DNS + DHCP

Michael Tsai
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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)

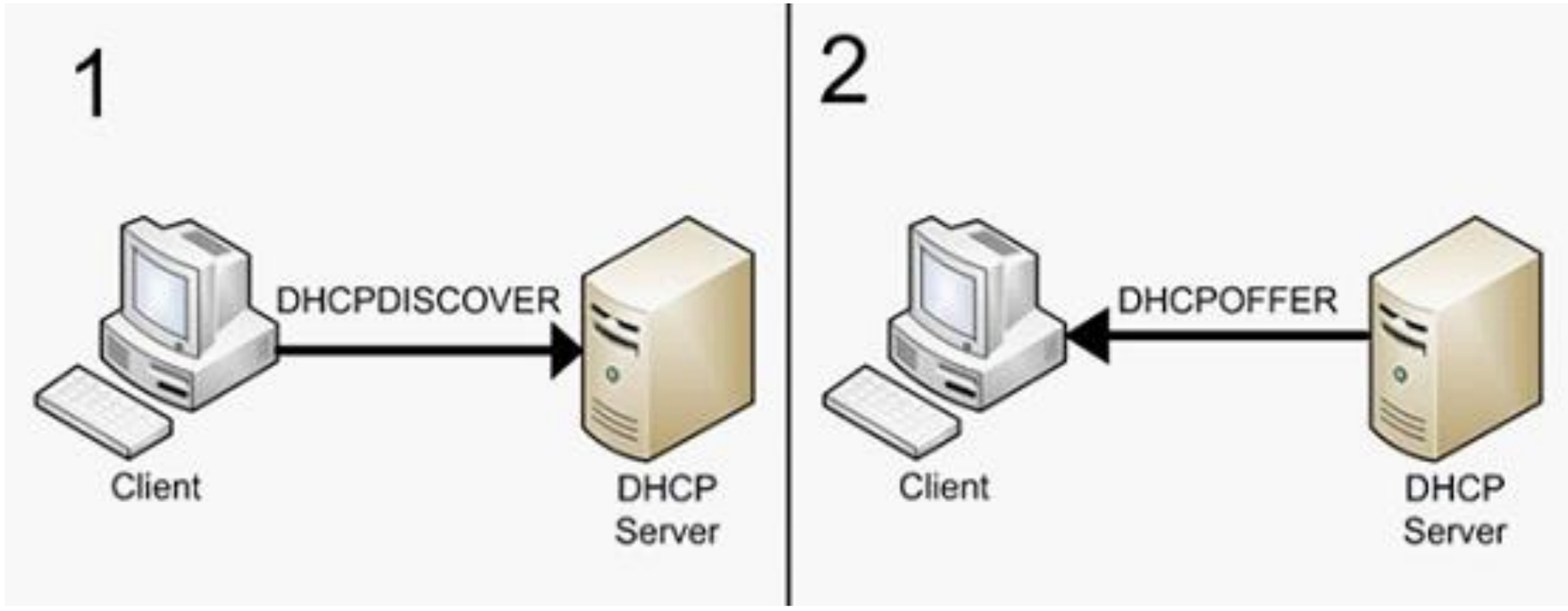
DHCP 4部曲

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



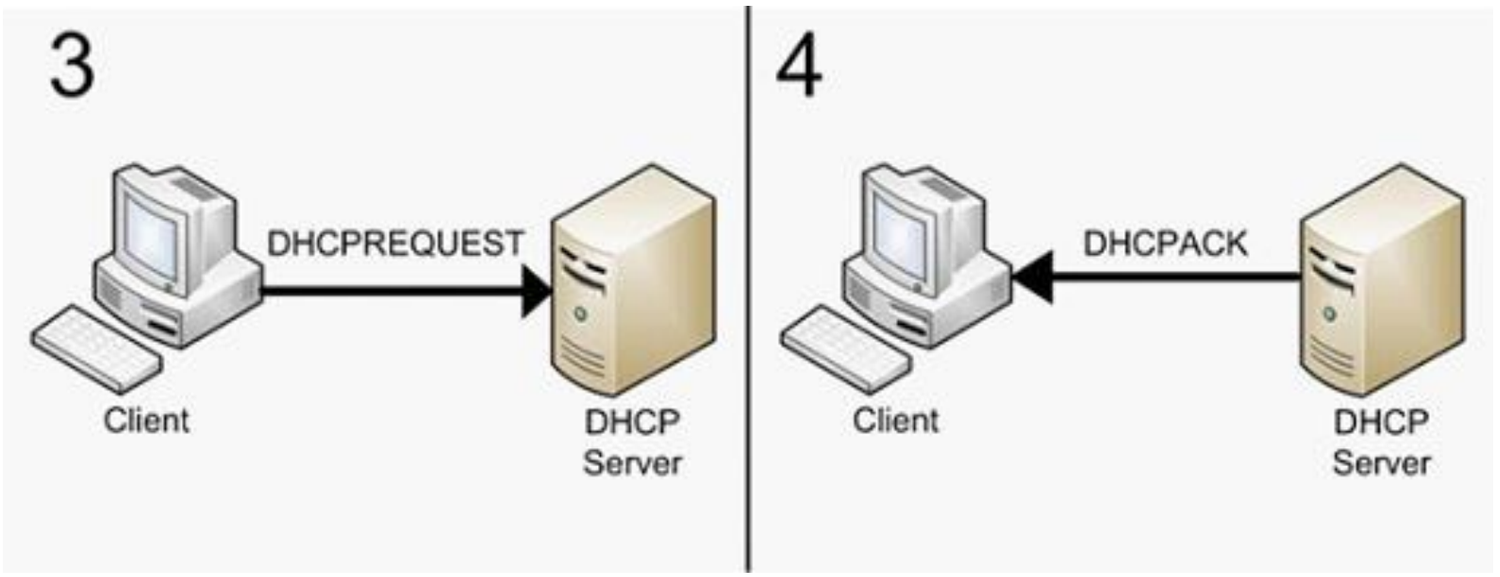
DHCP 4部曲

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



Some additional facts

- Originally designed as BOOTP - for diskless workstations.
  - Today, You can still use PXEBOOT on various network interface card for diskless operation.
- A server keeps track of “lease” (of IPs), which would expire after a predefined time period
- A client usually “renews” the lease when the time is half over
- The lease information must survive reboot for network stability
- A typical lease entry:

```
lease 192.168.20.4 {
    starts 6 2009/06/27 00:40:00;
    ends 6 2009/06/27 12:40:00;
    hardware ethernet 00:00:00:00:00:00;
    uid 00:00:00:00:00:00;
    client-hostname "examle-workstation1";
}
```

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?

A typical DHCP server configuration file

- The following dhcpd.conf is used by ISC DHCPD

```
default-lease-time 600;
max-lease-time 7200;
option subnet-mask 255.255.255.0;
option broadcast-address 192.168.1.255;
option routers 192.168.1.254;
option domain-name-servers 192.168.1.1, 192.168.1.2;
option domain-search "example.com";
subnet 192.168.1.0 netmask 255.255.255.0 {
   range 192.168.1.10 192.168.1.100;
}

host apex {
   option host-name "apex.example.com";
   hardware ethernet 00:A0:78:8E:9E:AA;
   fixed-address 192.168.1.4;
}
```

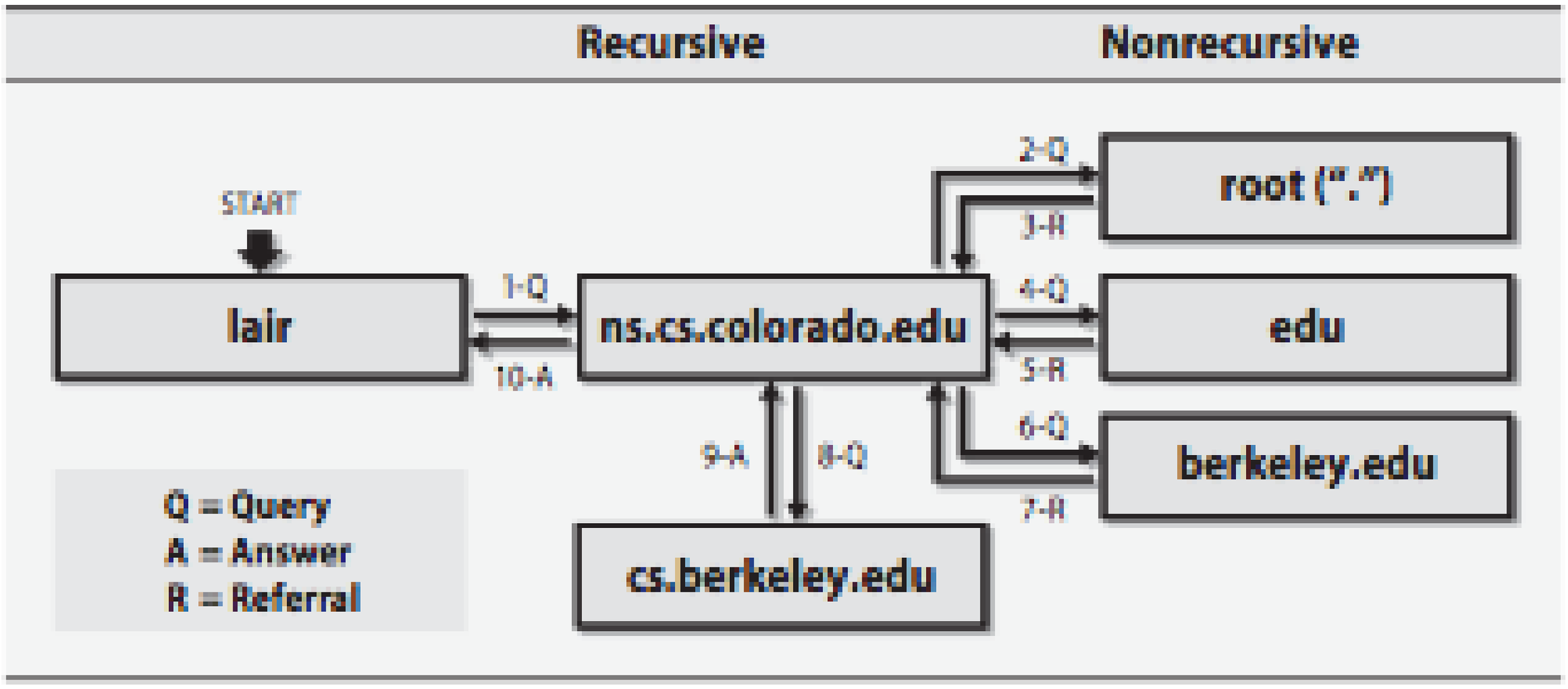
DNS =

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

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

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

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)
```

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