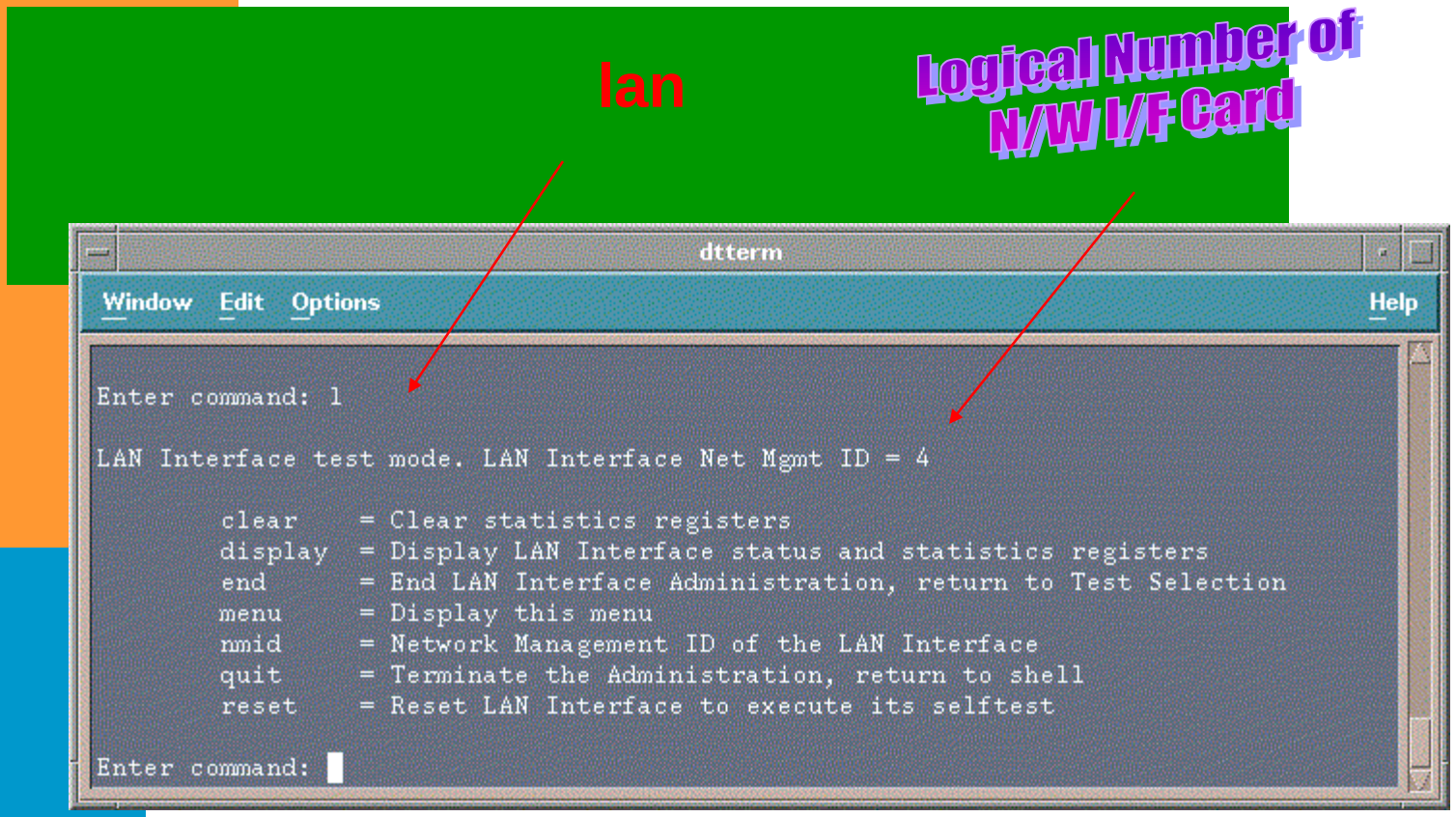


Lanadmin Command Menu: menu

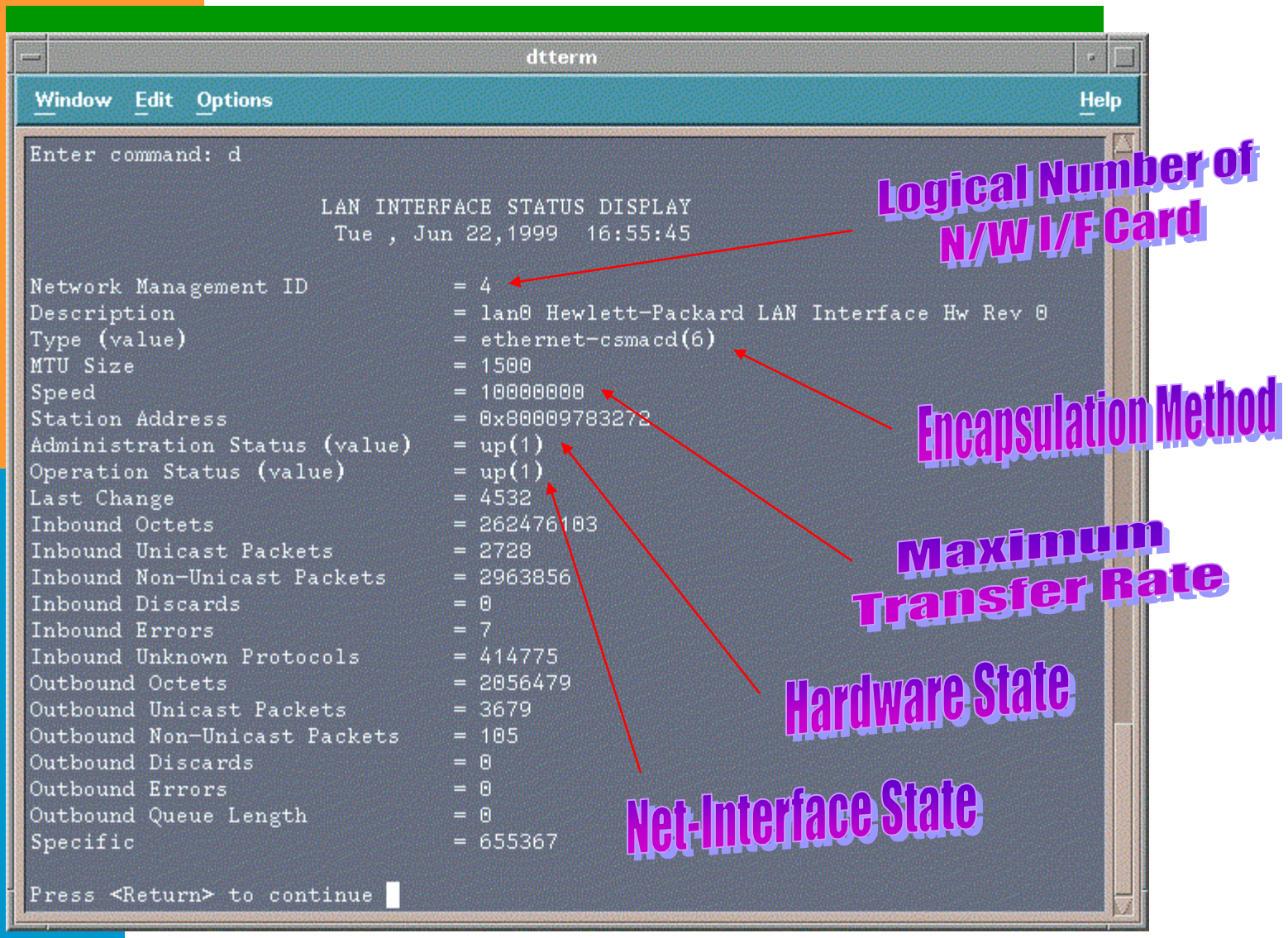


men u

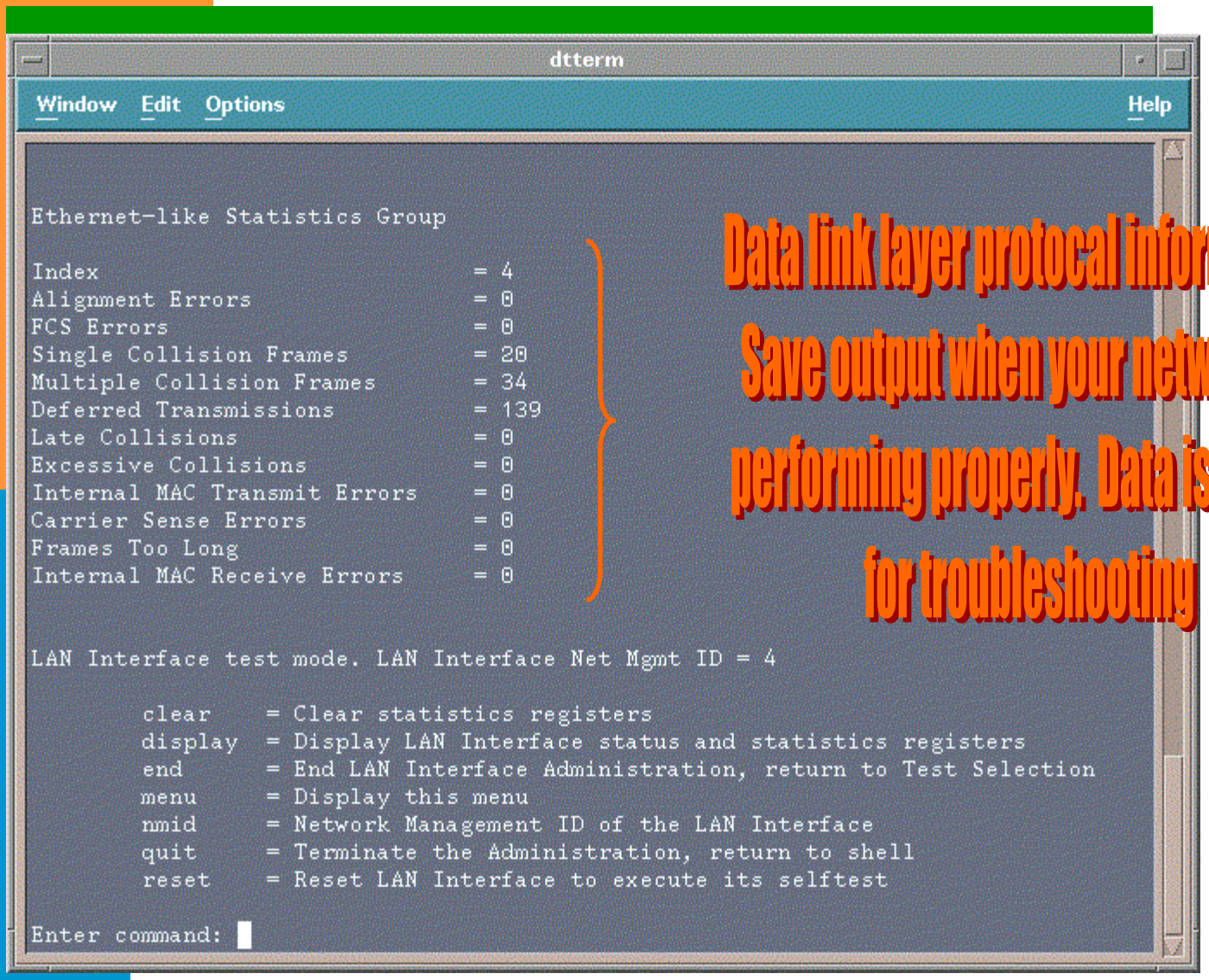
Lan Interface Administration Menu:



Lan Interface Administration Menu: lan => display (1st screen)

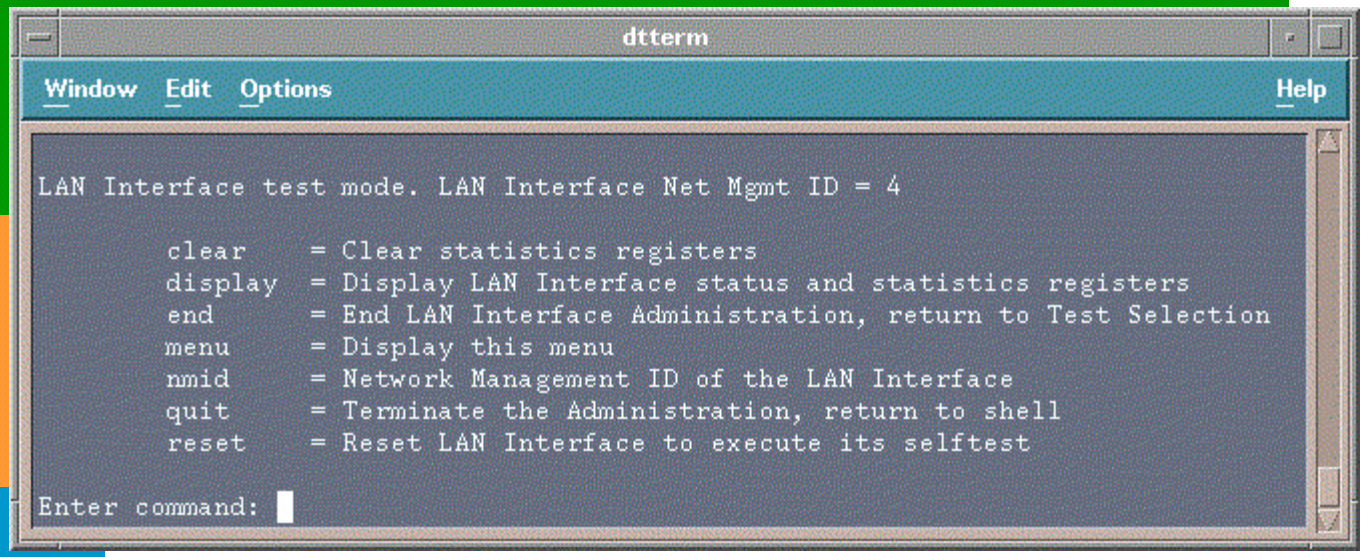


Lan Interface Administration Menu: lan => display (2nd screen)



Data link layer protocal information. Save output when your network is performing properly. Data is useful for troubleshooting

Lan Interface Administration Menu: nmid, clear, and reset



- The nmid command is helpful when a system contains multiple LAN cards.
- The reset command may be used when the hardware status of the LAN card is down

Lanadmin Additional Notes: Interprocess Dialogue rol

- Full-duplex
  - two-way simultaneous mode of communication
- Half-duplex
  - two-way alternative mode of communication
  - only one end of the connection can transmit at a time
- Simplex
  - one-way mode of communication

Lanadmin Additional Notes: How To Determine Duplex Type

- lanadmin -x <nmid>
- lanadmin menu
  - lanadmin
  - <nmid>
  - display

Lanadmin Additional Notes: How To Determine Duplex Type

```
#  lanadmin -x 4
Speed                = 100 Full-Duplex
```

Lanadmin Additional Notes: How To Determine Speed

- lanadmin -s <nmid>
- lanadmin menu
  - lanadmin
  - <nmid>
  - display

Lanadmin Additional Notes: How To Determine Speed

```
#  lanadmin -s 4
Speed                = 100

#  lanadmin -s 5
Speed                = 10000000
```

Lanadmin Additional Notes: How To Set Duplex Type

- lanadmin -X duplex_value <nmid>
- Valid entries for the duplex_value

10HD 10FD

100HD 100FD

Lanadmin Additional Notes: How To Set Speed

- lanadmin -S speed <nmid>
- Valid entries for the speed

10 100

Lanadmin Additional Notes: Configuration File

- Every interface type has its own configuration file:
  - hpetherconf 10BaseT
  - hpgsc100conf 100BaseT
  - hpfddiconf fddi
- Location: /etc/rc.config.d

Lanadmin Additional Notes: Configuration File

...

HP_GSC100_INTERFACE_NAME[0]=lan0

HP_GSC100_STATION_ADDRESS{0}=0x0060B 0C17BE9

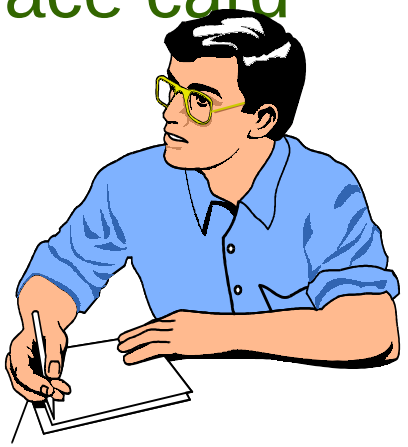
HP_GSC100_DUPLEX[0]=FULL

HP_GSC100_SPEED[0]=100FD

...

Configuring Network Connectivity: ifconfig definition

- Assigns IP address to network interface card.
- Checks the configuration values of the network interface card



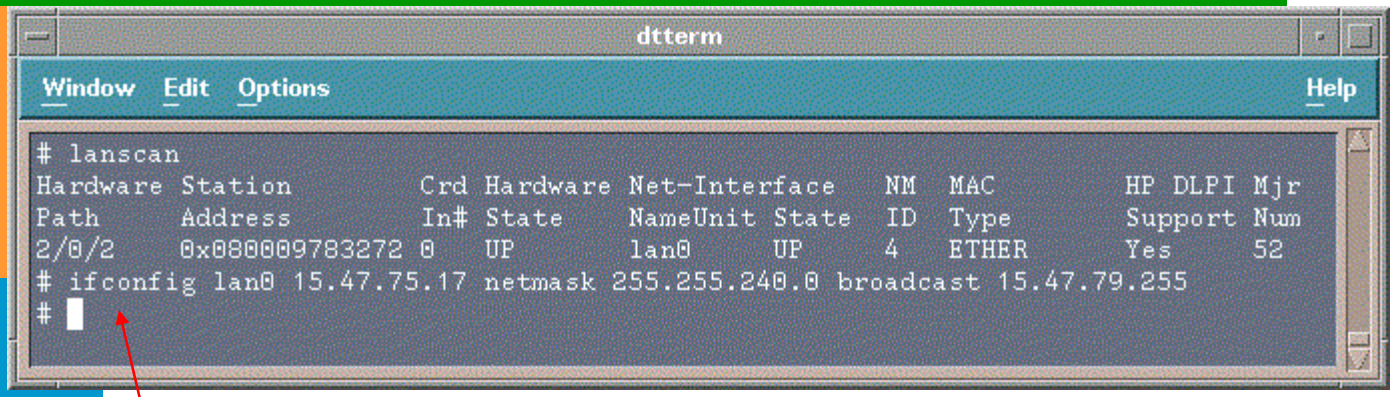
Configuring Network Connectivity: ifconfig syntax

ifconfig *interface IP_address* **netmask** *mask*
broadcast *address*

Optional Fields

Configuring Network Connectivity: ifconfig example

ifconfig *interface IP_address* **netmask** *mask* **broadcast** *address*

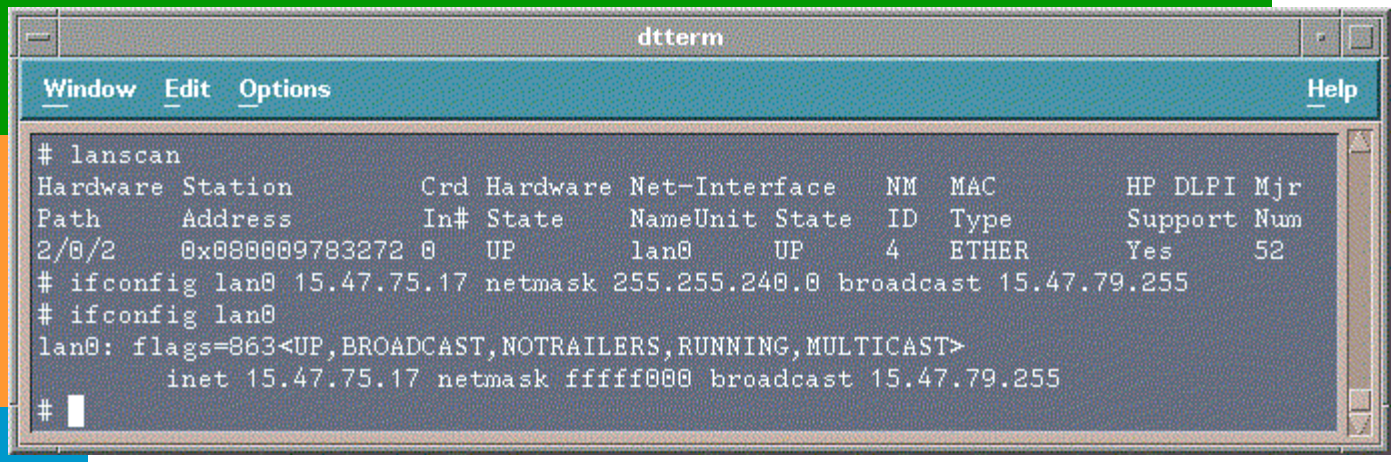


Did this command actually work ???

Configuring Network Connectivity: ifconfig example

ifconfig

interface



- **up** Indicates that the interface is enabled. If the interface is disabled, the up is substituted by the null character.
- **broadcast** Indicates that the interface is configured to accept broadcasts
- **notrailers** Encapsulation does not support trailer encapsulation which is becoming less popular. See man page on ifconfig for further discussion.

Configuring Network Connectivity: ifconfig example

ifconfig ***down***

dtterm

Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.47.75.17 netmask fffff000 broadcast 15.47.79.255
# ifconfig lan0 down
# ifconfig lan0
lan0: flags=862<BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.47.75.17 netmask fffff000 broadcast 15.47.79.255
#
```

Configuring Network Connectivity: ifconfig example

ifconfig ***up***

dtterm

Window Edit Options Help

```
# ifconfig lan0
lan0: flags=862<BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.47.75.17 netmask fffff000 broadcast 15.47.79.255
# ifconfig lan0 up
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.47.75.17 netmask fffff000 broadcast 15.47.79.255
#
```

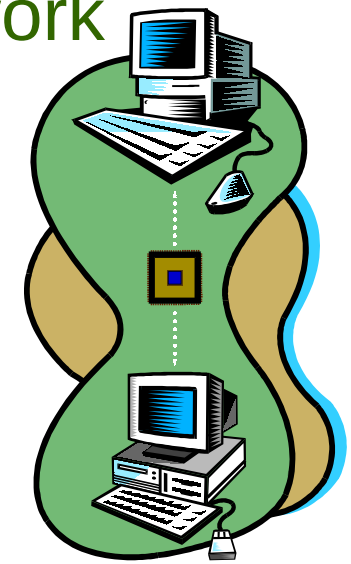
Configuring Network Connectivity: ifconfig example

Warning ...

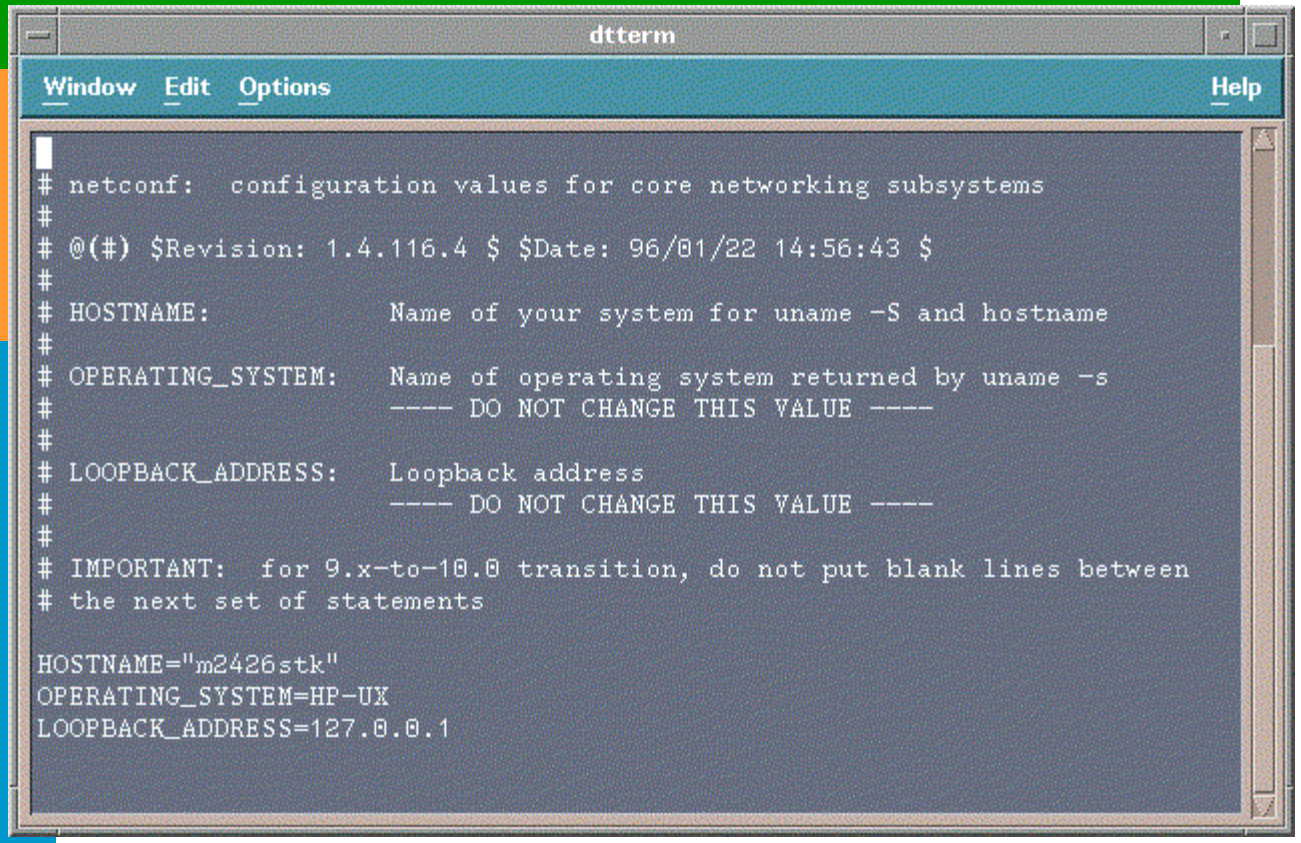
Configuring the LAN card via the ifconfig command is not permanent. A reboot will cause the LAN card to be set to its default configuration.

Configuring Network Connectivity: /etc/rc.config.d/netconf file

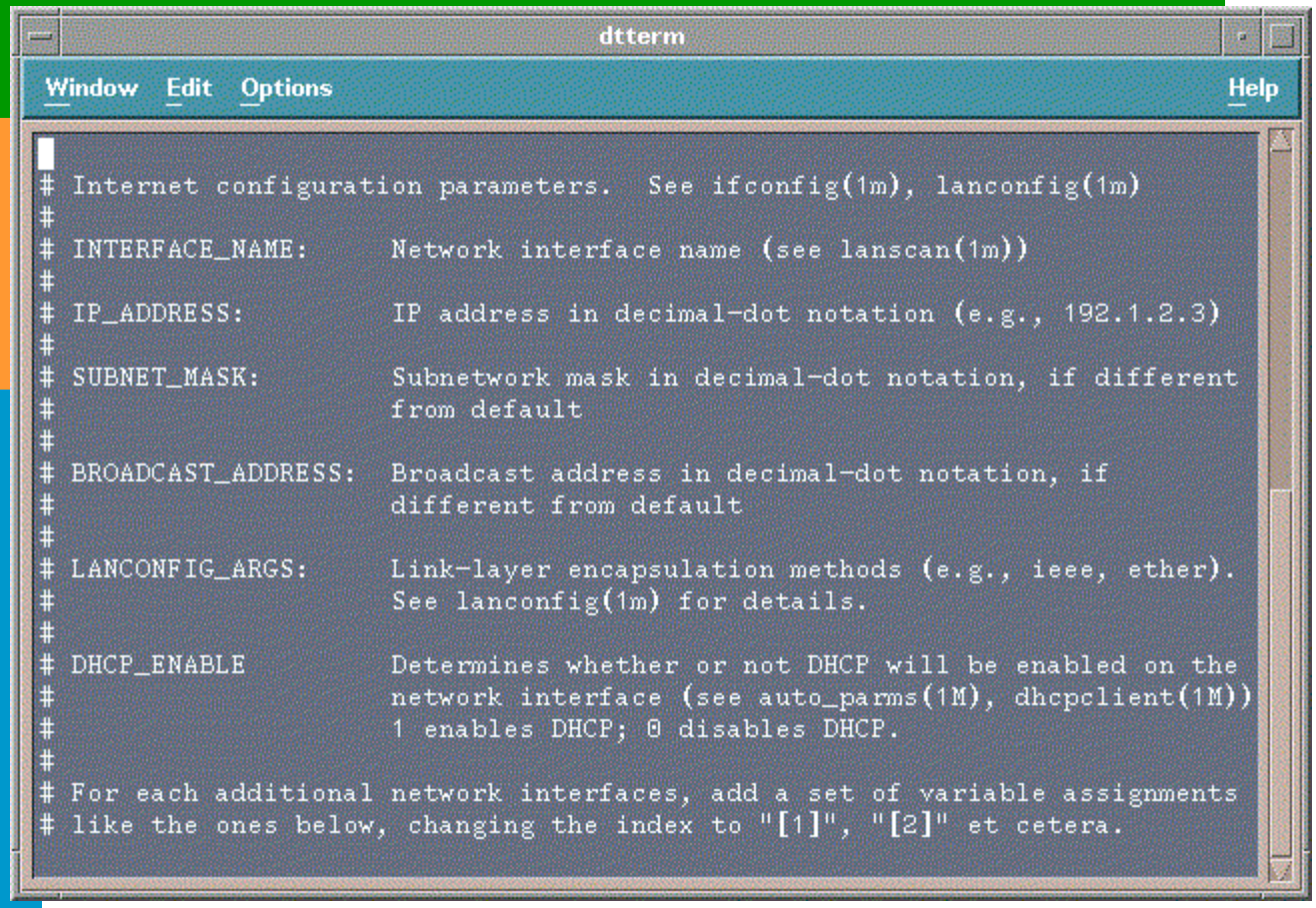
- Contains configuration values for the network subsystems:
  - Hostname
  - Interface Name
  - IP Address
  - Subnetmask
  - Broadcast Address

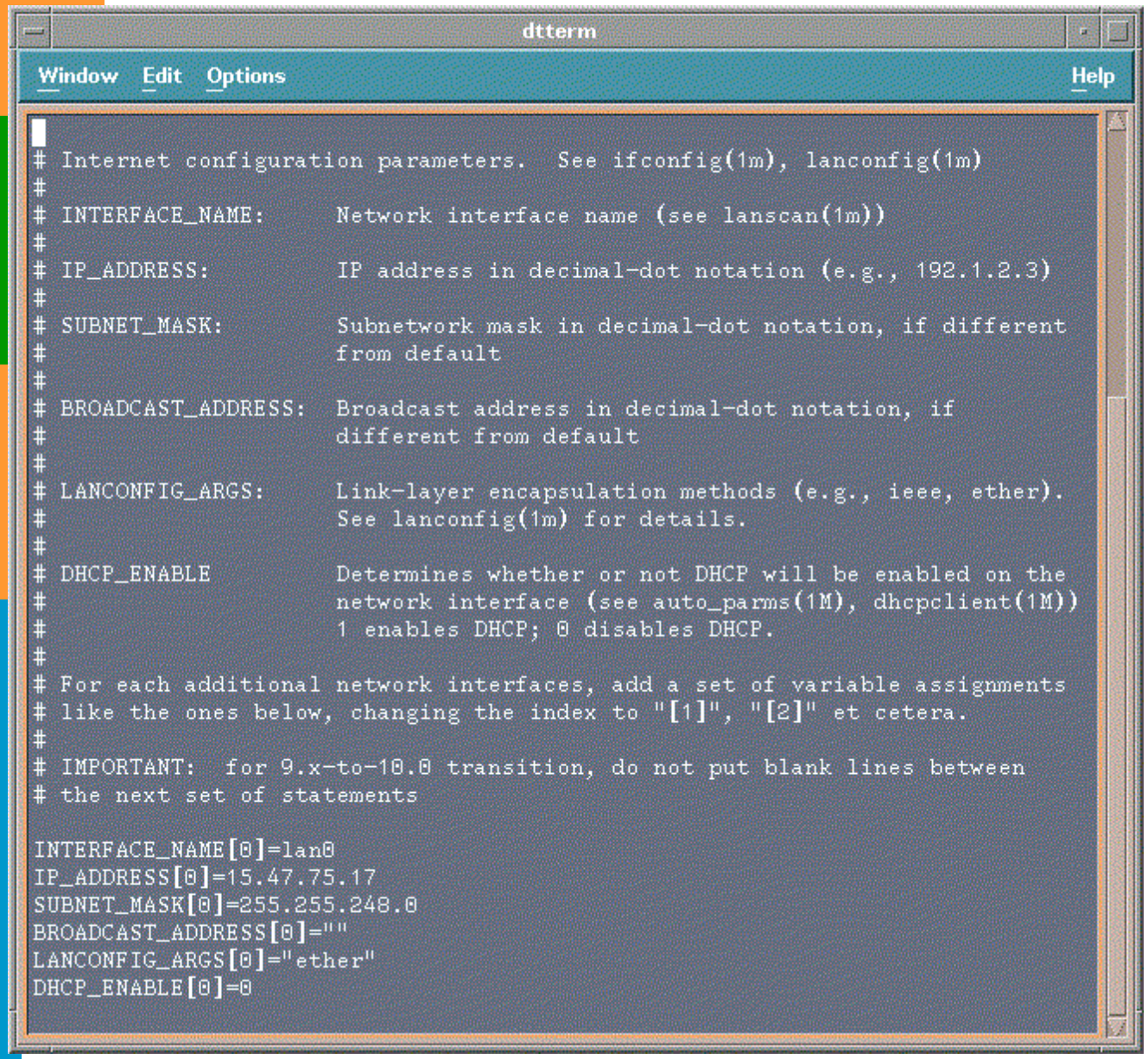


Configuring Network Connectivity: netconf file: hostname information

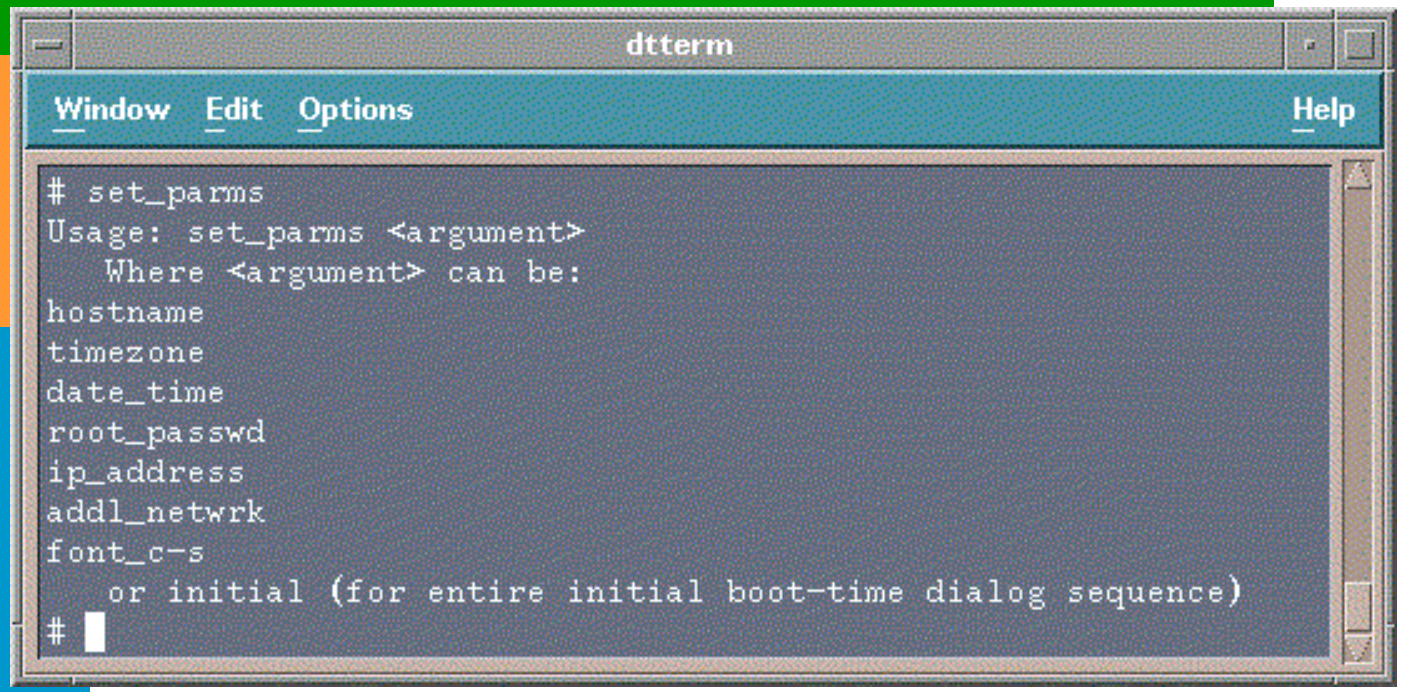


Configuring Network Connectivity: netconf file: LAN card configuration




dtterm
Window Edit Options Help
Internet configuration parameters. See ifconfig(1m), lanconfig(1m)
#
INTERFACE_NAME: Network interface name (see lanscan(1m))
#
IP_ADDRESS: IP address in decimal-dot notation (e.g., 192.1.2.3)
#
SUBNET_MASK: Subnetwork mask in decimal-dot notation, if different
from default
#
BROADCAST_ADDRESS: Broadcast address in decimal-dot notation, if
different from default
#
LANCONFIG_ARGS: Link-layer encapsulation methods (e.g., ieee, ether).
See lanconfig(1m) for details.
#
DHCP_ENABLE Determines whether or not DHCP will be enabled on the
network interface (see auto_parms(1M), dhcpclient(1M))
1 enables DHCP; 0 disables DHCP.
#
For each additional network interfaces, add a set of variable assignments
like the ones below, changing the index to "[1]", "[2]" et cetera.
#
# IMPORTANT: for 9.x-to-10.0 transition, do not put blank lines between
# the next set of statements
INTERFACE_NAME[0]=lan0
IP_ADDRESS[0]=15.47.75.17
SUBNET_MASK[0]=255.255.248.0
BROADCAST_ADDRESS[0]=""
LANCONFIG_ARGS[0]="ether"
DHCP_ENABLE[0]=0

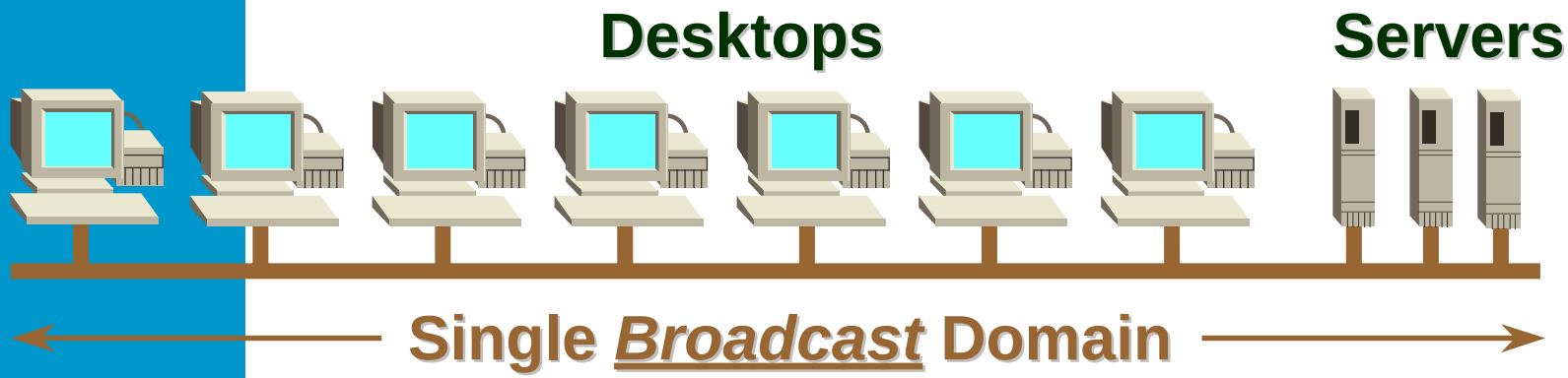
Configuring Network Connectivity: set_parms command



Routing

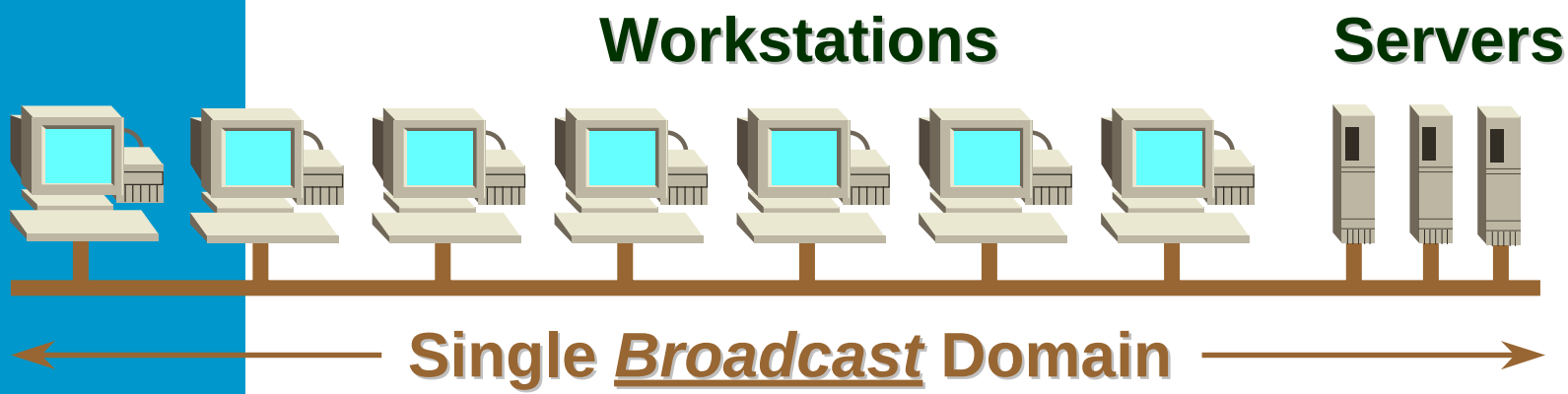
Ethernet LAN

A shared medium network that interconnects attached nodes by broadcasting a frame transmitted by one attached node to all other attached nodes. Each node individually decides whether to receive or discard the frame.



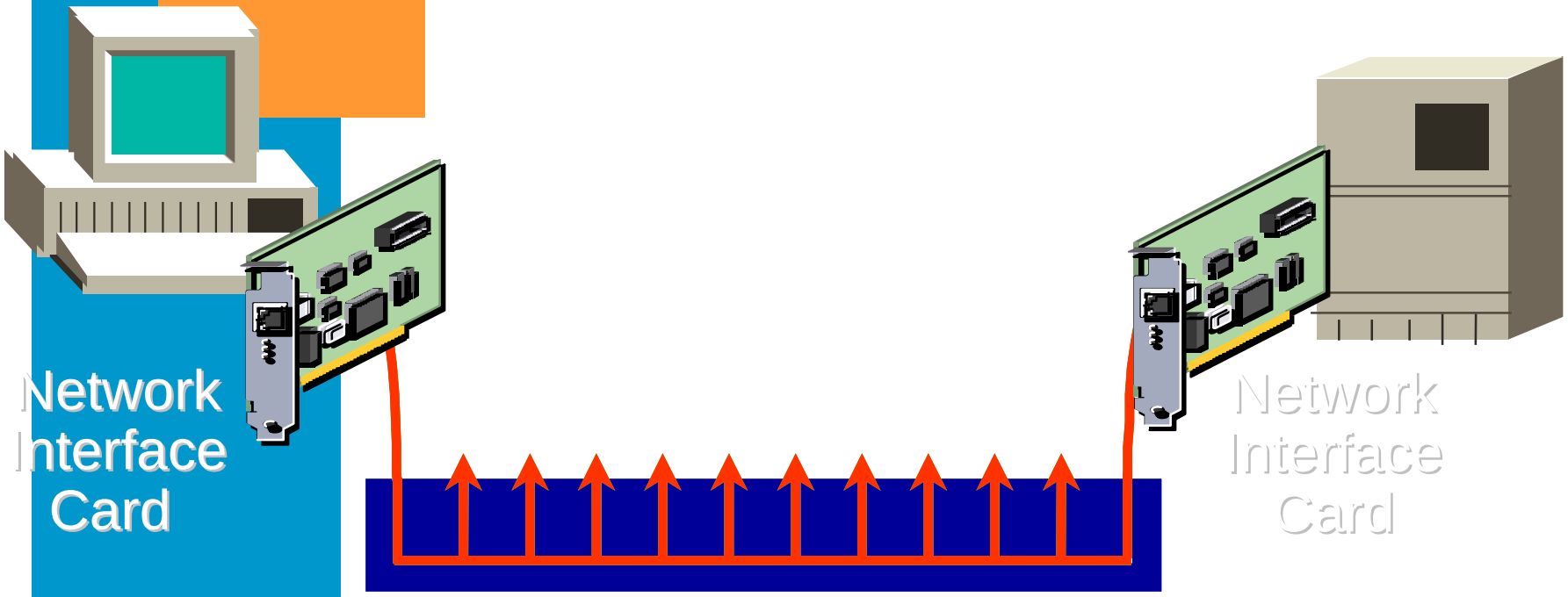
Ethernet LAN Problems

- A shared medium network requires all nodes to share the bandwidth of the physical link
- A shared medium network limits effective utilization of the physical link. Ethernets traditionally achieved only 30%- 40% efficiency because all nodes were in a single collision domain.



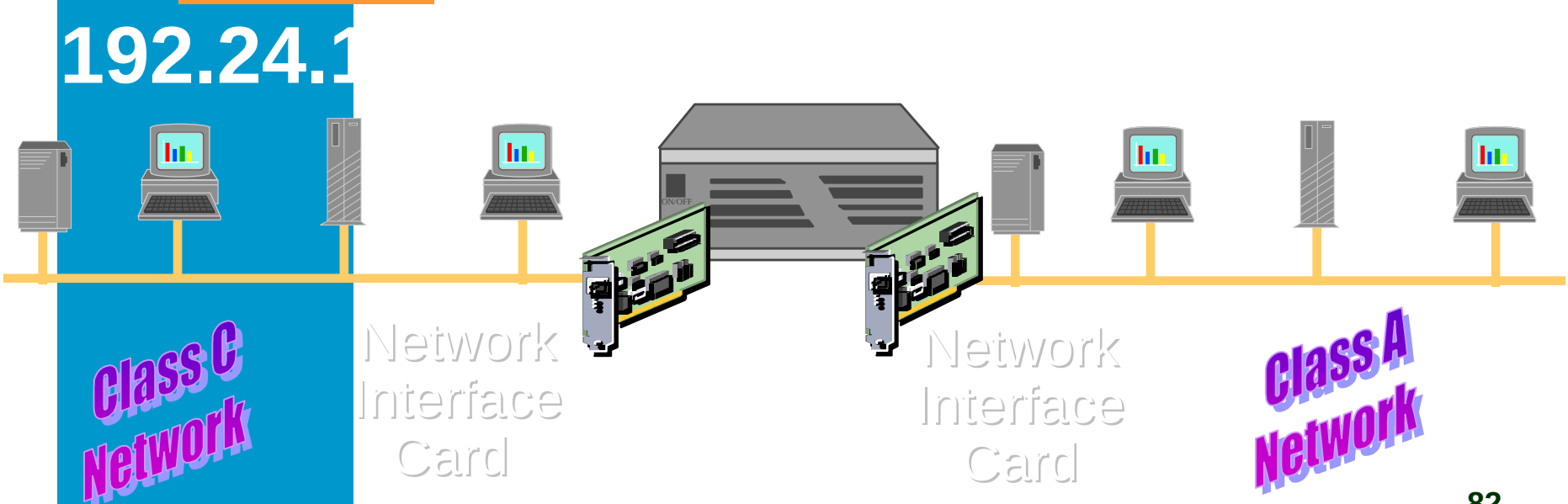
Hub Definition

- Hub sends packets out of all ports
- Single collision domain
- Single broadcast domain
- Appears as a single wire



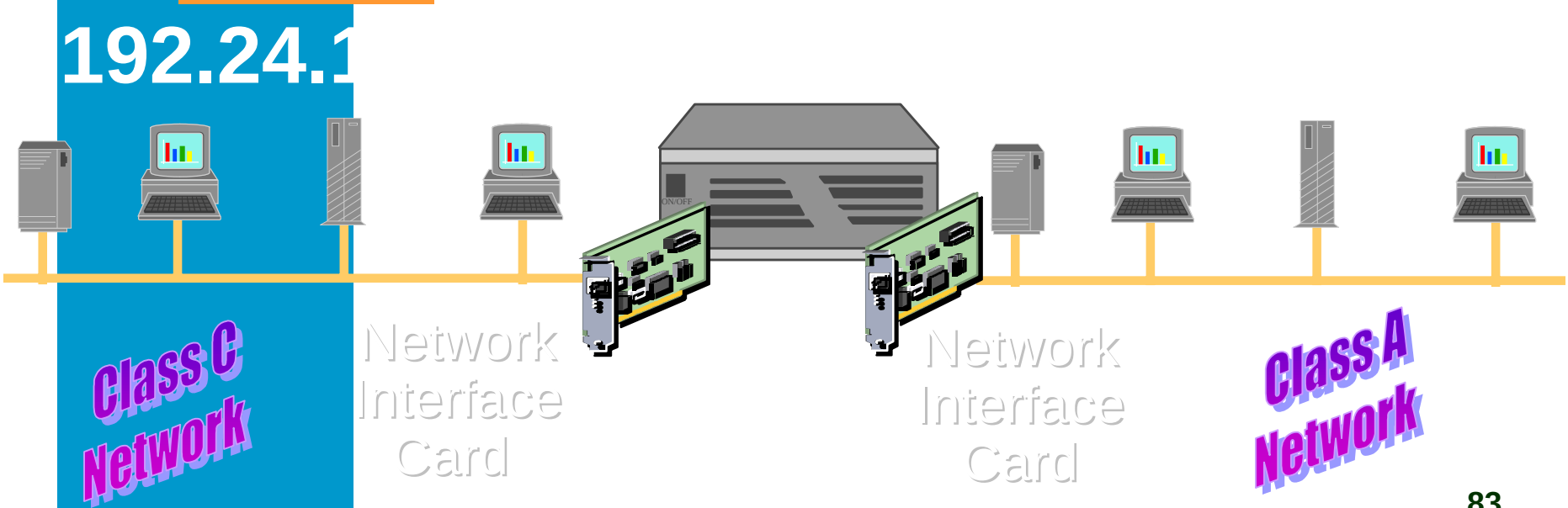
Implementing Subnetting

- Use router to implement subnetworks
- Illustrated router subnetting example is an outdated implementation
- Router contains multiple LAN cards



Routing Concepts

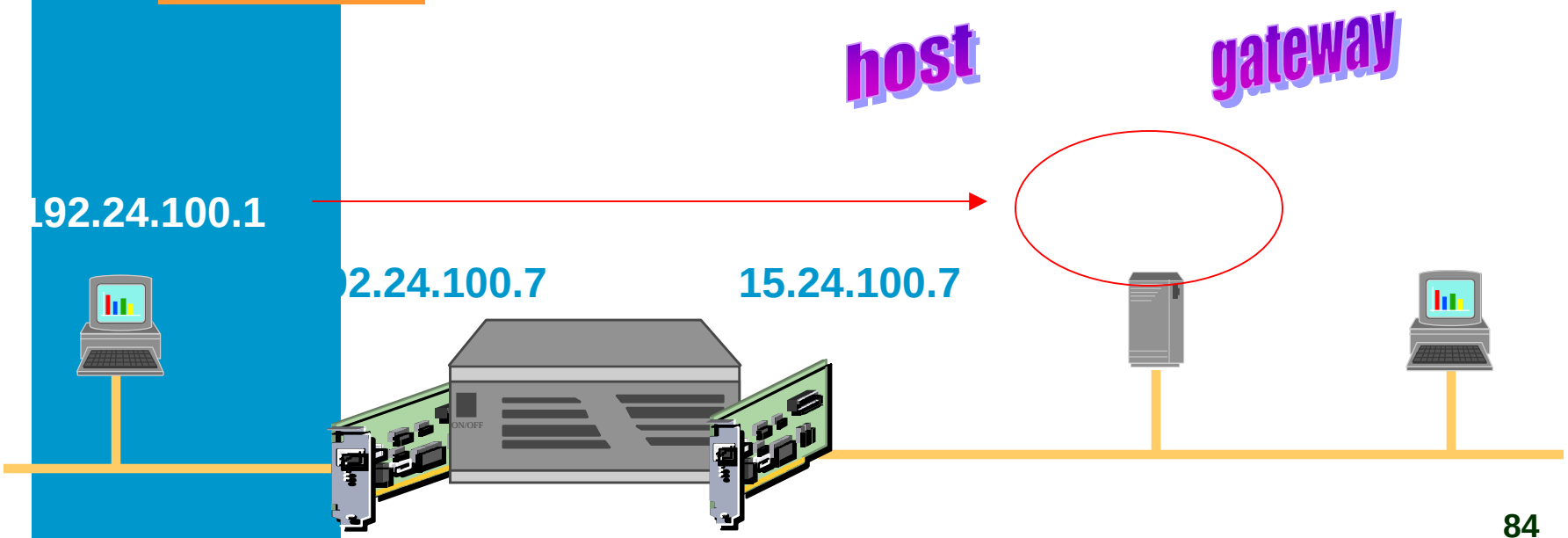
- Process of choosing a path over which to send a packet
- Only static routes presented
- Configure route to a host or network



Routing By Host

- Route packages from 192.24.100.1 to host 15.24.100.2
- Low usage since routing is generally based on networks

/usr/sbin/route add host 15.24.100.2 192.24.100.7 1

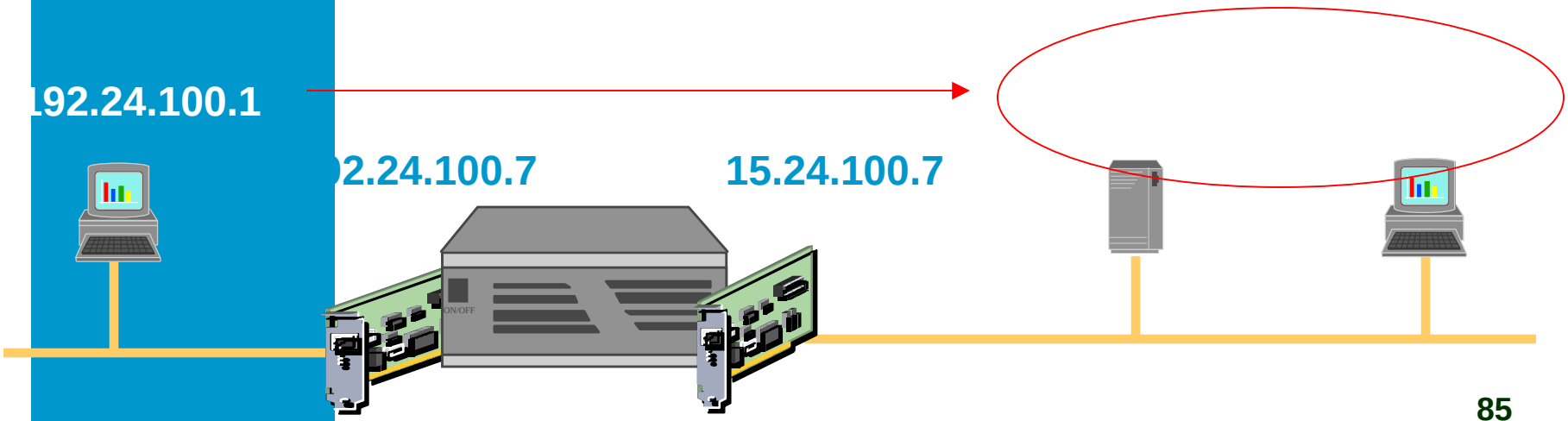


Routing By Network

- **Route packages from 192.24.100.1 to network 15.0.0.0**

/usr/sbin/route add net 15 192.24.100.7 1

network gateway

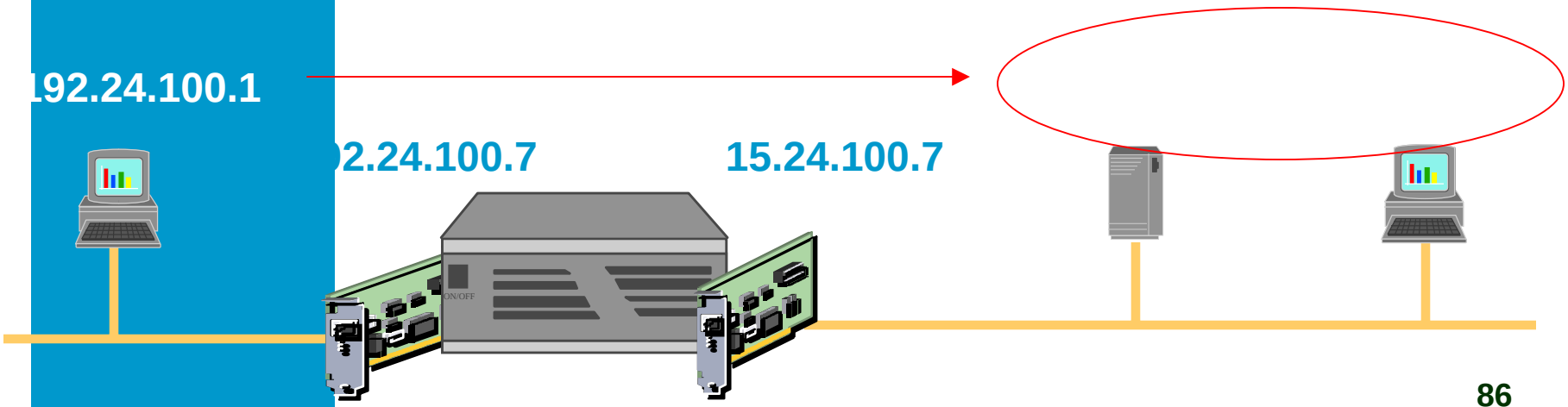


Routing By Default

- **Route all packages from 192.24.100.1 through a default address**

/usr/sbin/route add default 192.24.100.7 1

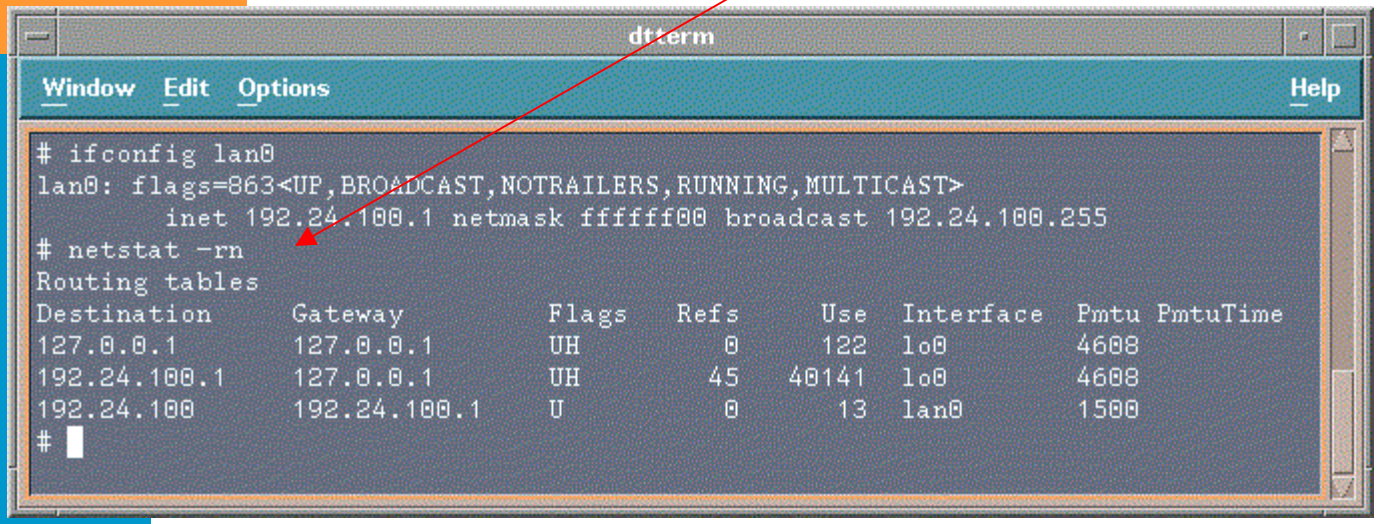
default gateway



Display Routes

- **Display all the routes in the local routing table**

/usr/bin/netstat -rn



Display Routes

- The Flags field may contain any or all of U,G, or H
  - U The router is up and running
  - G The router entry is a gateway
  - H The destination is a host, not a network
- The Refs field gives the current number of active uses of the route
- The Use count (number of packets) is cumulative since the last activation of the network interface
- The mtu field applies only to host routes - see man page for definitions

Display Routes

dtterm

Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# netstat -rn
Routing tables
Destination     Gateway         Flags    Refs     Use  Interface  Pmtu PmtuTime
127.0.0.1       127.0.0.1       UH          0     122  lo0        4608
192.24.100.1    127.0.0.1       UH         45   40141  lo0        4608
192.24.100      192.24.100.1    U           0      13  lan0       1500
#
```

terface refers to the loopback interface on the network card. This loopback interface allows the host to tself the same way as it addresses other hosts on the There is one difference, however, is that packets are ack and prevented from contributing to network traffic.

dtterm

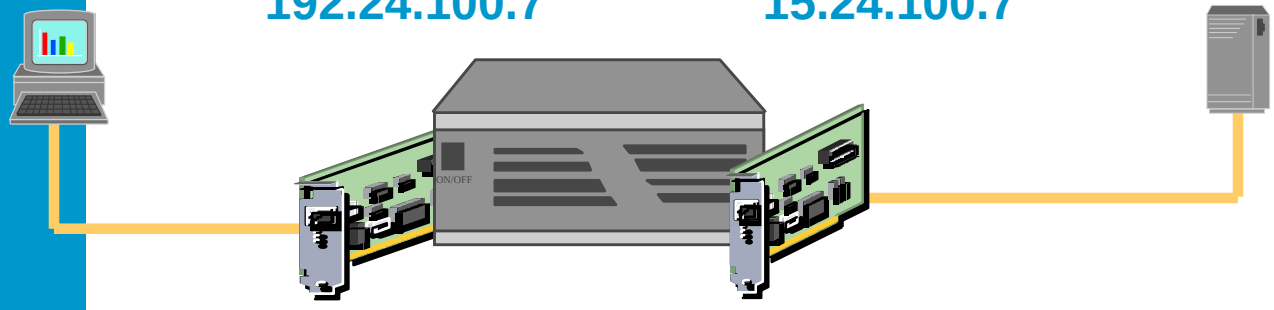
Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# netstat -rn
Routing tables
Destination     Gateway         Flags    Refs     Use  Interface  Pmtu PmtuTime
127.0.0.1       127.0.0.1       UH          0     122  lo0        4608
192.24.100.1    127.0.0.1       UH         45   40141  lo0        4608
192.24.100      192.24.100.1    U           0      13  lan0       1500
#
```

192.24.

192.24.100.7

15.24.100.7



dtterm

Window Edit Options Help

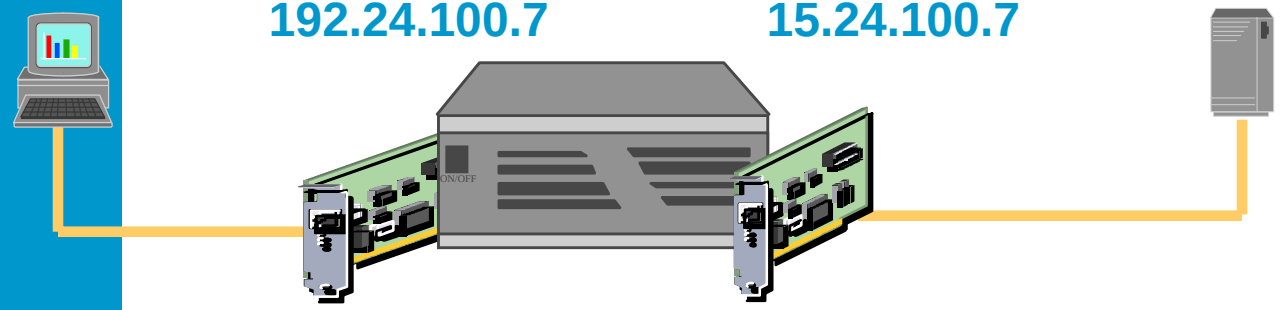
```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# ping 192.24.100.7 -n 2
PING 192.24.100.7: 64 byte packets
64 bytes from 192.24.100.7: icmp_seq=0. time=7. ms
64 bytes from 192.24.100.7: icmp_seq=1. time=3. ms

----192.24.100.7 PING Statistics----
2 packets transmitted, 2 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 3/5/7
#
```

192.24.1

192.24.100.7

15.24.100.7



dtterm

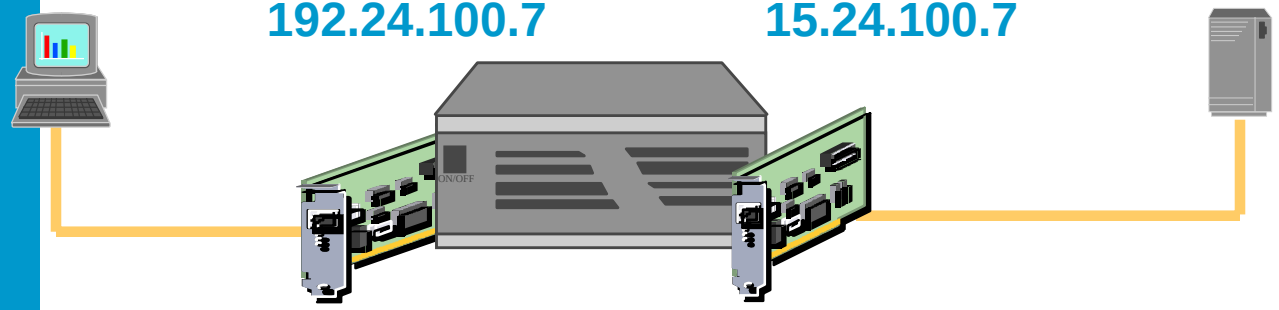
Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# ping 15.24.100.7 -n 2
PING 15.24.100.7: 64 byte packets
ping: sendto: Network is unreachable
ping: wrote 15.24.100.7 64 chars, ret=-1
ping: sendto: Network is unreachable
ping: wrote 15.24.100.7 64 chars, ret=-1

----15.24.100.7 PING Statistics----
2 packets transmitted, 0 packets received, 100% packet loss
#
```

192.2

192.24.100.7 15.24.100.7



dtterm

Window Edit Options Help

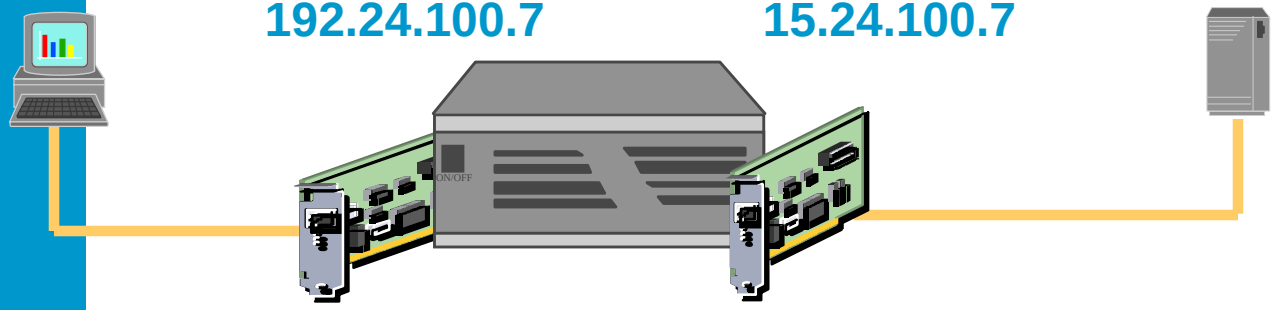
```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# ping 15.24.100.2 -n 2
PING 15.24.100.2: 64 byte packets
ping: sendto: Network is unreachable
ping: wrote 15.24.100.2 64 chars, ret=-1
ping: sendto: Network is unreachable
ping: wrote 15.24.100.2 64 chars, ret=-1

----15.24.100.2 PING Statistics----
2 packets transmitted, 0 packets received, 100% packet loss
#
```

192.24.

192.24.100.7

15.24.100.7



dtterm

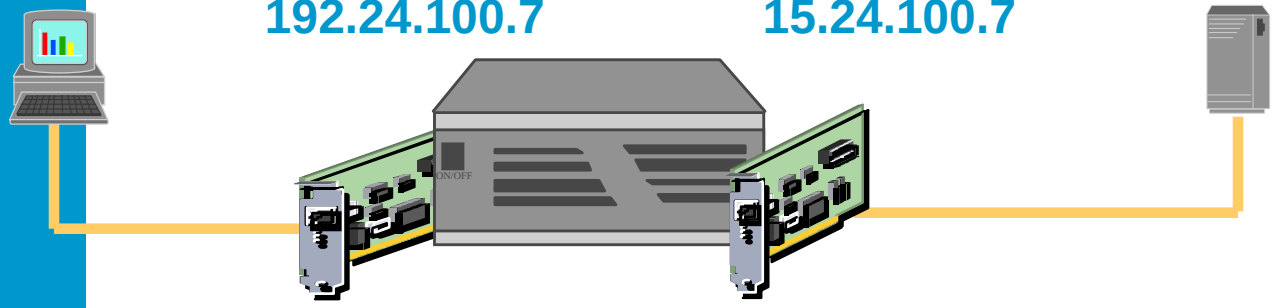
Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# route add net 15 192.24.100.7 1
add net 15: gateway 192.24.100.7
# netstat -rn
Routing tables
Destination     Gateway         Flags    Refs     Use  Interface  Pmtu PmtuTime
127.0.0.1       127.0.0.1       UH          0     122  lo0        4608
192.24.100.1    127.0.0.1       UH         45   42629  lo0        4608
15              192.24.100.7    UG          0       0  lan0       1500
192.24.100      192.24.100.1    U           0      13  lan0       1500
#
```

192.24.

192.24.100.7

15.24.100.7



dtterm

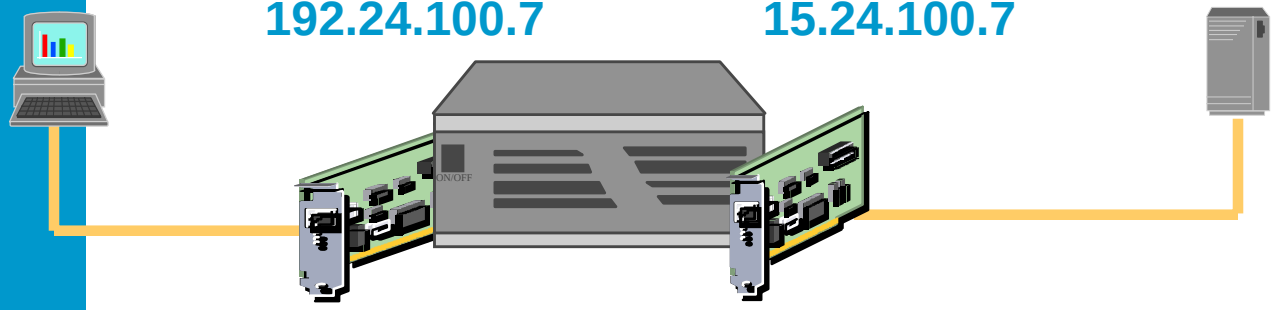
Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# ping 15.24.100.7 -n 2
PING 15.24.100.7: 64 byte packets
64 bytes from 15.24.100.7: icmp_seq=0. time=7. ms
64 bytes from 15.24.100.7: icmp_seq=1. time=3. ms

----15.24.100.7 PING Statistics----
2 packets transmitted, 2 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 3/5/7
#
```

192.24.

192.24.100.7 15.24.100.7



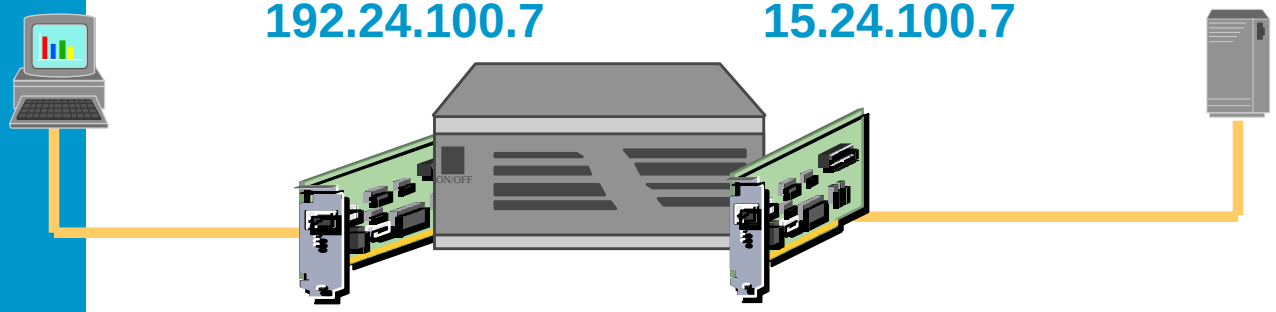
dtterm

Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# ping 15.24.100.2 -n 2
PING 15.24.100.2: 64 byte packets

----15.24.100.2 PING Statistics----
2 packets transmitted, 0 packets received, 100% packet loss
#
```

192.24.



dtterm

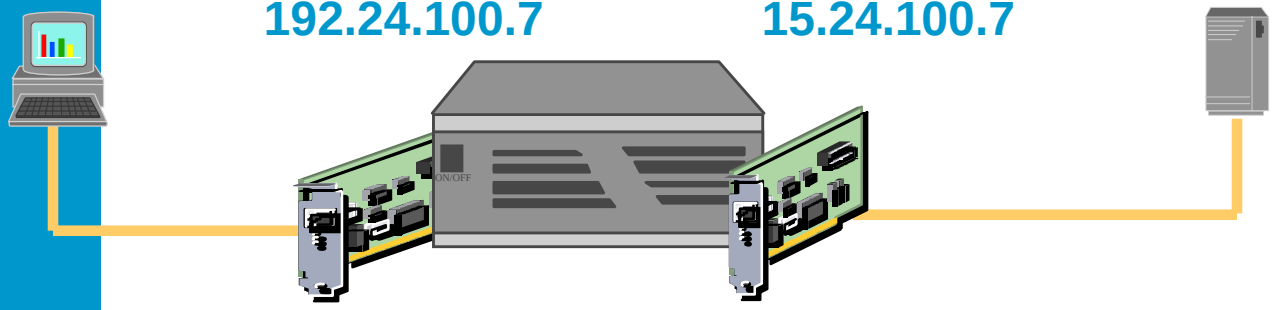
Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.24.100.2 netmask ff000000 broadcast 15.255.255.255
# netstat -rn
Routing tables
Destination     Gateway         Flags    Refs     Use  Interface  Pmtu PmtuTime
15.24.100.2     127.0.0.1       UH         51   11688  lo0        4608
127.0.0.1       127.0.0.1       UH          0     122  lo0        4608
15              15.24.100.2     U           0       0  lan0       1500
#
```

192.24.1

192.24.100.7

15.24.100.7



dtterm

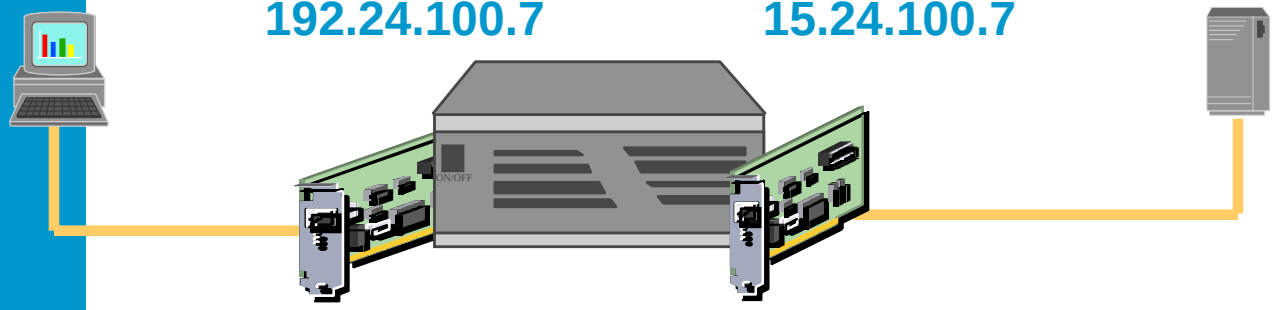
Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.24.100.2 netmask ff000000 broadcast 15.255.255.255
# route add default 15.24.100.7 1
add net default: gateway 15.24.100.7
# netstat -rn
Routing tables
Destination     Gateway         Flags    Refs     Use  Interface  Pmtu PmtuTime
15.24.100.2     127.0.0.1       UH         51   14318  lo0          4608
127.0.0.1       127.0.0.1       UH          0     122  lo0          4608
default         15.24.100.7     UG          0       9  lan0         1500
15              15.24.100.2     U           0       0  lan0         1500
#
```

192.24.

192.24.100.7

15.24.100.7



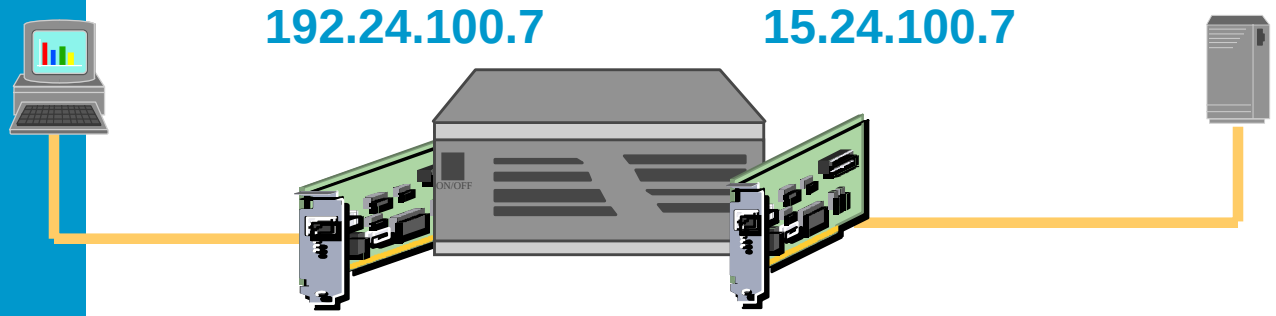
dtterm

Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 15.24.100.2 netmask ff000000 broadcast 15.255.255.255
# ping 192.24.100.1 -n 2
PING 192.24.100.1: 64 byte packets
64 bytes from 192.24.100.1: icmp_seq=0. time=6. ms
64 bytes from 192.24.100.1: icmp_seq=1. time=3. ms

----192.24.100.1 PING Statistics----
2 packets transmitted, 2 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 3/4/6
#
```

192.24.



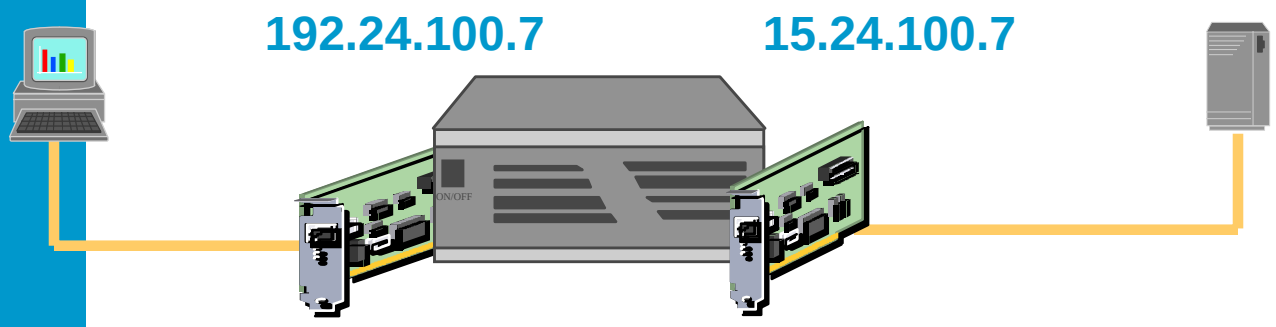
dtterm

Window Edit Options Help

```
# ifconfig lan0
lan0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 192.24.100.1 netmask ffffff00 broadcast 192.24.100.255
# ping 15.24.100.2 -n 2
PING 15.24.100.2: 64 byte packets
64 bytes from 15.24.100.2: icmp_seq=0. time=8. ms
64 bytes from 15.24.100.2: icmp_seq=1. time=3. ms

----15.24.100.2 PING Statistics----
2 packets transmitted, 2 packets received, 0% packet loss
round-trip (ms)  min/avg/max = 3/5/8
#
```

192.24.



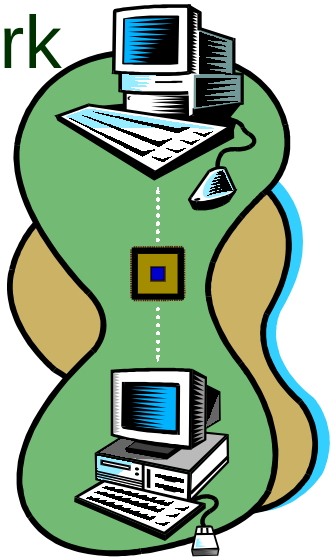
Configure Routes

Warning ...

Configuring the LAN card routes via the route command is not permanent. A reboot will cause the LAN card routes to be set to its default configuration.

Configure Routes: /etc/rc.config.d/netconf

- Contains configuration values for the network subsystems:
  - Route



Configure Routes: /etc/rc.config.d/netconf

dtterm

Window Edit Options Help

```
# Internet routing configuration.  See route(1m), routing(7)
#
# ROUTE_DESTINATION:  Destination host or network IP address in
#                     decimal-dot notation, preceded by the word
#                     "host" or "net"; or simply the word "default".
#
# ROUTE_MASK:         Subnetwork mask in decimal-dot notation, or C language
#                     hexadecimal notation.  This is an optional field.
#                     A IP address, subnet mask pair uniquely identifies
#                     a subnet to be reached. If a subnet mask is not given,
#                     then the system will assign the longest subnet mask
#                     of the configured network interfaces to this route.
#                     If there is no matching subnet mask, then the system
#                     will assign the default network mask as the route's
#                     subnet mask.
#
# ROUTE_GATEWAY:      Gateway IP address in decimal-dot notation.
#                     If local interface, must use the same form
#                     as used for IP_ADDRESS above.
#
# ROUTE_COUNT:        An integer that indicates whether the gateway is a
#                     remote interface (one) or the local interface (zero).
#
# ROUTE_ARGS:         Route command arguments and options.  This variable
#                     may contain a combination of the following arguments:
#                     "-f", "-n" and "-p pmtu".
#
# For each additional route, add a set of variable assignments like the ones
# below, changing the index to "[1]", "[2]" et cetera.
#
# IMPORTANT:  for 9.x-to-10.0 transition, do not put blank lines between
```

Configure Routes:

/etc/rc.config.d/netconf

dtterm

Window Edit Options Help

```
#
# For each additional route, add a set of variable assignments like the ones
# below, changing the index to "[1]", "[2]" et cetera.
#
# IMPORTANT:  for 9.x-to-10.0 transition, do not put blank lines between
# the next set of statements

ROUTE_DESTINATION[0]=default
ROUTE_MASK[0]=""
ROUTE_GATEWAY[0]=15.47.72.1
ROUTE_COUNT[0]=1
ROUTE_ARGS[0]=""
```