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IP Addresses and Domain Names

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Learning Objectives

IP Address

Domain Name System (DNS)

IP Address and DNS

Ports

Summary

IP Address -1

Every device (computer, laptop, cell phone, tablet, etc.) connected to a network has an address.

- Comparable to a telephone number
  - One per device
  - Unique world-wide
- Most common form
  - A.B.C.D – called an IP Address (IPv4)
    - Pronounced A dot B dot C dot D or A B C D
    - A, B, C, and D: a number between 0 and 255
    - Read left to right
    - Examples
      - 128.237.30.13
      - 192.88.209.7
      - 23.196.50.167

IP Address -2

“Magic” addresses (aka private addresses)

Think: business PBX (Private Branch Exchange) for telephone

- Many internal (private) telephone numbers
- Few external (public) numbers
- All calls from inside to outside appear to come from one of the public telephone numbers.

Home and company networks work the same way.

- One public address
- Many private addresses
  - Magic – very specific addresses:
    - 10.B.C.D
    - 172.16.C.D
    - 192.168.C.D
- How most home networks work by default

IP Address -3

The current IPv4 address scheme is running out of space.

- The Internet of Things
  - What if everything – EVERYTHING – was on the Internet?
    - Plugs
    - Cabinet locks
    - The refrigerator
    - …

New format coming

- Called IPv6 (Internet Protocol Version 6)
- Examples
  - FE80:0000:0000:0000:0202:B3FF:FE1E:8329
  - FE80::0202:B3FF:FE1E:8329
- You may see this in the field, but it is less likely.

IP Address -4

What then is my current public IP address?

- Examples
  - http://www.showmyipaddress.com/
  - http://showip.net/
  - http://www.google.com/search?q="what is my ip address”
  - Many, many more
  - Check with your management chain to see what if any recommendations they may have

Domain Name System (DNS) -1

Numbers hard to remember

Names easier to remember

First create naming scheme

- Same dot notation, except names not numbe
- Read left to right
- But hierarchy is right to left, like people’s names and address
  - Joe Smith
  - 4500 Fifth Avenue, Pittsburgh, PA, US
- “Is a member of”
- Example
  - www.microsoft.com
  - www.cert.org
  - www.army.mil

Domain Name System (DNS) -2

Everything but the first part is called a domain.

Right most part is called a Top Level Domain.

- Examples
  - .com – Commercial – Worldwide
  - .mil – Military – US
  - .edu – Education - Worldwide
  - .gov – Government - US
  - .mobi – Mobile sites - Worldwide
  - .xxx – Pornographic sites - Worldwide

Top Level Domains can also be countries.

- Examples
  - .us – United States
  - .ru – Russia
  - .tv – Tuvalu (Pacific Island) but they sold it; now TV (www.tbs.tv)
  - .de – Germany (Deutschland)
  - .es – Spain (España)

IP Address and DNS -1

Translate names to numbers and numbers to names

Telephone

- Phone Book
- Printed because it is (somewhat) static
- Translate name to address

Internet

- Domain Name System, or DNS for short
- Not printed because it is very dynamic
- Translate names to IP addresses

Names to numbers examples

- www.cert.org ➔ 128.237.30.13
- www.microsoft.com ➔ 23.196.50.167
- www.army.mil ➔ 143.69.251.141

Most often one-to-one, but not always

Only translate public numbers

IP Address and DNS -2

“Hold for the next available operator …”

Sometimes many hosts have the same name (www.microsoft.com)

- Load balancing
  - Spread the load over many computers
  - Transparent
- Answer based on question
  - www.google.com - address based on country where lookup originates
    - Translate www.google.com from US gives host in US
    - Translate www.google.com from RU (Russia) gives host In Russia

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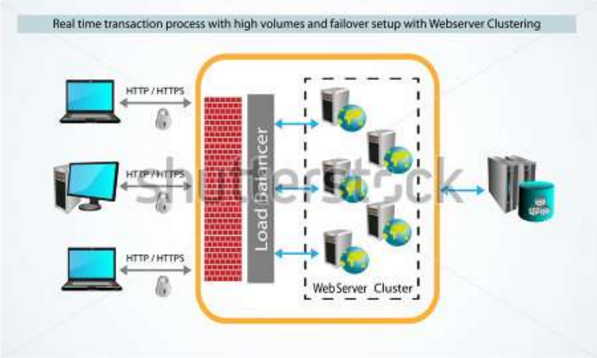
Real time transaction process with high volumes and failover setup with Webserver Clustering
HTTP / HTTPS
HTTP / HTTPS
HTTP / HTTPS
Load Balancer
WebServer Cluster

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DNS Resource Records -1

DNS is a distributed database used to translate hostnames into IP addresses and visa versa, but it has much more information.

Common DNS Resource Records (RR):

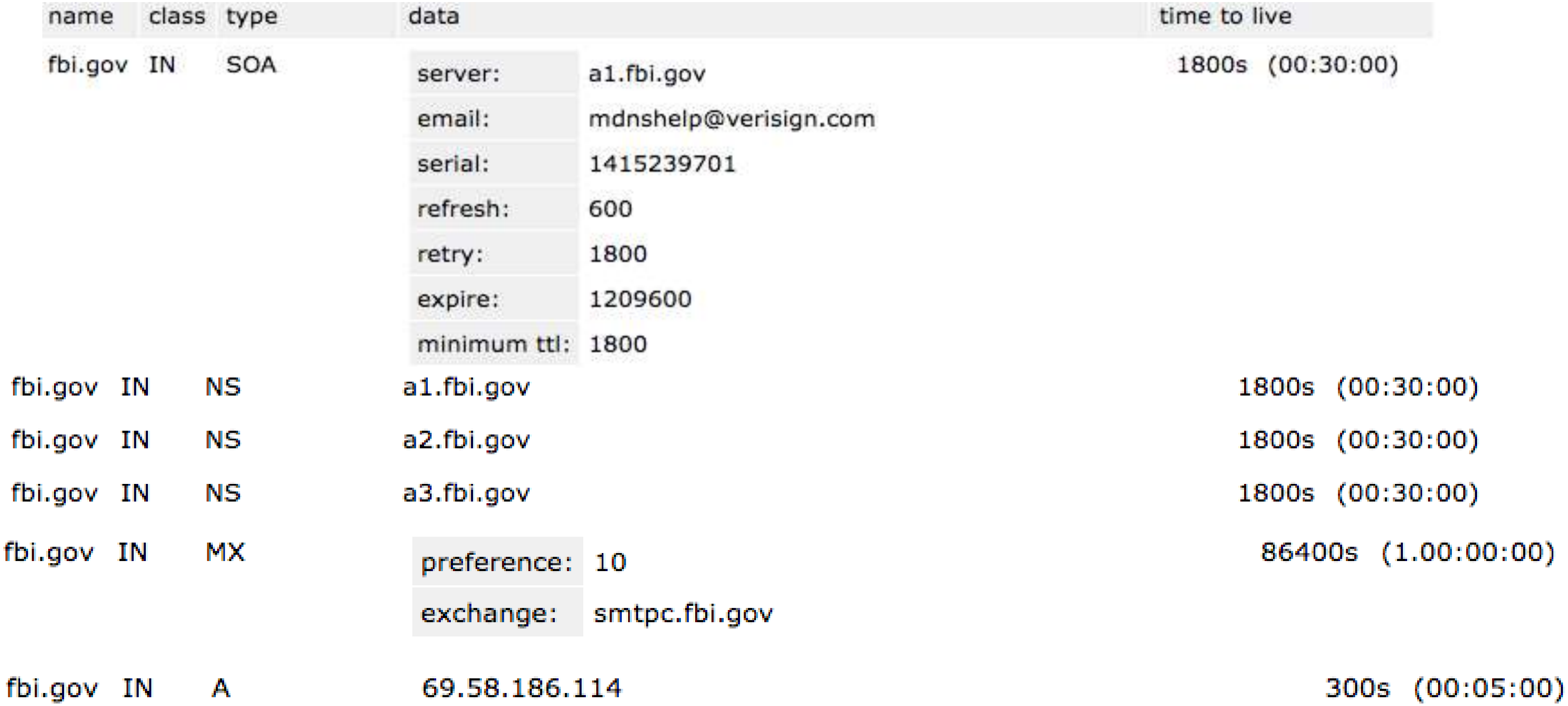
- Address (A) – Map hostname onto IP address(es)
- PoinTeR (PTR) – Map IP address onto hostname, aka an alias
- Canonical NAME (CNAME) – Map hostname alias onto hostname
- Start Of Authority (SOA) – Contact information (mail and email)
- Mail eXchanger (MX) – Host(s) receive mail for domain
- All RRs https://en.wikipedia.org/wiki/List_of_DNS_record_types

DNS Resource Records -2

Useful DNS query websites

- http://www.dnsstuff.com/
- http://centralops.net/co/DomainDossier.aspx
- Many, many more

DNS Resource Records -3



name	class	type	data	time to live
fbi.gov	IN	SOA	server: a1.fbi.gov email: mdnshelp@verisign.com serial: 1415239701 refresh: 600 retry: 1800 expire: 1209600 minimum ttl: 1800	1800s (00:30:00)
fbi.gov	IN	NS	a1.fbi.gov	1800s (00:30:00)
fbi.gov	IN	NS	a2.fbi.gov	1800s (00:30:00)
fbi.gov	IN	NS	a3.fbi.gov	1800s (00:30:00)
fbi.gov	IN	MX	preference: 10 exchange: smtpc.fbi.gov	86400s (1.00:00:00)
fbi.gov	IN	A	69.58.186.114	300s (00:05:00)

Ports -1

Analogy

- Department of Motor Vehicles
  - One street address
  - Many services at that address
    - Driver’s License renewal
    - Title Transfer
    - Registration
    - Etc.
- Network-connected hosts
  - One network address (typically)
  - Many services at that address
    - Web service – port 80 – (http://myhost.mydomain.com)
    - Secure web service – port 443 – (https://myhost.mydomain.com)
    - DNS – 53
    - Whois – 43

Ports -2

Syntax:

- http://host.domain.tld:PortNumber

http://myhost.mydomain.com = http://myhost.mydomain.com:80

https://myhost.mydomain.com = http://myhost.mydomain.com:443

Port numbers are convention, not rules

- Just because the services is running on port 80 doesn’t mean it is web traffic
- Trust but verify

Summary

Hosts need IP addresses to communicate on a network

IPv4 (A.B.C.D) is most prevalent

IPv6 is coming

DNS is a distributed database that maps hostnames to IP addresses and visa versa

DNS contains lots of other data about domains

Hosts provide services at ports