DNS + DHCP

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http://goo.gl/Bax8B8

DNS + DHCP

- DNS: domain name <— —> IP address

- DHCP:
  gives you a IP + configuration when you joins a new network

DHCP =
Dynamic Host
Configuration Protocol

DHCP (Dynamic Host Configuration Protocol)

- 每個地方有自己的subnet及IP設定
- 到一個新的地方，一開始怎麼取得此一subnet的IP呢?
- 通常同一個subnet中會設置一台DHCP server
- 此server將負責”接待”新來的機器，分發未使用的IP給它們
- 想像全系如果都需要手動設定IP, 會發生什麼事情?
  - 網管需要分配IP給所有電腦 (全系有多少電腦???)
  - IP衝突 (同樣的IP被不同的電腦使用)

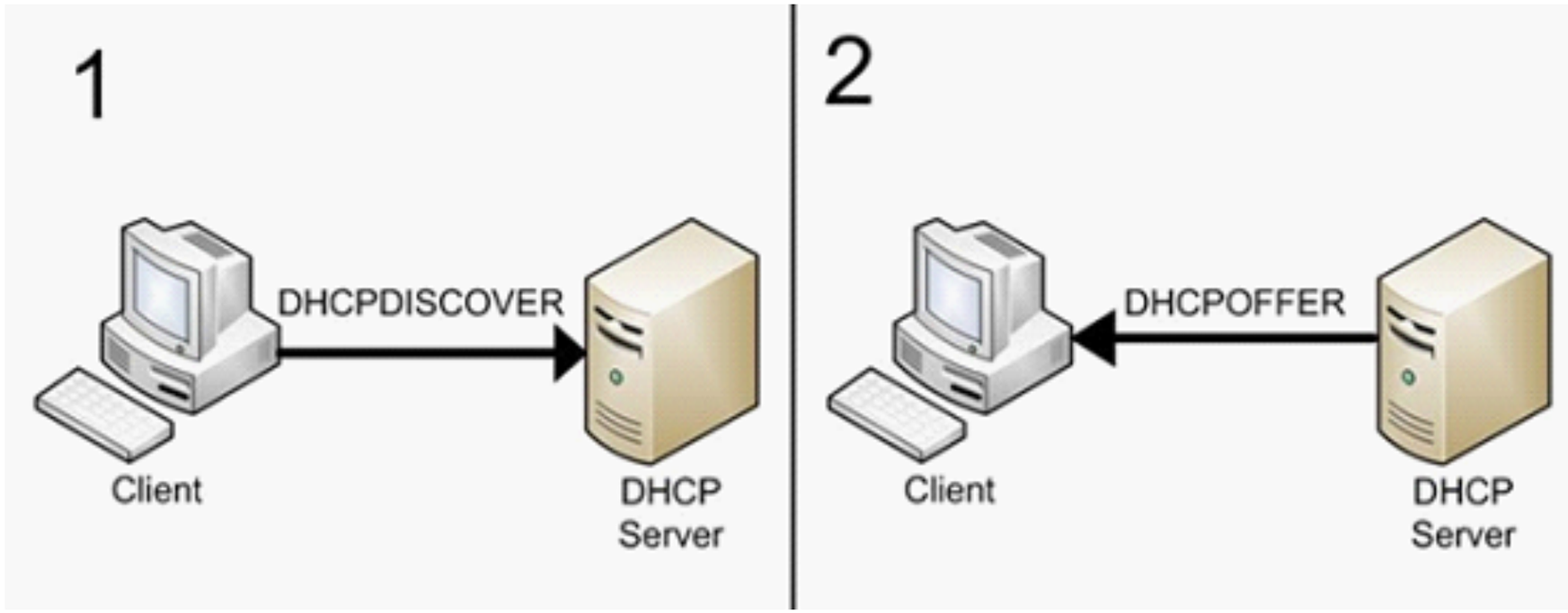
DHCP 4部曲

DHCP Discover: 請問有人可以發IP給我嗎?

Src: 0.0.0.0, 68
Dest: 255.255.255.255, 67
DHCPDISCOVER
Yiaddr: 0.0.0.0
Transaction ID: 654
Request:
Subnet Mask, Router, Domain Name Server

DHCP Offer:我這邊有一組IP看看你要不要用.

Src: 192.168.55.254, 67
Dest: 255.255.255.255, 68
DHCPOFFER
Yiaddr: 192.168.48.15
DHCP server ID: 192.168.55.254
Transaction ID: 654
Lifetime: 4 hrs
Netmask: 255.255.248.0
Router: 192.168.55.254
DNS: 140.112.30.21, 140.112.254.4



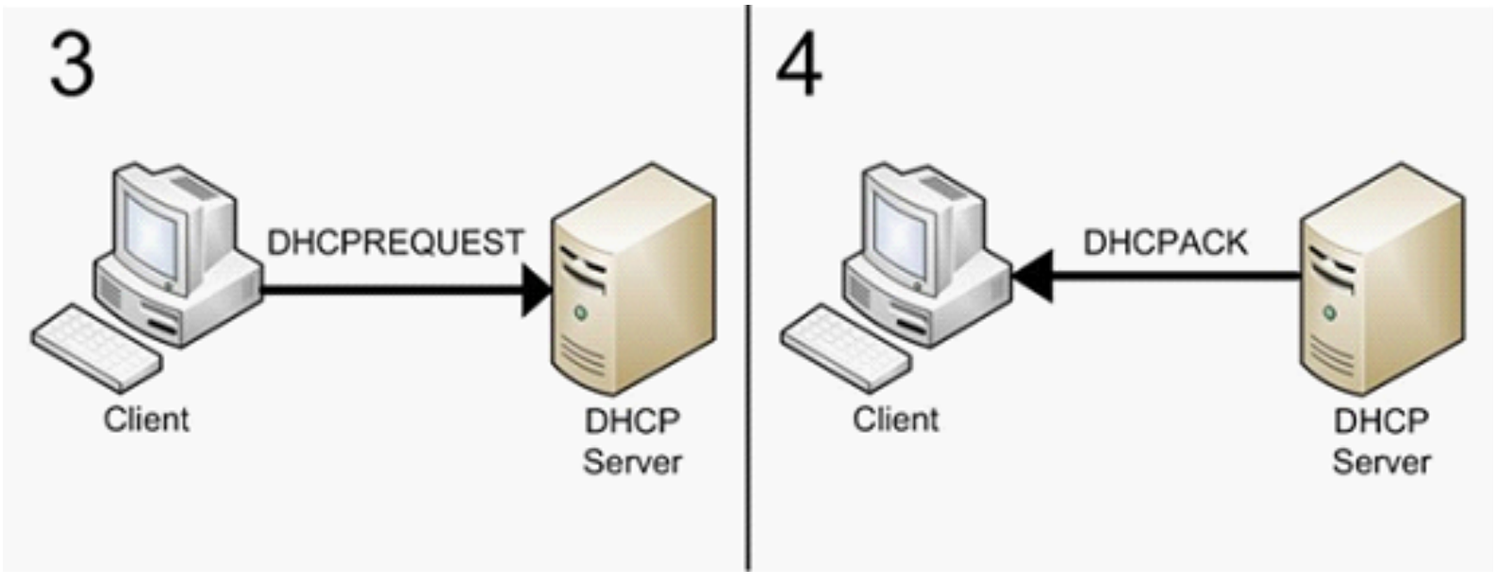
DHCP 4部曲

DHCP Request:那我要把這組IP拿走囉!

Src: 0.0.0.0, 68
Dest: 255.255.255.255, 67
DHCPREQUEST
Yiaddr: 192.168.48.15
Transaction ID: 655
DHCP server ID: 192.168.55.254
Lifetime: 4 hrs

DHCP Ack: 沒問題. 請用.

Src: 192.168.55.254, 67
Dest: 255.255.255.255, 68
DHCPACK
Yiaddr: 192.168.48.15
DHCP server ID: 192.168.55.254
Transaction ID: 655
Lifetime: 4 hrs
Netmask: 255.255.248.0
Router: 192.168.55.254
DNS: 140.112.30.21, 140.112.254.4



DHCP 的細節

- 一個subnet上可能有多個DHCP server. 因此發出DHCPREQUEST之後，可能收到多個DHCPOFFER。
- Client可以要求使用之前使用過的IP，但DHCP server可以拒絕(可能根本已經不在同一個網段，或是已經被別的client使用中)
- Authoritative & non-authoritative: 有主管權的DHCP server可以發出”拒絕”client使用某IP的要求，而沒有主管權的DHCP server則會忽略該要求(沒有回應)
- 想想看: DHCP server的安全漏洞. 如果有人接在系上網路上且開啟DHCP server，會發生什麼事情?

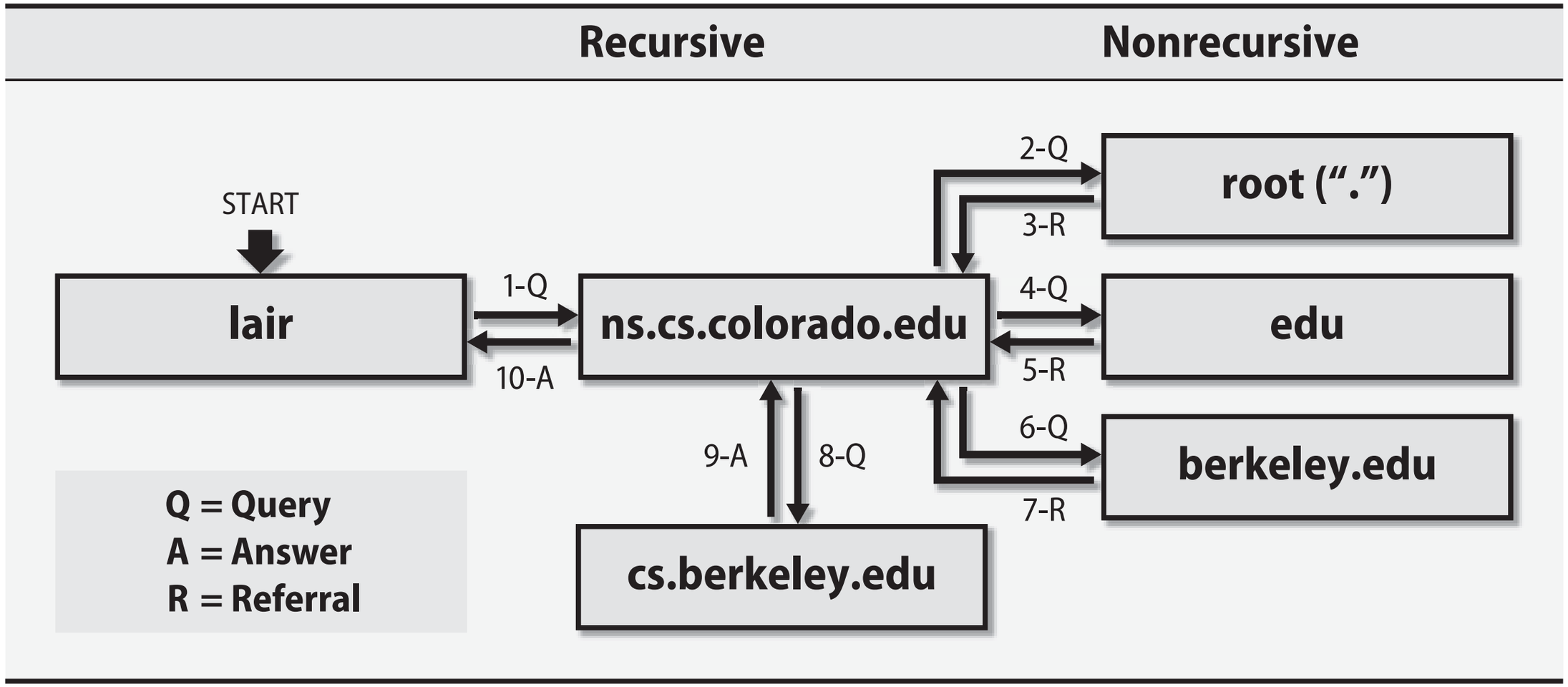
DNS =

Domain Name System

DNS (Domain Name Service)

- 一言以蔽之: 將名稱轉為IP的服務
- 常見的轉換種類:
  - Domain name -> IP (type A):
    ntucsv.csie.ntu.edu.tw -> 140.112.30.28
  - @domainname的mail server (type MX):
    csie.ntu.edu.tw -> ms.csie.ntu.edu.tw
  - Domain name -> domain name (type CNAME):
    www.csie.ntu.edu.tw -> ntucsv.csie.ntu.edu.tw
  - IP -> domain name (type PTR)
    140.112.30.21 -> csman.csie.ntu.edu.tw
- 可以多重宣告: 增加可靠度或分散性.
  - 例如www.google.com的A指到了6個IP!

Delegation = distributed



DNS Basics

- **Forward mapping**: domain name —> IP
- **Reverse mapping**: IP —> domain name
- **Master (primary) server**:
  holds the “reference copy” of the domain data
- **Slave (secondary) server**:
  copy the data from the master server
- **Caching-only server**:
  holds the domain data only temporarily in cache
- **Zone transfer**:
  the “copying” or “propagation” of DNS data from master to slave

DNS Basics

- **Authoritative**: from the server responsible for that “zone”
- **Non-authoritative**: from caching server (your local DNS)
- **TTL (time-to-live)**: How long can the caching server save the answer in the (temporary) database
- Example:
  roots: 42 days
  edu: 2 days
  berkeley.edu: 2 days
  vangogh.cs.berkeley.edu: 1 day
- Example: moving CSIE servers to BL —>
  set TTL to be 1 hr or less

Client Setting

- In /etc/resolv.conf
  (but most OS have similar fields)

- **search:** search domain name with these postfix

- **nameserver**: the **IP addresses** of the nameserver
  first will be used
  if not working (timeout), the next one will be used

- **options**: additional options can be specified
  (e.g., options rotate timeout:2 attempts:2)
  try every server, times out in 2 sec, query each server at most 2 times

常用DNS指令

- Examples:
  - dig @8.8.8.8 -t MX csie.ntu.edu.tw
  - dig @140.112.30.21 www.csie.ntu.edu.tw

```
;; ANSWER SECTION:
www.csie.ntu.edu.tw.    600     IN      A       140.112.30.28

;; AUTHORITY SECTION:
csie.ntu.edu.tw.        86400   IN      NS      csman2.csie.ntu.edu.tw.
csie.ntu.edu.tw.        86400   IN      NS      ntuns.ntu.edu.tw.
csie.ntu.edu.tw.        86400   IN      NS      csman.csie.ntu.edu.tw.

;; ADDITIONAL SECTION:
csman.csie.ntu.edu.tw.  600     IN      A       140.112.30.21
ntuns.ntu.edu.tw.       85489   IN      A       140.112.254.6
csman2.csie.ntu.edu.tw. 600     IN      A       140.112.30.12
```

課堂作業1

- 找出linux1到www.wikipedia.org經過了哪些機器(domain name可) keyword: mtr，traceroute

- 找出csie.ntu.edu.tw和ntu.edu.tw的mail server們(SMTP)的IP是什麼

- 答案請寄給hsinmu+wnfa15spring-0413@gmail.com

Resource Records

```
            IN   MX 10 mail
mail        IN   A  140.112.91.209

www         IN   CNAME mvnl.csie.ntu.edu.tw.

mvnl        IN   NS   ns-mvnl

ns-mvnl     IN   A    140.112.91.208

208         IN   PTR  mvnl.csie.ntu.edu.tw
```

Mail server

Alias

Sub-domain

Forward

Reverse

Resource Records

- **;** comments
- **@** the current zone name
- () allows data to span line
- **IN** Internet (default)
- Formal syntax: zone [ttl] [IN] record_type record_content

Fire up your VM!

1. Install bind9 in your ubuntu VM
   (sudo apt-get install bind9)

2. Add forward setting —> point to 140.112.30.21
   (in /etc/bind/named.conf.options
   “service bind9 reload” after you’re done)

3. Make sure your ubuntu is using this nameserver
   (check /etc/resolv.conf)

4. Check if you can get the answers from your own DNS server

Considerations in DNS service

- No name service = no service at all (mostly)
- Diversity: Geographically, software, etc.
- Standalone (not many users)
- Uninterruptible power supply
- Two slaves, one is off-site
- Separate authoritative and caching-only servers (security)

DNS
can be used for attacks!

- DNS spoofing (cache poisoning)
  - Redirect the user to a malicious server instead of the official server
- DNS hijacking
- DNS DDoS (reflection / amplification)
  - Request (30 bytes) versus response (3297 bytes): **100x !**
  - Send requests to a large number of DNS servers **on behalf of the host to be attacked** (no check on the source IP)
  - Mitigation (DNS server): limit the hosts (with IP in certain ranges) which can query your DNS

SOA record

```
; start of the authority record for nasa2015.com
@    IN  SOA  ns.nasa2015.com.
root.nasa2015.com. (
                2015042701 ; serial number
                10800      ; refresh (3 hr)
                1200       ; retry (20 min)
                3600000    ; expire (40+ day)
                3600 )     ; minimum ( 1 hr)
```

課堂作業2

- Create a new zone “[your ID].com” in your DNS server!

1. In /etc/bind/named.conf.local, add

```
zone “[your ID].com” {
        type master;
        file “/etc/bind/db.[your ID].com”;
};
```

2. Copy /etc/bind/db.local to /etc/bind/db.[your ID].com
   And modify the record.

3. Edit /etc/bind/db.[your ID].com and add a few entries.
   (try adding an A record and test it with dig)
   (remember to do “service bind9 reload”)

課堂作業2

- Show to one of the TAs the following queries are successful: (please check with dig)

    1. www.[your ID].com is mapped to multiple IPs (for load-balancing, for example)

    2. Map www-csie.[your ID].com to www.csie.ntu.edu.tw (not its IP)

    3. [Bonus] Create a subdomain “nasa.[your ID].com” which will be handled by nameserver at 192.168.200.253. (<— not an actual server)