

Linux Networking: interfaces and routing

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Configuring networking

- Concepts
- Manual configuration
- Automating it at bootup

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Concepts

- Packets
- Addresses
- Interfaces
- Routes

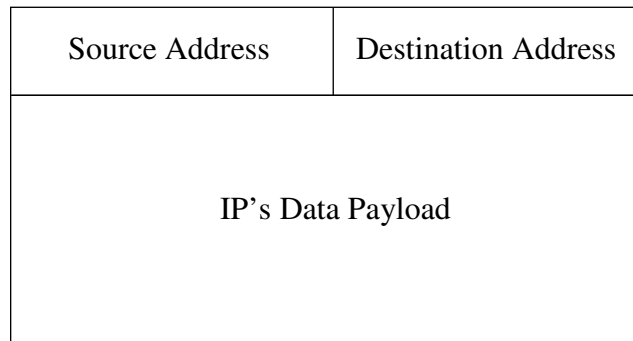
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“Packets,” also known as:

- frames (esp. for ethernet and other datalink layer)
- datagrams (esp. for UDP and other transport layer)
- segments (esp. for TCP)
- packets (esp. for IP and other network layer)
- pdu's (generally, “protocol data units”)

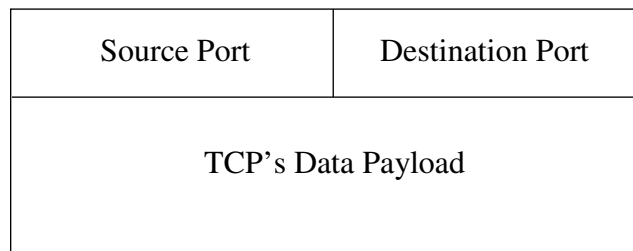
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IP packet structure



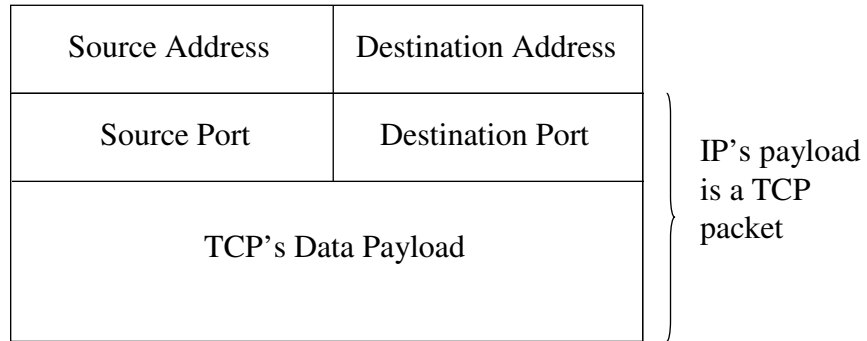
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TCP segment structure



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TCP/IP packet structure



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IP addresses

- 32 bit numbers
 - 11000000 10101000 00000100 00000001
- Expressed as “dot quads” or “dotted decimal”
 - 192.168.4.1

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IP addresses - subnet masks

- Go with addresses
- Are also 32-bit numbers
- Operationally, like shoe sizes but for networks
 - they express the *size* of a network
- e.g., Netmask 255.255.255.248 is synonym for “network size is 8 addresses”

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Common netmasks, small LANs

How netmask is written	Size it indicates
255.255.255.128 or /25	128 addresses
255.255.255.192 or /26	64
255.255.255.224 or /27	32
255.255.255.240 or /28	16
255.255.255.248 or /29	8
255.255.255.252 or /30	4

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Interfaces

- Communication outlets to the external world
 - how many doors in your house?
 - how many passenger gates in the airport terminal?
 - how many interfaces in your box?
- Interface devices
 - ethernet cards `/dev/eth0`, `/dev/eth1`...
 - modems (point-to-point) `/dev/ppp0`, ...
 - exotic `/dev/isdn0`, `/dev/fddi0`

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Routes

- Electronic location of other computers
- By IP address
- Via interfaces

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Routing – IPdest-Iface correlation

Maintained in a “routing table”:

```
[root@EMACH1 /root]# route
Kernel IP routing table
Destination      Gateway          Genmask         Iface
209.233.193.22  *                255.255.255.255 ppp0
192.168.4.0      *                255.255.255.0   eth0
default          209.233.193.22  0.0.0.0         ppp0
[root@EMACH1 /root]#
```

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Analogy – airport departure board

Departure board

Destination	Gate
Phoenix	33A
Portland	36B
international	Terminal 4

Local, not outside
of airport

Local, not outside
of computer

Routing table

Destination	Interface
209.233.193.22 /32	ppp0
192.168.4.0 /24	eth0

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Commands to config networks

- Older collection of special-purpose commands
 - ifconfig (for setting up addresses)
 - route (for setting up routes)
 - others (arp, netstat...)
- Newer rewritten umbrella command “ip”
 - “ip address” alternative equivalent to ifconfig
 - “ip route” alternative to route
 - “ip neighbor” alternative to arp
- old commands implemented elsewhere, but “ip” is linux-only

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ifconfig command

- manually configuring interfaces

- View interface status
 - ifconfig -a
- Set interface characteristics
 - ifconfig eth0 192.168.4.1

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ifconfig command



```
root@hostz:~  
File Edit View Terminal Tabs Help  
[root@hostz ~]# ifconfig eth0 192.168.4.98  
[root@hostz ~]#  
[root@hostz ~]# ifconfig eth0  
eth0      Link encap:Ethernet  HWaddr 00:C0:4F:27:FF:2E  
          inet addr:192.168.4.98  Bcast:192.168.4.255  Mask:255.255.255.0  
          inet6 addr: fe80::2c0:4fff:fe27:ff2e/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
          RX packets:32 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:32 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:10591 (10.3 KiB)  TX bytes:2830 (2.7 KiB)  
          Interrupt:11 Base address:0xdc00  
  
[root@hostz ~]#
```

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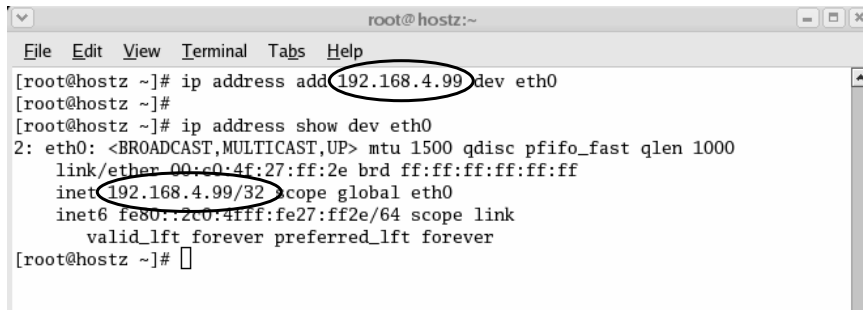
or “ip address” command

- manually configuring interfaces

- View interface status
 - ip address show
- Set interface characteristics
 - ip address add 192.168.4.1 dev eth0

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“ip address” command



```
root@hostz:~  
File Edit View Terminal Tabs Help  
[root@hostz ~]# ip address add 192.168.4.99 dev eth0  
[root@hostz ~]#  
[root@hostz ~]# ip address show dev eth0  
2: eth0: <BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast qlen 1000  
    link/ether 00:c0:4f:27:ff:2e brd ff:ff:ff:ff:ff:ff  
    inet 192.168.4.99/32 scope global eth0  
    inet6 fe80::2c0:4fff:fe27:ff2e/64 scope link  
        valid_lft forever preferred_lft forever  
[root@hostz ~]#
```

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route command

— manually configuring routes

- host route - to a single machine
 - route add –host 192.168.4.2 eth0
- network route, local - to a group of machines
 - route add –net 192.168.4.0 netmask 255.255.255.0 eth0
- network route, thru gateway - to a group of machines
 - route add –net 192.168.5.0 netmask 255.255.255.0 gw 192.168.4.1
- default route - to “any and all” else
 - route add default gw 192.168.4.1

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or “ip route” command

— manually configuring routes

- host route - to a single machine
 - ip route add 192.168.4.2 dev eth0
- network route, local - to a group of machines
 - ip route add 192.168.4.0/24 dev eth0
- network route, thru gateway - to a group of machines
 - ip route add 192.168.5.0/24 via 192.168.4.1
- default route - to “any and all” else
 - ip route replace default via 192.168.4.1

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Great. But that’s too hard.

- Can’t somebody else run the commands for me?
- To the rescue: pre-written scripts do it!
- You just feed them the values to use

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General boot process control: /etc/sysconfig

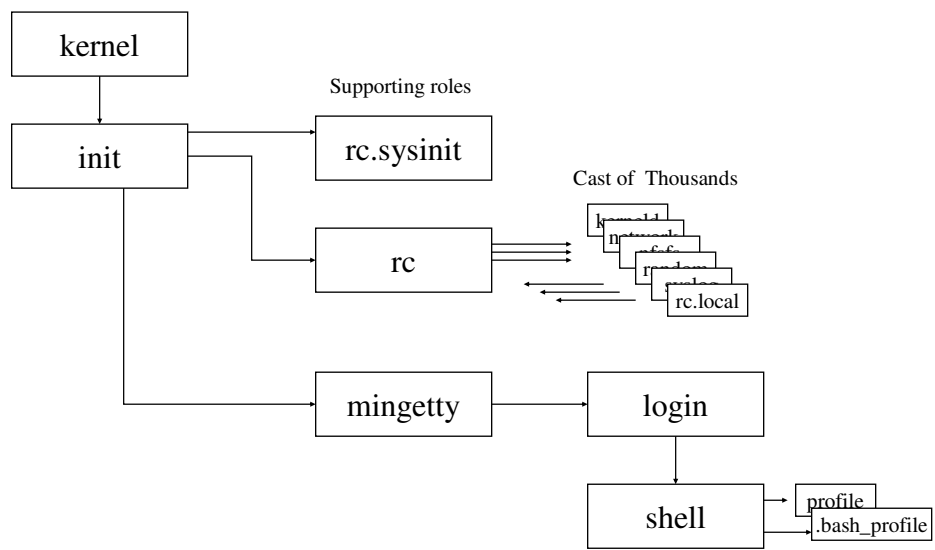
- boot process runs scripts (eg, rc.sysinit)
- scripts pick up parameter values from files...
- ...to incorporate into their commands

- such files centralized in /etc/sysconfig
- edit them to feed desired values to scripts

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Boot process runs scripts

Starring roles



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Boot time automation

- Initialization script: `/etc/rc.d/init.d/network`
- `/etc/sysconfig/network`

- `/etc/sysconfig/network-scripts/ifup`
- `/etc/sysconfig/network-scripts/ifcfg-ethX`

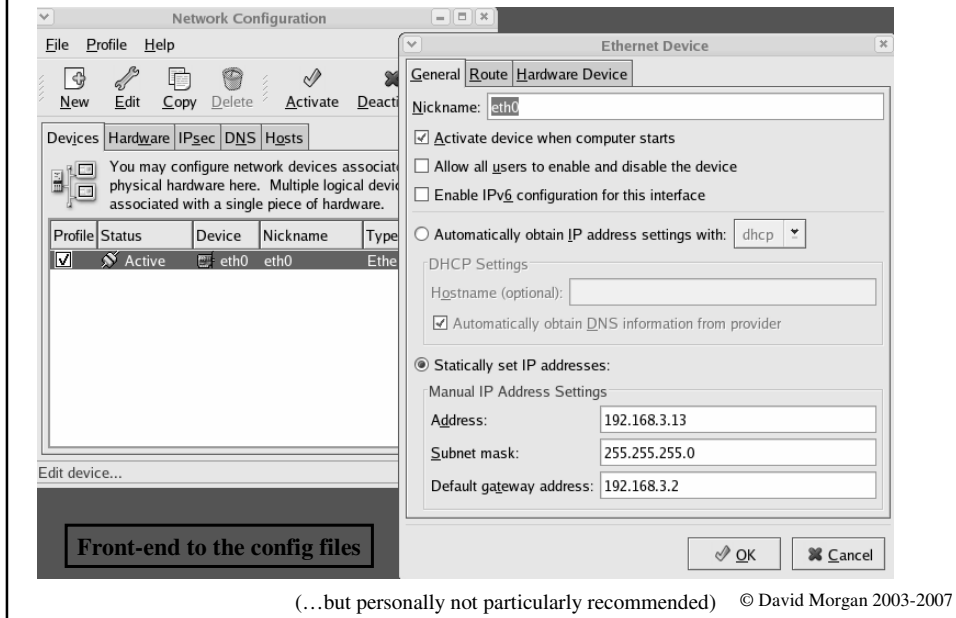
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Network config control at bootup

- Edit the `network/ifcfg-ethX` files yourself
- Use an admin tool, which does the same thing
 - `/usr/sbin/system-config-network` (Fedora)
 - `webmin`

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Fedora's system-config-network



It's up. What can you do with it?

- Test it - ping
- Watch it – tcpdump
- Interfere with it - iptables
- Work with others - services

Biblio

- “IP Command Reference,” Alexey Kuznetsov
(run “gv \$(locate ipref.ps)” in your linux GUI)
- The Linux Network Administrator’s Guide,
Olaf Kirsch (<http://www.tldp.org/LDP/sag/html/index.html>)

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