NETWORKING BASICS

Switching
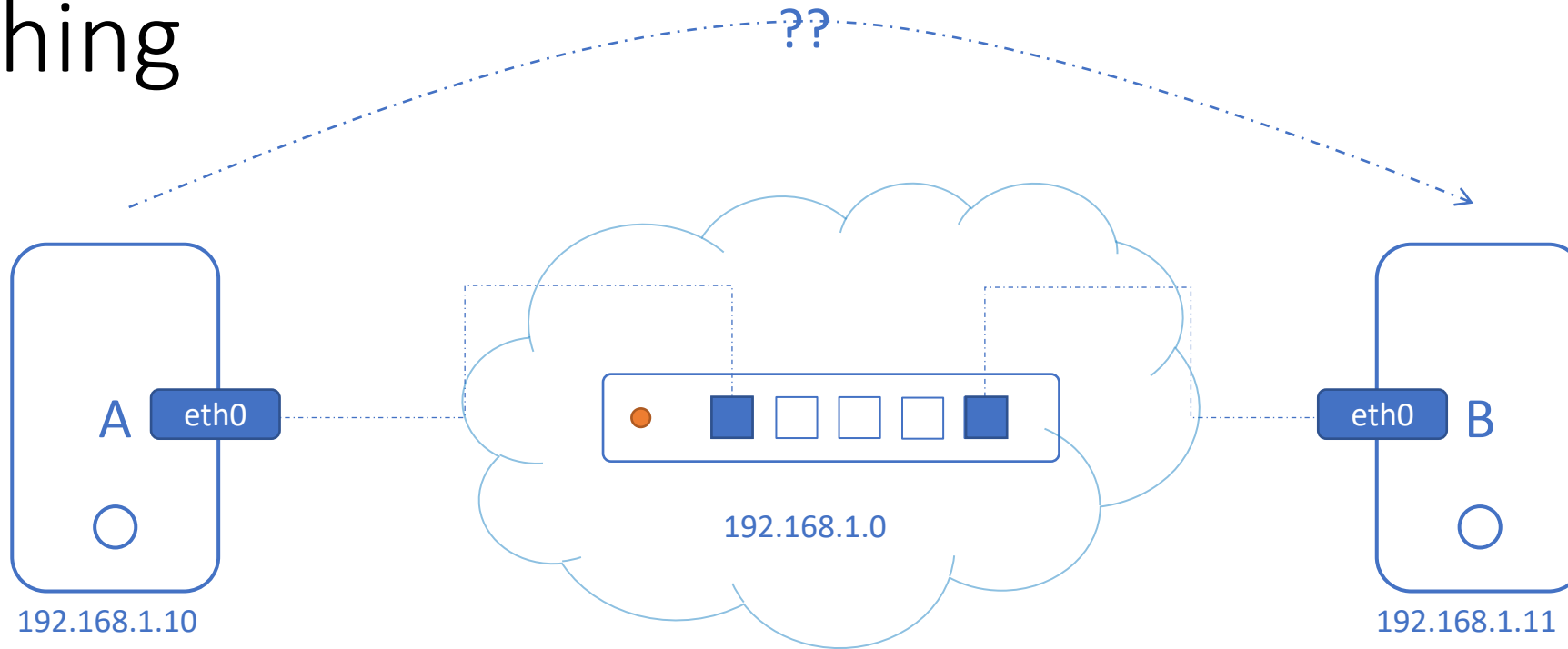
A — eth0
192.168.1.10

192.168.1.0

eth0 — B
192.168.1.11

??

```
ip link
```
```
eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc
fq_codel state UP mode DEFAULT group default qlen 1000
```

```
ip addr add 192.168.1.10/24 dev eth0
```
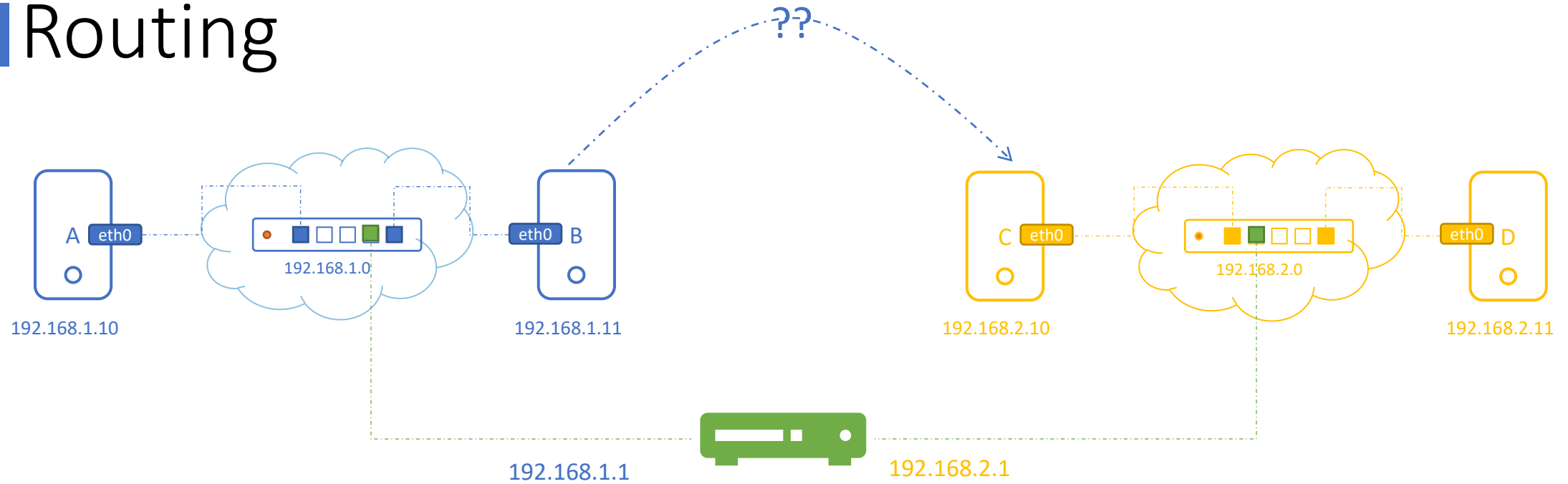
```
ip link
```
```
eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc
fq_codel state UP mode DEFAULT group default qlen 1000
```
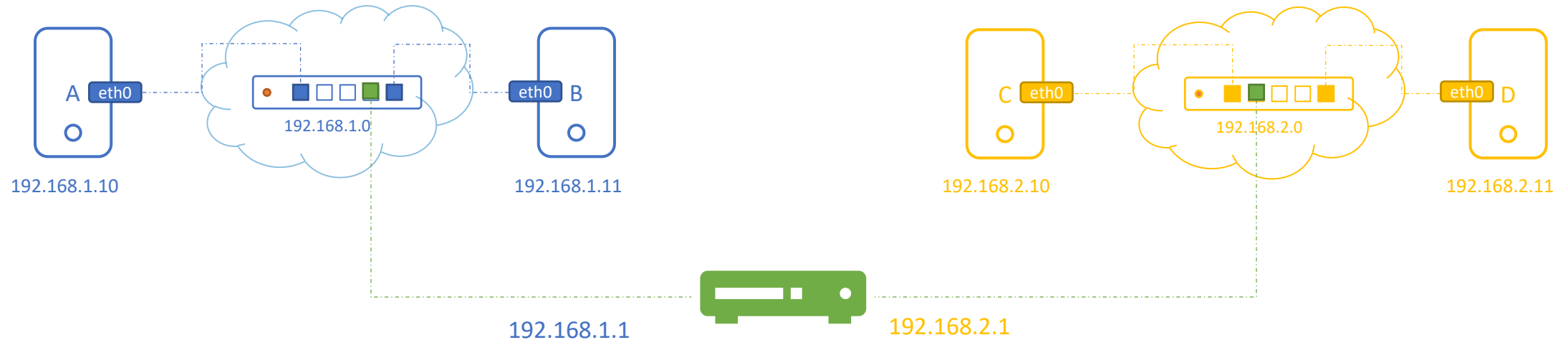
```
ip addr add 192.168.1.11/24 dev eth0
```

```
ping 192.168.1.11
```
```
Reply from 192.168.1.11: bytes=32 time=4ms TTL=117
Reply from 192.168.1.11: bytes=32 time=4ms TTL=117
```

Routing

Gateway


```
route
```

```
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref   Use Iface
```

```
ip route add 192.168.2.0/24 via 192.168.1.1
```

```
route
```

```
Kernel IP routing table
Destination      Gateway         Genmask         Flags Metric Ref   Use Iface
192.168.2.0      192.168.1.1     255.255.255.0   UG    0      0       0 eth0
```
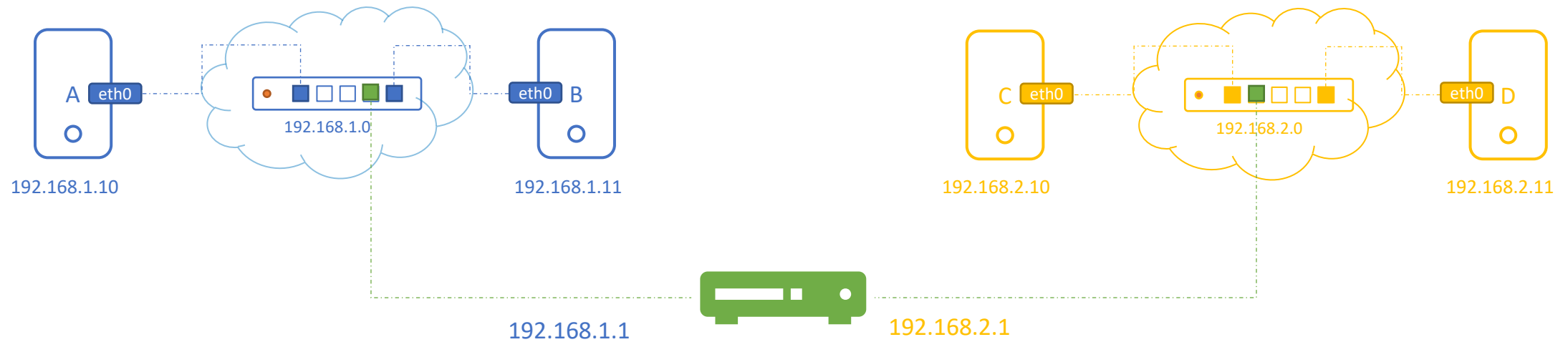
Gateway


```
ip route add 192.168.1.0/24 via 192.168.2.1
```

```
route
```

```
Kernel IP routing table
Destination      Gateway        Genmask          Flags Metric Ref    Use Iface
192.168.1.0      192.168.2.1    255.255.255.0    UG    0      0        0 eth0
```

Default Gateway

INTERNET
172.217.194.0

INTERNET
216.134.45.0

INTERNET
16.44.53.0

A eth0
192.168.1.10

192.168.1.0

eth0 B
192.168.1.11

C eth0
192.168.2.10

192.168.2.0

eth0 D
192.168.2.11

192.168.1.1

192.168.2.1

```
ip route add 192.168.1.0/24 via 192.168.2.1
```

```
ip route add default via 192.168.2.1
```

```
route
```

```
Kernel IP routing table
Destination      Gateway         Genmask           Flags Metric Ref    Use Iface
192.168.1.0      192.168.2.1     255.255.255.0     UG    0      0        0 eth0

0.0.0.0          192.168.2.1     255.255.255.0     UG    0      0        0 eth0
192.168.2.0      0.0.0.0         255.255.255.0     UG    0      0        0 eth0
```

Default Gateway
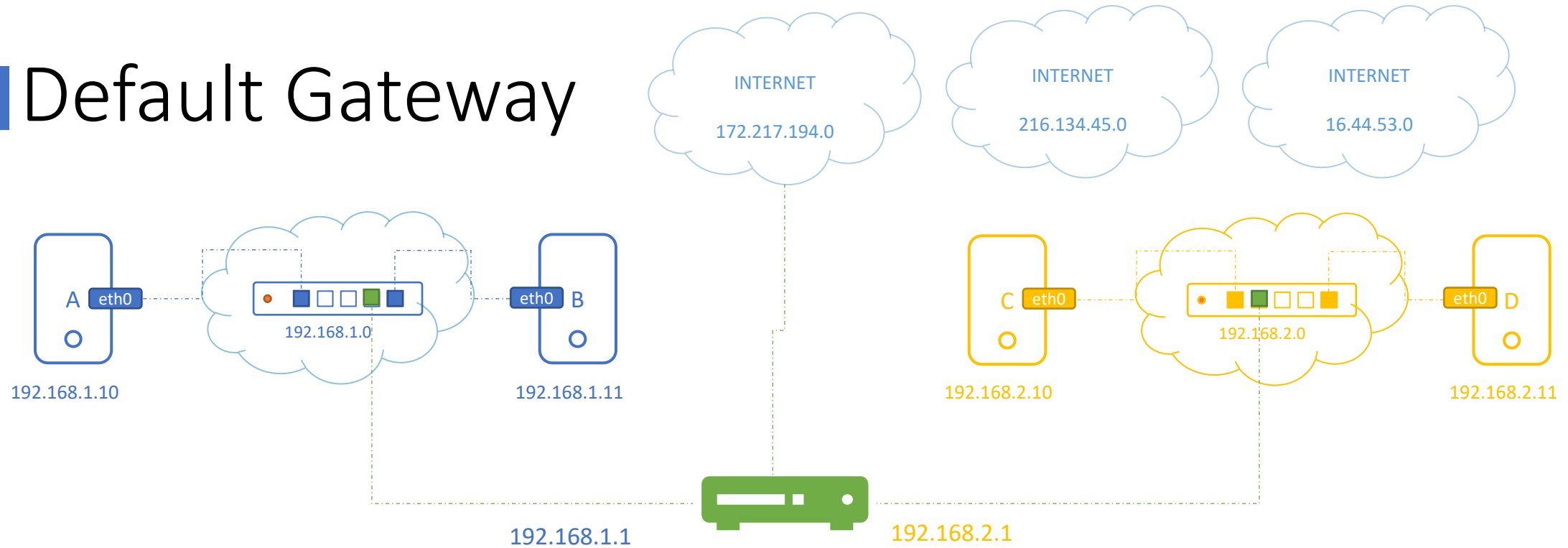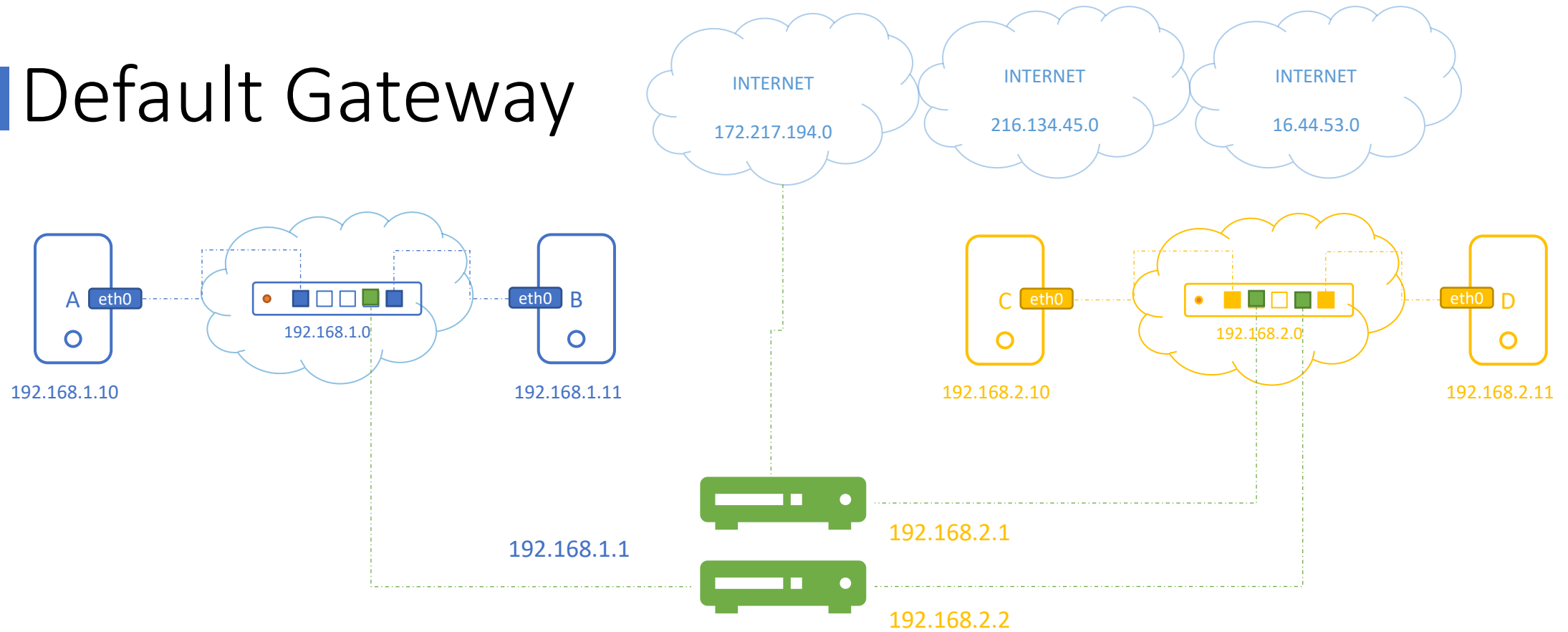


```
ip route add 192.168.1.0/24 via 192.168.2.2
```

```
route
```

```
Kernel IP routing table
Destination     Gateway          Genmask          Flags Metric Ref    Use Iface
default         192.168.2.1      255.255.255.0    UG    0      0        0 eth0
192.168.1.0     192.168.2.2      255.255.255.0    UG    0      0        0 eth0
```

A — eth0 — 192.168.1.0 — **B** eth0 / eth1 — 192.168.2.0 — eth0 **C**

192.168.1.5   192.168.1.6   192.168.2.6   192.168.2.5

??
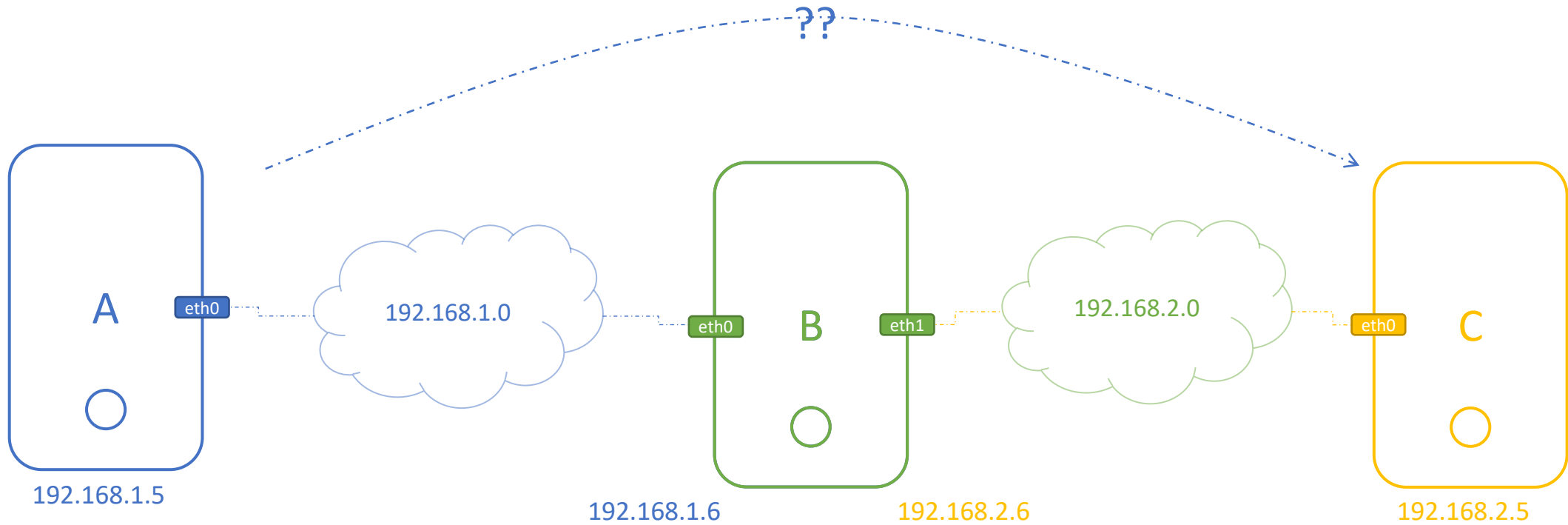
```
ping 192.168.2.5
```
```
Connect: Network is unreachable
```

```
ip route add 192.168.2.0/24 via 192.168.1.6
```

```
ip route add 192.168.1.0/24 via 192.168.2.6
```

```
ping 192.168.2.5
```

A
eth0
192.168.1.0
192.168.1.5

B
eth0   eth1
192.168.1.6   192.168.2.6

192.168.2.0

C
eth0
192.168.2.5
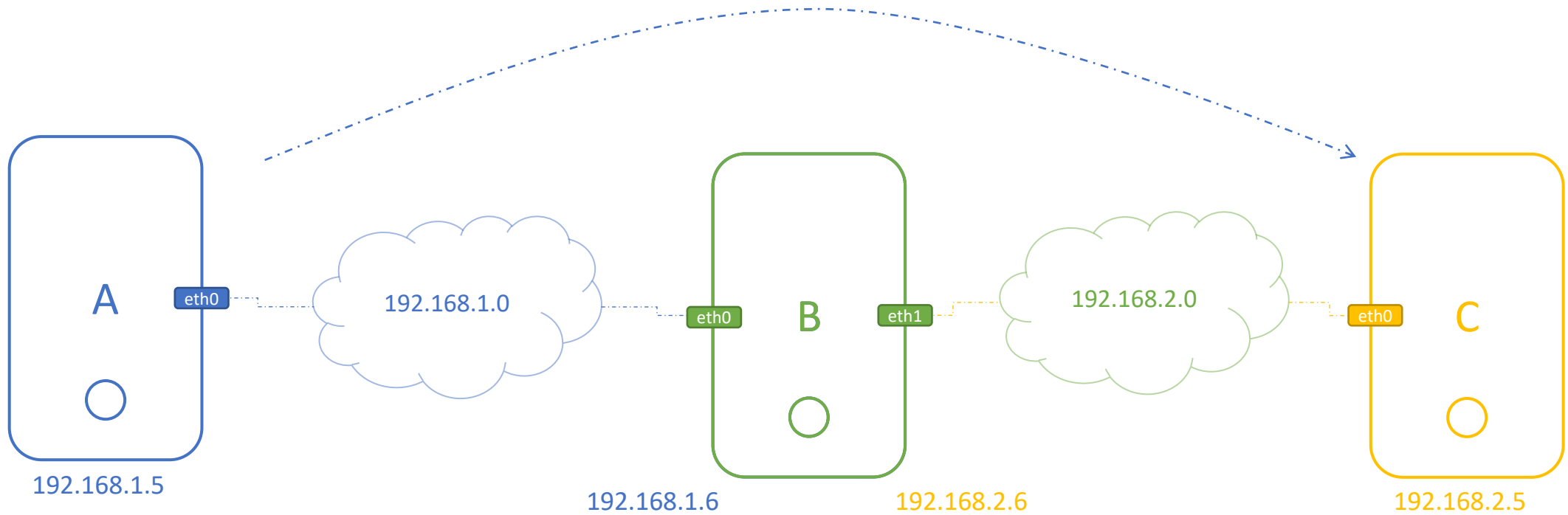
```
cat /proc/sys/net/ipv4/ip_forward
0
```

```
echo 1 > /proc/sys/net/ipv4/ip_forward
1
```

/etc/sysctl.conf
```
…
net.ipv4.ip_forward = 1
…
```

.6

```
ping 192.168.2.5
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
```

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Take Aways

```
ip link
```

```
ip addr
```

```
ip addr add 192.168.1.10/24 dev eth0
```

```
ip route
```

```
route
```

```
ip route add 192.168.1.0/24 via 192.168.2.1
```

```
cat /proc/sys/net/ipv4/ip_forward
1
```

DNS

For the Absolute Beginners
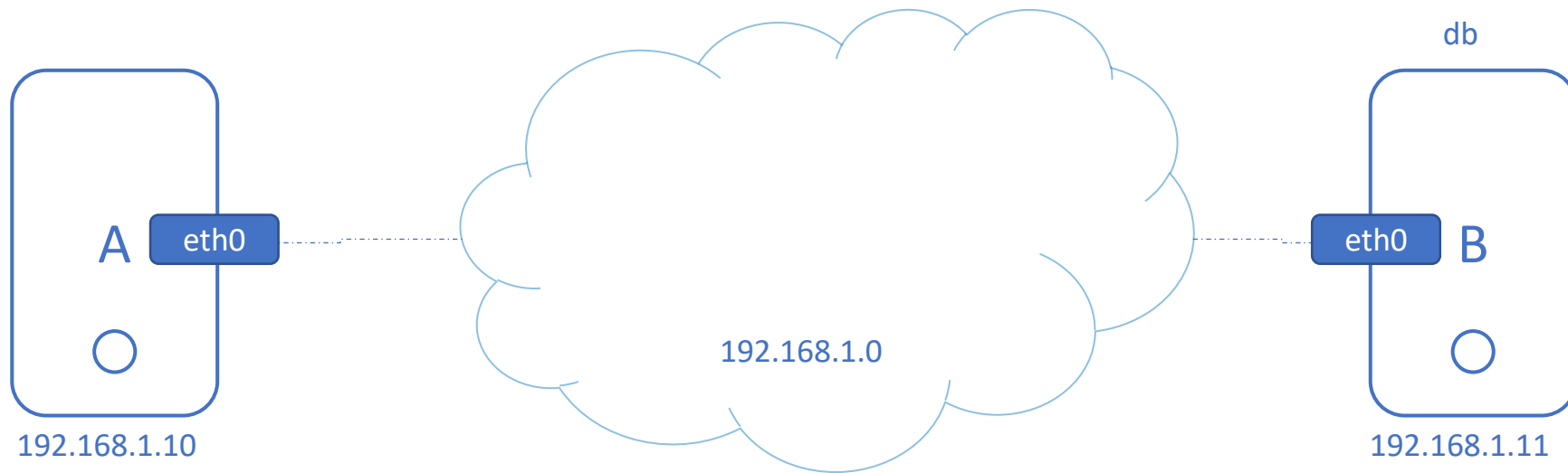
A
eth0
192.168.1.10

192.168.1.0

db
eth0
B
192.168.1.11

```
ping db
```
```
ping: unknown host db
```

```
hostname
```
```
host-2
```

```
cat >> /etc/hosts
```
```
192.168.1.11        db
```

```
ping db
```
```
PING db (192.168.1.11) 56(84) bytes of data.
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```

A — eth0 — 192.168.1.10

192.168.1.0

db — eth0 — B — 192.168.1.11

```
▶ cat >> /etc/hosts
192.168.1.11        db
192.168.1.11        www.google.com
```

```
▶ hostname
host-2
```
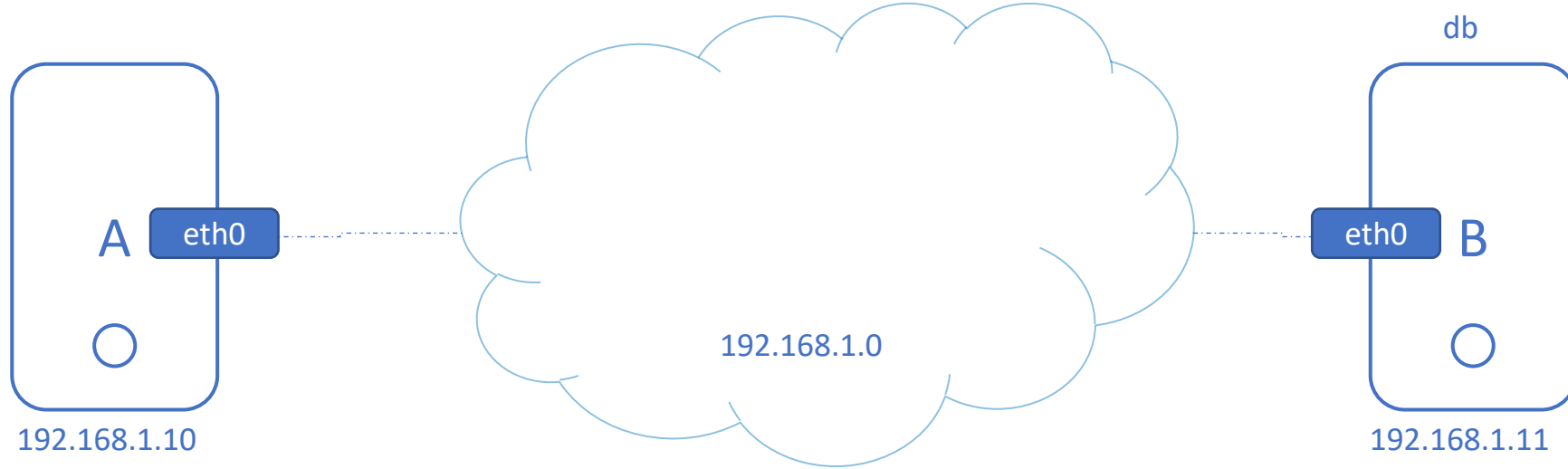
```
▶ ping db
```
```
PING db (192.168.1.11) 56(84) bytes of data.
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```

```
▶ ping www.google.com
```
```
PING www.google.com (192.168.1.11) 56(84) bytes of data.
64 bytes from www.google.com (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from www.google.com (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```

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Name Resolution

A — eth0 ⋯⋯ [cloud: 192.168.1.0] ⋯⋯ eth0 — B (db)

192.168.1.10

192.168.1.11

```
▶ cat >> /etc/hosts
192.168.1.11        db
192.168.1.11        www.google.com
```

```
▶ hostname
host-2
```
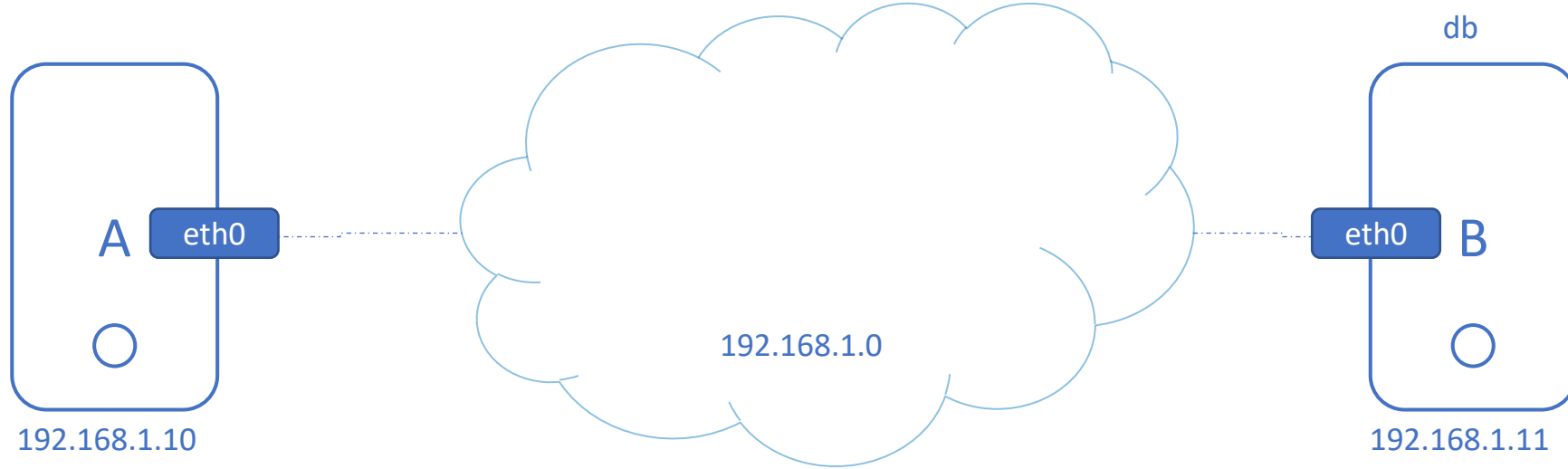
```
▶ ping db
```

```
▶ ssh db
```

```
▶ curl http://www.google.com
```

Name Resolution

web

A | eth0

192.168.1.10

```
▶ cat >> /etc/hosts
192.168.1.10          web
192.168.1.11          db
192.168.1.12          nfs
```

192.168.1.0

db

eth0 | B

192.168.1.11

```
▶ cat >> /etc/hosts
192.168.1.10          web
192.168.1.11          db
192.168.1.12          nfs
```

eth0

C

nfs

192.168.1.12

```
▶ cat >> /etc/hosts
192.168.1.10          web
192.168.1.11          db
192.168.1.12          nfs
```
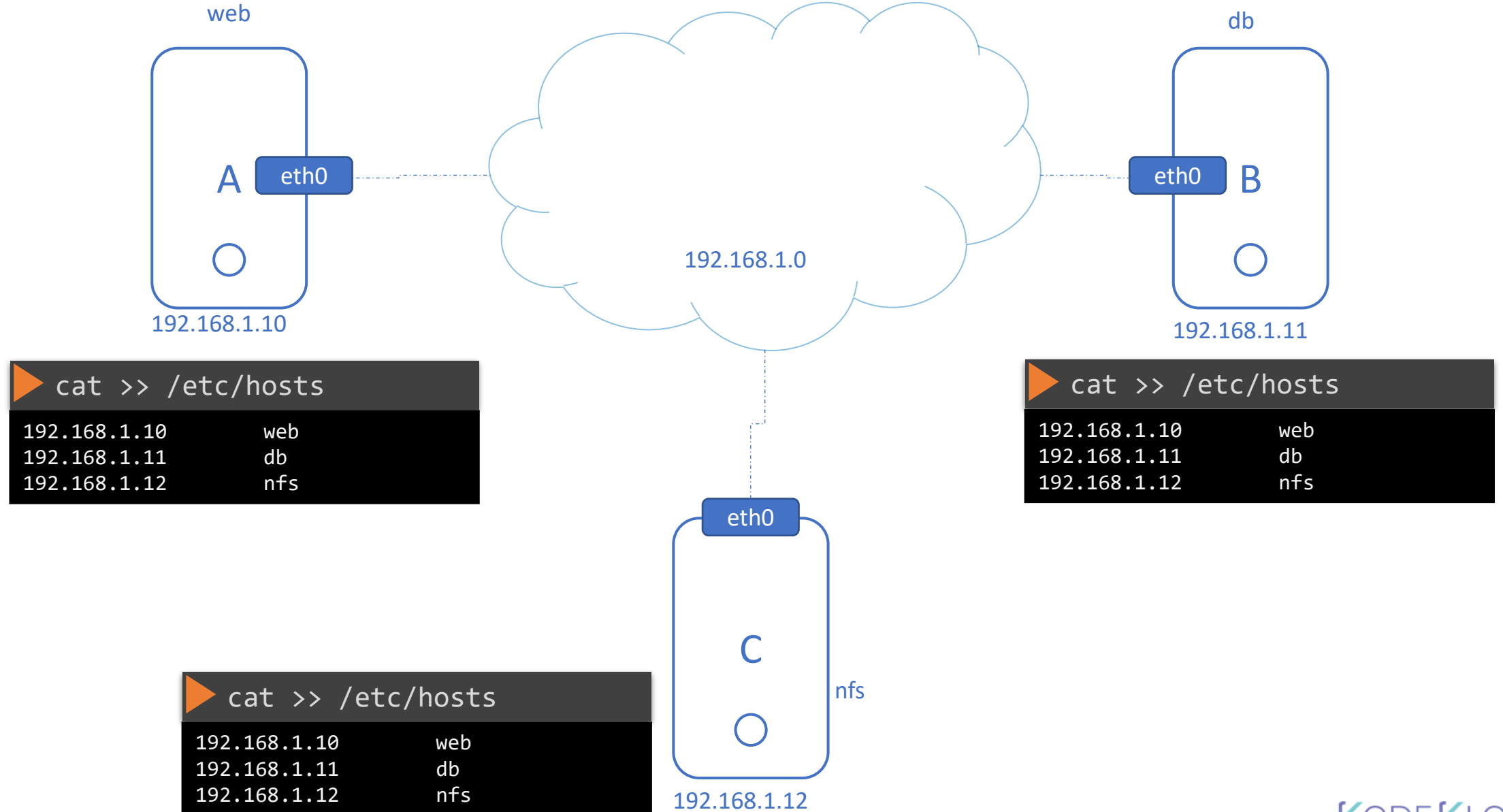
Name Resolution

```
▶ cat >> /etc/hosts
192.168.1.10      web
192.168.1.11      db
192.168.1.12      nfs

192.168.1.20      web
192.168.1.21      db-1
192.168.1.22      nfs-1
192.168.1.30      web-1
192.168.1.31      db-2
192.168.1.32      nfs-2
192.168.1.40      web-2
192.168.1.41      sql
192.168.1.42      web-5
192.168.1.50      web-test
192.168.1.61      db-prod
192.168.1.52      nfs-4
192.168.1.60      web-3
192.168.1.61      db-test
192.168.1.62      nfs-prod
```

A   eth0

192.168.1.0

eth0   B

eth0   Z

eth0   D

eth0   S

eth0   W

eth0   C

eth0   P

eth0   L

eth0   K

DNS


```
192.168.1.10      web
192.168.1.11      db
192.168.1.12      nfs

192.168.1.20      web
192.168.1.21      db-1
192.168.1.22      nfs-1
192.168.1.30      web-1
192.168.1.31      db-2
192.168.1.32      nfs-2
192.168.1.40      web-2
192.168.1.41      sql
192.168.1.42      web-5
192.168.1.50      web-test
192.168.1.61      db-prod
192.168.1.52      nfs-4
192.168.1.60      web-3
192.168.1.61      db-test
192.168.1.62      nfs-prod
```

DNS

A   eth0

192.168.1.0

eth0 B

```
> cat >> /etc/hosts
```

eth0   eth0   eth0   eth0   eth0   eth0   eth0   eth0

C   C   C   C   C   C   C   C

DNS


```
192.168.1.10      web
192.168.1.11      db
192.168.1.12      nfs

192.168.1.20      web
192.168.1.21      db-1
192.168.1.22      nfs-1
192.168.1.30      web-1
192.168.1.31      db-2
192.168.1.32      nfs-2
192.168.1.40      web-2
192.168.1.41      sql
192.168.1.42      web-5
192.168.1.50      web-test
192.168.1.61      db-prod
192.168.1.52      nfs-4
192.168.1.60      web-3
192.168.1.61      db-test
192.168.1.62      nfs-prod
```

A eth0

192.168.1.10

192.168.1.0

eth0 DNS

192.168.1.100

▶ `cat /etc/resolv.conf`

```
nameserver        192.168.1.100
```

▶ `ping db`

```
PING db (192.168.1.11) 56(84) bytes of data.
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```
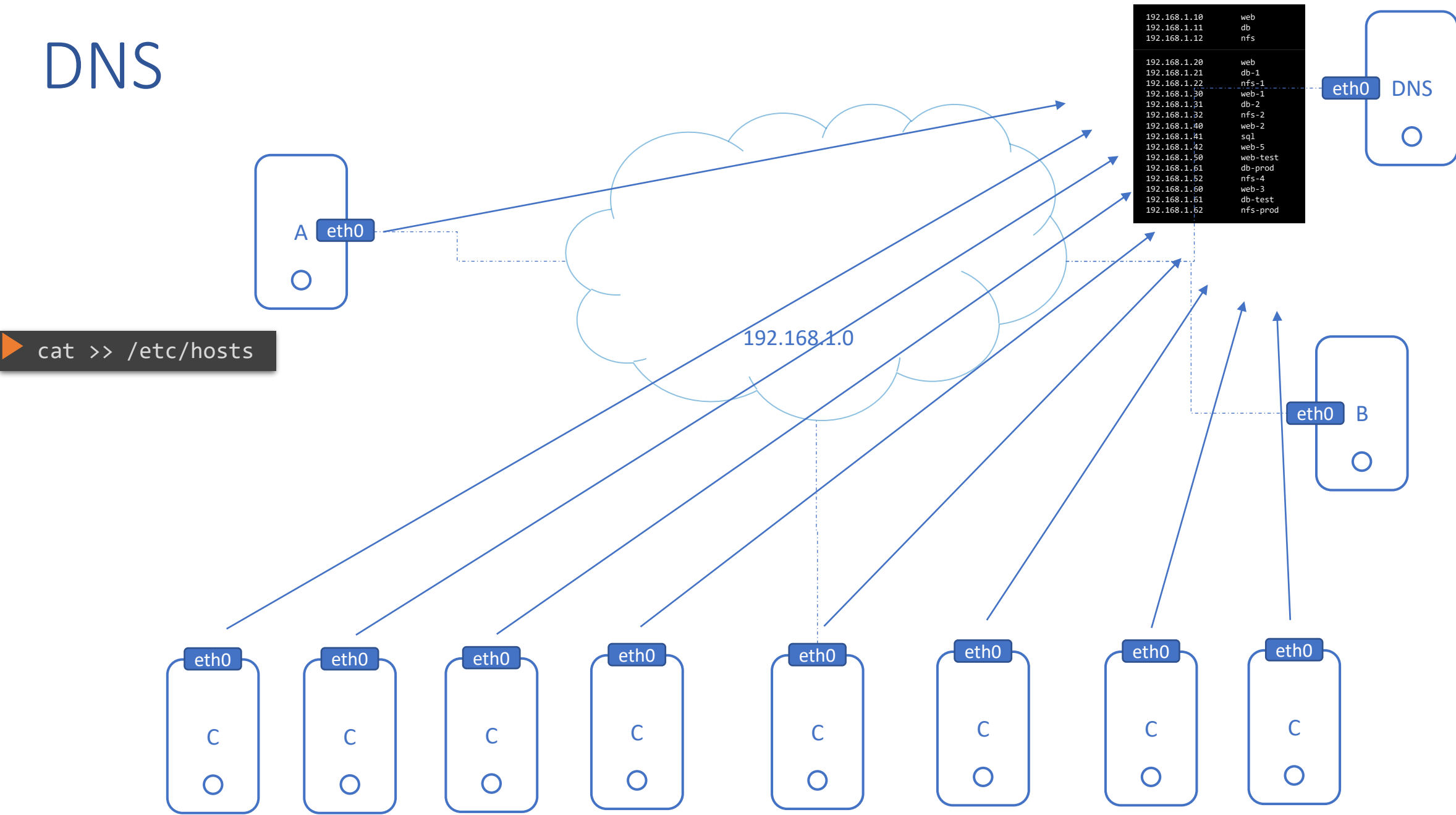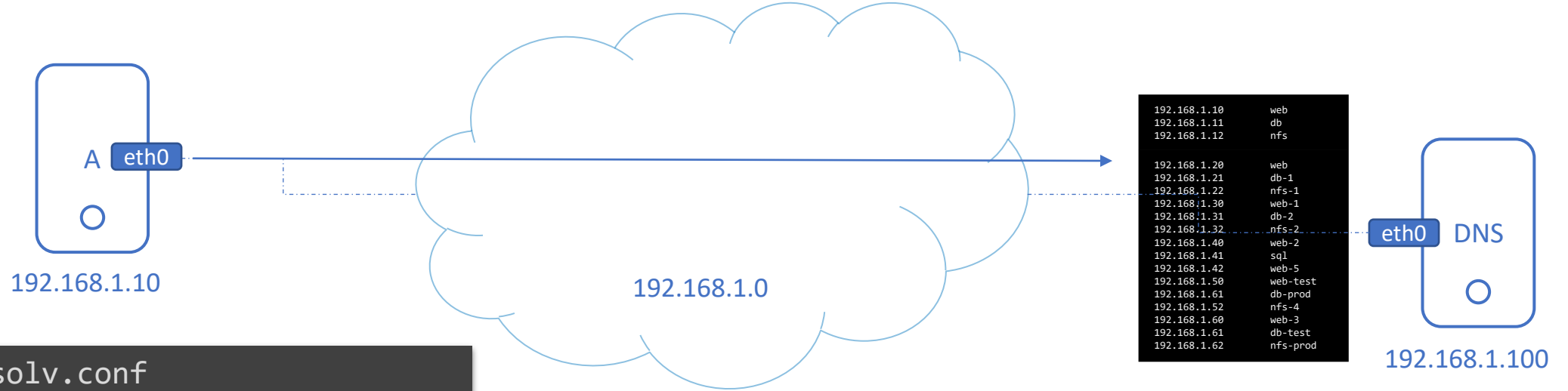
DNS


```
192.168.1.10      web
192.168.1.11      db
192.168.1.12      nfs

192.168.1.20      web
192.168.1.21      db-1
192.168.1.22      nfs-1
192.168.1.30      web-1
192.168.1.31      db-2
192.168.1.32      nfs-2
192.168.1.40      web-2
192.168.1.41      sql
192.168.1.42      web-5
192.168.1.50      web-test
192.168.1.61      db-prod
192.168.1.52      nfs-4
192.168.1.60      web-3
192.168.1.61      db-test
192.168.1.62      nfs-prod
```
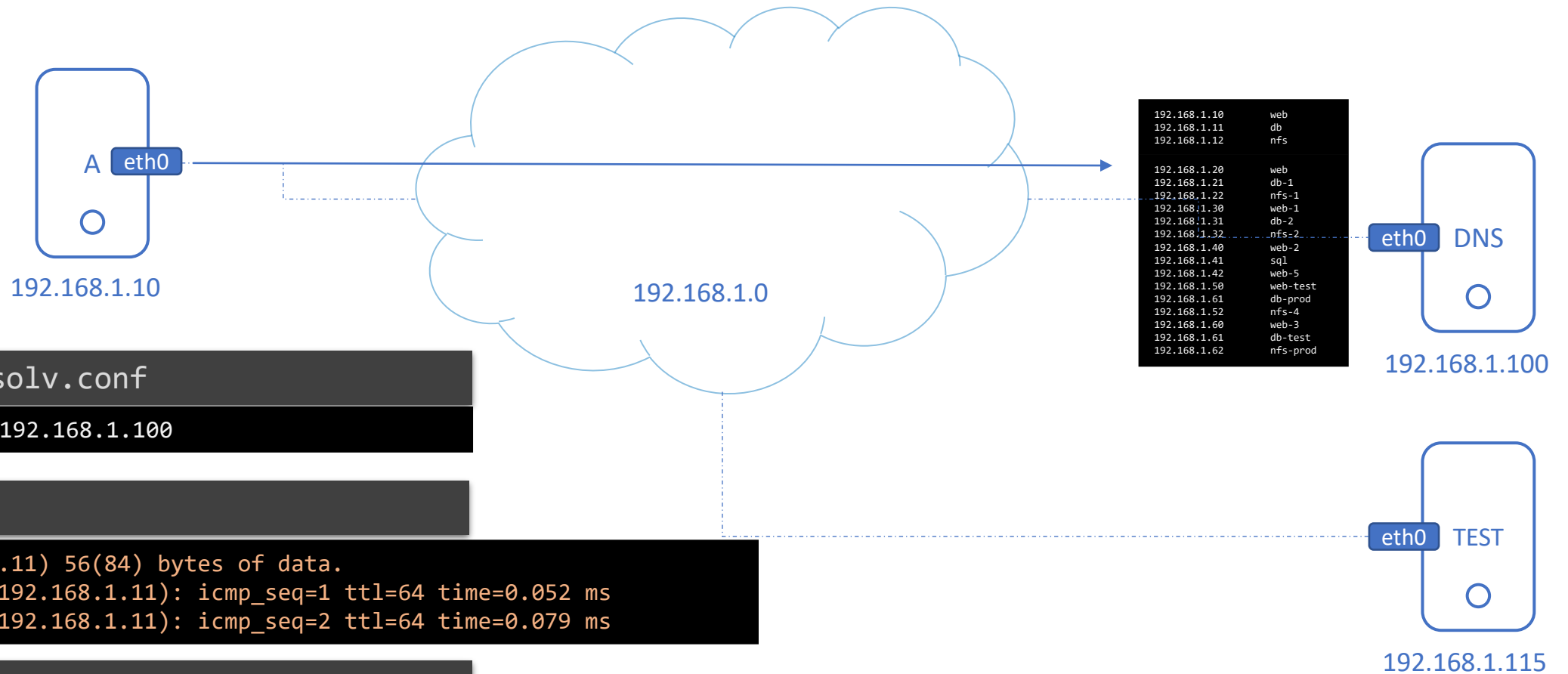
A eth0

192.168.1.10

192.168.1.0

eth0 DNS

192.168.1.100

eth0 TEST

192.168.1.115

cat /etc/resolv.conf

```
nameserver          192.168.1.100
```

ping db

```
PING db (192.168.1.11) 56(84) bytes of data.
64 bytes from db (192.168.1.11): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from db (192.168.1.11): icmp_seq=2 ttl=64 time=0.079 ms
```
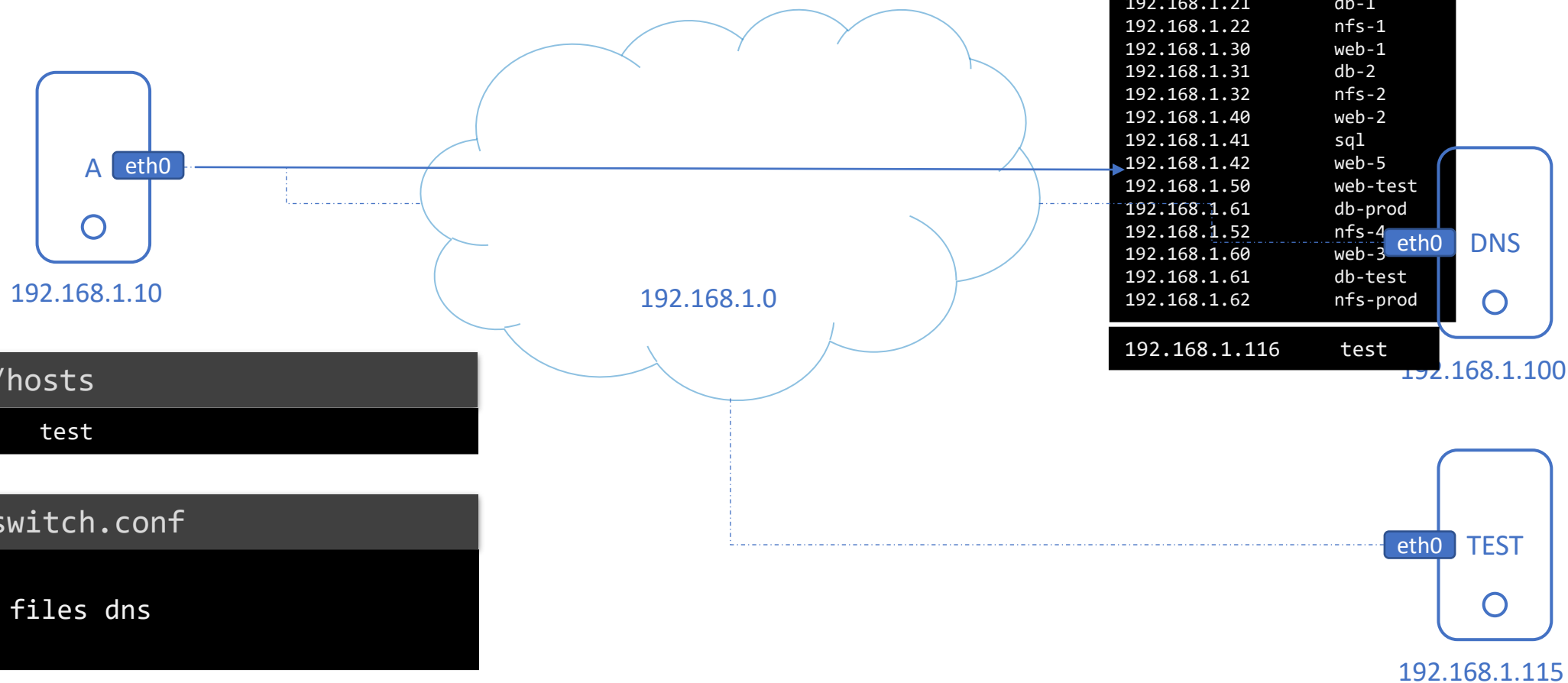
cat >> /etc/hosts

```
192.168.1.115          test
```

ping test

```
PING test (192.168.1.115) 56(84) bytes of data.
64 bytes from test (192.168.1.115): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from test (192.168.1.115): icmp_seq=2 ttl=64 time=0.079 ms
```

DNS

```
192.168.1.10      web
192.168.1.11      db
192.168.1.12      nfs

192.168.1.20      web
192.168.1.21      db-1
192.168.1.22      nfs-1
192.168.1.30      web-1
192.168.1.31      db-2
192.168.1.32      nfs-2
192.168.1.40      web-2
192.168.1.41      sql
192.168.1.42      web-5
192.168.1.50      web-test
192.168.1.61      db-prod
192.168.1.52      nfs-4
192.168.1.60      web-3
192.168.1.61      db-test
192.168.1.62      nfs-prod

192.168.1.116     test
```

A eth0

192.168.1.10

eth0 **DNS**

192.168.1.100

192.168.1.0

```
▶  cat >> /etc/hosts
```
```
192.168.1.115        test
```

```
▶  cat /etc/nsswitch.conf
```
```
…
hosts:        files dns
…
```

eth0 **TEST**

192.168.1.115

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DNS


```
192.168.1.10        web
192.168.1.11        db
192.168.1.12        nfs

192.168.1.20        web
192.168.1.21        db-1
192.168.1.22        nfs-1
192.168.1.30        web-1
192.168.1.31        db-2
192.168.1.32        nfs-2
192.168.1.40        web-2
192.168.1.41        sql
192.168.1.42        web-5
192.168.1.50        web-test
192.168.1.61        db-prod
192.168.1.52        nfs-4
192.168.1.60        web-3
192.168.1.61        db-test
192.168.1.62        nfs-prod

192.168.1.116       test
Forward All to 8.8.8.8
```

G
8.8.8.8

A eth0
192.168.1.10

192.168.1.0

eth0 DNS
192.168.1.100

eth0 TEST
192.168.1.115

cat >> /etc/hosts
```
192.168.1.115        test
```

ping www.facebook.com
```
ping: www.facebook.com: Temporary failure in
name resolution
```

cat >> /etc/resolv.conf
```
nameserver           192.168.1.100
```

ping www.facebook.com
```
PING star-mini.c10r.facebook.com (157.240.13.35) 56(84) bytes of data.
64 bytes from edge-star-mini-shv-02-sin6.facebook.com (157.240.13.35): icmp_seq=1 ttl=50 time=5.70 ms
```

E{K}LOUD

Domain Names

www.codepen.io

wwwkubernetes.io

www.facebook.com

www.un.org

www.mit.edu

www.google.com

www.behance.net

www.speedtest.net

www.stanford.edu

www.care.org

KODEKLOUD

Domain Names

.com	.net	.edu	.org	.io

www.google

www.facebook

www.behance

www.speedtest

www.stanford

www.mit

www.care

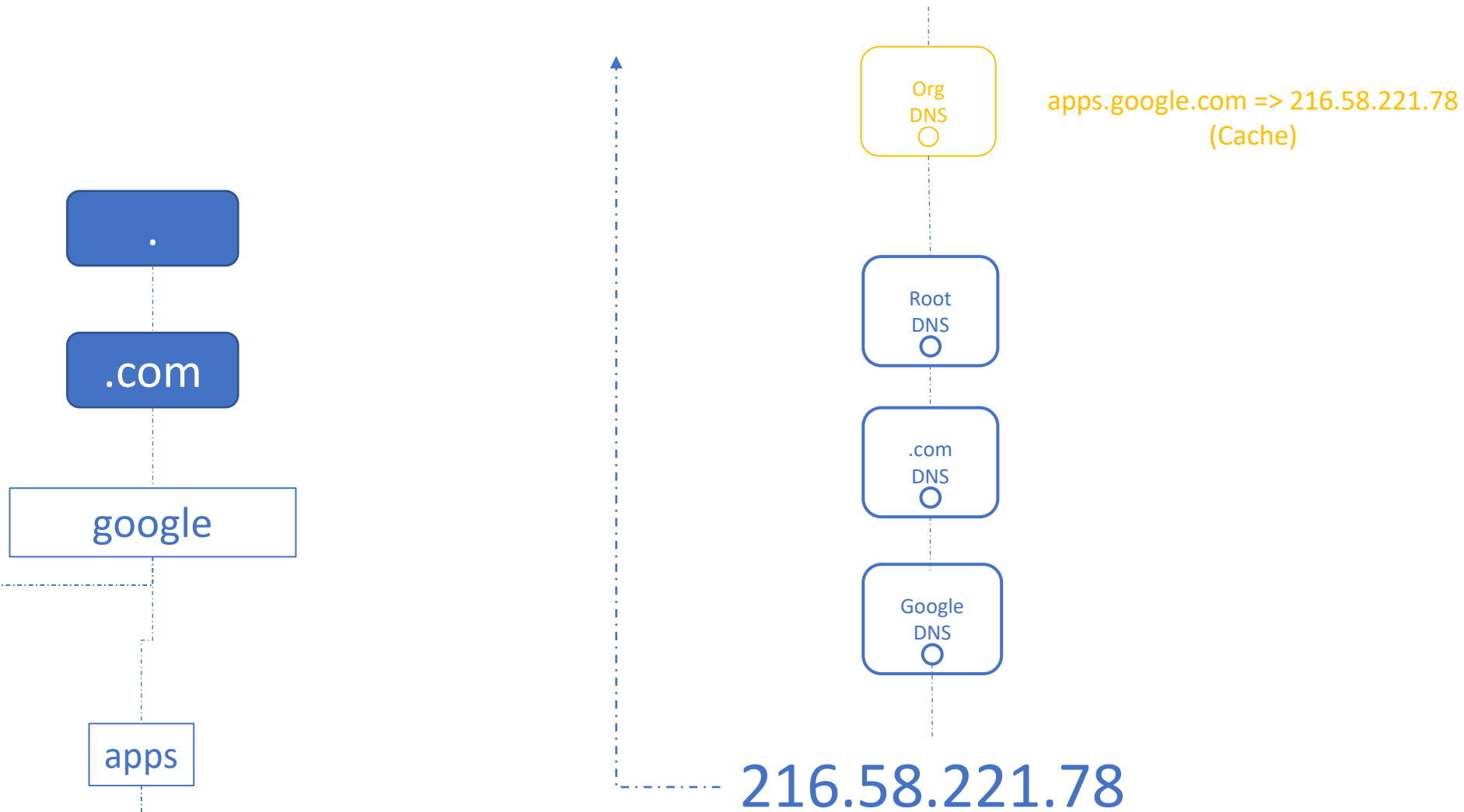www.un

www.kubernetes

www.codepen

{ODE{LOUD

Domain Names

Root

Top Level Domain Name
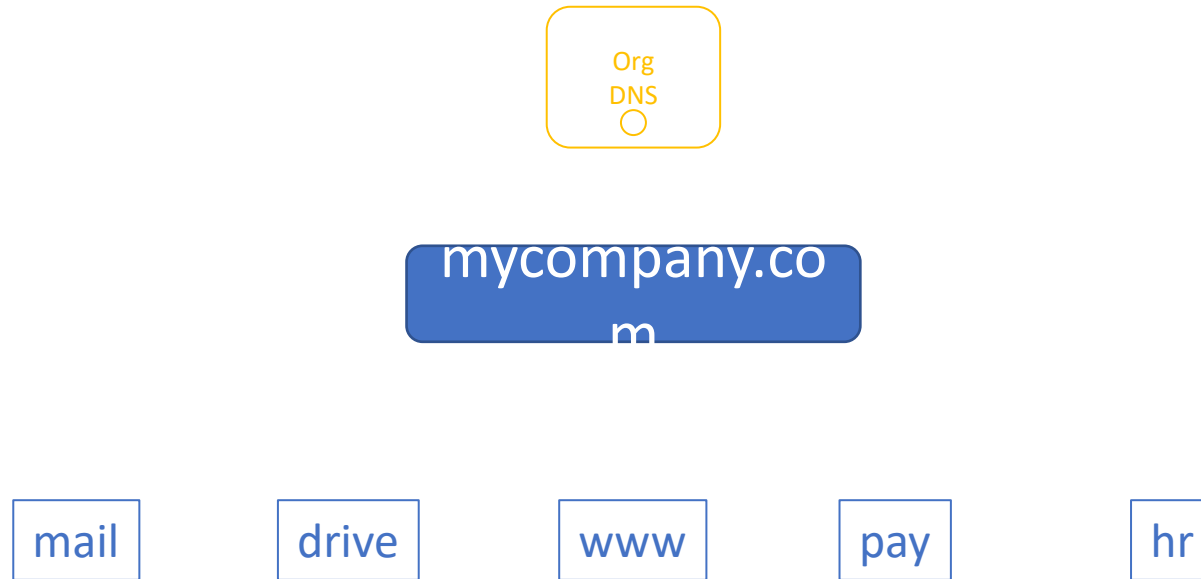
Subdomain

```
                    .
                    |
                  .com
                    |
                 google
     ┌──────┬──────┼──────┬──────┐
   mail   drive   www    maps   apps
```

KODEKLOUD
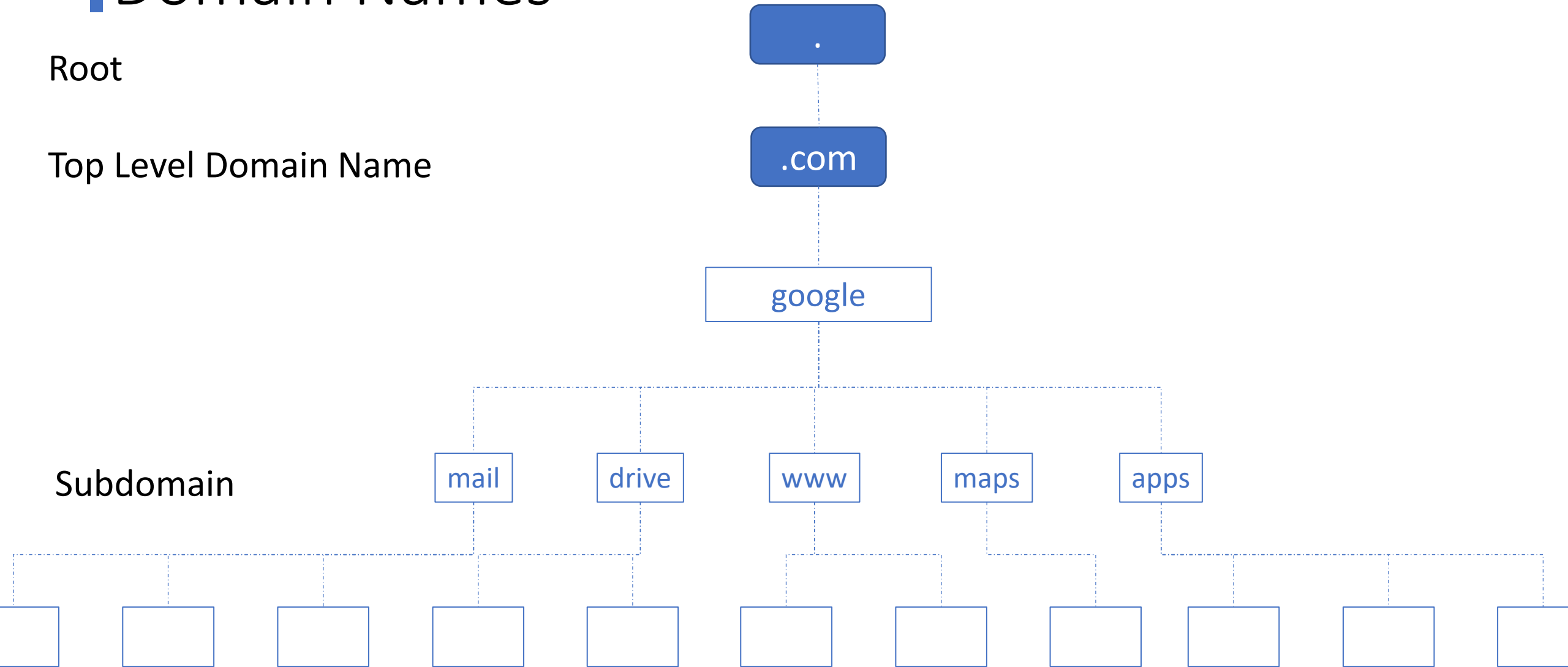
Domain Names

apps.google.com

.

.com

google

apps

Org
DNS
○

apps.google.com => 216.58.221.78
(Cache)

Root
DNS
○

.com
DNS
○

Google
DNS
○

216.58.221.78

Domain Names

Org
DNS

mycompany.com

mail

drive

www

pay

hr

Search Domain

Org DNS

mycompany.com
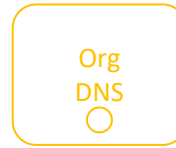
192.168.1.10	web.mycompany.com
192.168.1.11	db.mycompany.com
192.168.1.12	nfs.mycompany.com
192.168.1.13	web-1.mycompany.com
192.168.1.14	sql.mycompany.com

nfs   web   mail   drive   www   pay   hr   sql

```
cat >> /etc/resolv.conf
```
```
nameserver          192.168.1.100
search              mycompany.com  prod.mycompany.com
```

```
ping web
```
```
PING web (192.168.1.10) 56(84) bytes of data.
64 bytes from web (192.168.1.10): icmp_seq=1 ttl=64 time=0.052 ms
64 bytes from web (192.168.1.10): icmp_seq=2 ttl=64 time=0.079 ms
```

```
ping web
```
```
PING web.mycompany.com (192.168.1.10) 56(84) bytes of data.
64 bytes from web.mycompany.com (192.168.1.10): … time=0.052 ms
64 bytes from web.mycompany.com (192.168.1.10): … time=0.079 ms
```

```
ping web
```
```
: web: Temporary failure in name resolution
```

```
ping web.mycompany.com
```
```
PING web.mycompany.com (192.168.1.10) 56(84) bytes of data.
64 bytes from web.mycompany.com (192.168.1.10): ttl=64 time=0.052 ms
```

```
ping web.mycompany.com
```
```
PING web.mycompany.com (192.168.1.10) 56(84) bytes of data.
    om web.mycompany.com (192.168.1.10): ttl=64 time=0.052 ms
```

Record Types

A	web-server	192.168.1.1
AAAA	web-server	2001:0db8:85a3:0000:0000:8a2e:0370:7334
CNAME	food.web-server	eat.web-server, hungry.web-server

nslookup

```
nslookup www.google.com

Server:          8.8.8.8
Address:         8.8.8.8#53

Non-authoritative answer:
Name:   www.google.com
Address: 172.217.0.132
```

dig

```
dig www.google.com
```

```
; <<>> DiG 9.10.3-P4-Ubuntu <<>> www.google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 28065
;; flags: qr rd ra; QUERY: 1, ANSWER: 6, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;www.google.com.                        IN      A

;; ANSWER SECTION:
www.google.com.         245     IN      A       64.233.177.103
www.google.com.         245     IN      A       64.233.177.105
www.google.com.         245     IN      A       64.233.177.147
www.google.com.         245     IN      A       64.233.177.106
www.google.com.         245     IN      A       64.233.177.104
www.google.com.         245     IN      A       64.233.177.99

;; Query time: 5 msec
;; SERVER: 8.8.8.8#53(8.8.8.8)
;; WHEN: Sun Mar 24 04:34:33 UTC 2019
;; MSG SIZE   rcvd: 139
```

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