Application Layer: DNS

CS484 Fall 22

The Domain Name System (DNS)

A global name lookup

Maps hostnames to IP addresses

Also lists other useful directory information (like MX records for email)

Its original design is unencrypted so it can be cached

New variations encrypt it

But who runs it?

Internet Governance

The Internet was originally mostly a US invention funded by US government grants.

In the 1990’s, Internet infrastructure was privatized, to encourage global adoption and lessen the perception that the US controlled it.

Internet Engineering Task Force (IETF)

Community for making Internet Standards

Divided into Working Groups

Standards are released as RFCs (Request for Comment)

Consensus, rather than majority rule

Humming → https://vimeo.com/281317847/ef24ff0d40

RFC 793 (original TCP)

RFC 9293 (latest TCP August 2022)

Internet Corporation for Assigned Names and Numbers ICANN

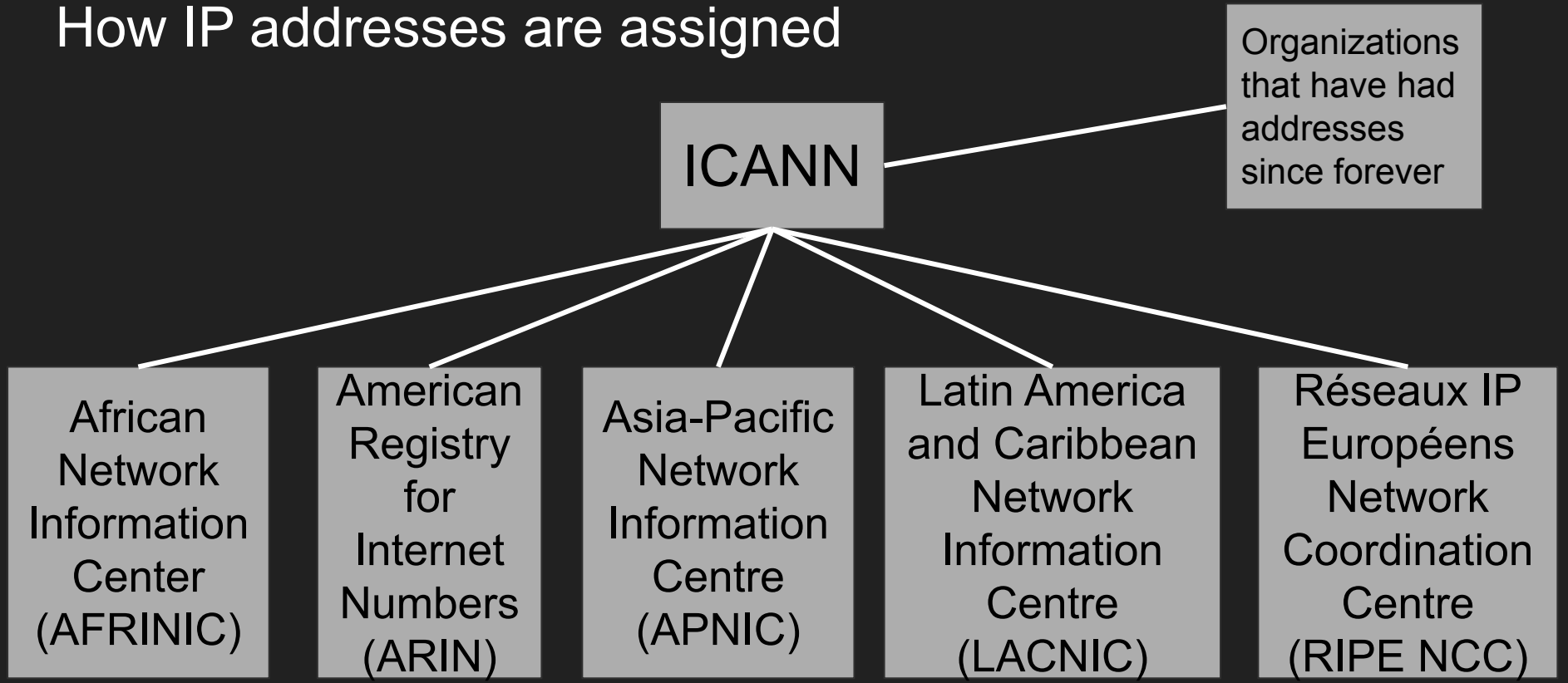
https://www.icann.org/en/history/icann-usg

IP Address allocation

Domain Name System

Allowed URI schemes

How IP addresses are assigned



Top Level Domains TLD

ICANN chooses which ones are allowed and which are not

They have approved .com, .org, .edu, .mx, .tv, .info, .site, .page, etc.

Each TLD may have rules on who can use it

(must be a real university to get a .edu)

(must have an Icelandic national ID number to get a .is)

If you run a TLD, you are responsible for keeping a registry of all domains and where to go to get DNS info about them

Root Name Servers

13 root name servers keep a registry of where to go to for every TLD

If you make a DNS request for an unusual TLD in your region, you may need to ask one of the ~dozen root name servers to point you to that TLD’s top DNS server.

Run by: Verisign, USC, NASA, University of Maryland, ICANN, RIPE NCC, US DOD, etc

TLD Servers

TLD servers have a registry of every domain name registered on their TLD.

google.com is listed in the .com registry

nsmu.edu is listed in the .edu registry

You can ask the registries for the IP addresses of anything in their registry

You can also politely request information on the owners of the companies with a WHOIS query.

WHOIS demo…

domains' Name Servers

What about sub-domains like cs.nmsu.edu?

The TLD servers can tell you where to find nmsu.edu's DNS servers, who can tell you more.

NMSU.edu's subdomain space is called a DNS Zone

A list of everything in that Zone is called a Zone File

If you have a zone, you need someone to provide DNS service for you.

Or do it yourself

A Records

You can find hostname _____ at IPv4 address x.x.x.x

You don’t need to ask again for at least _____ seconds (Time to Live, TTL)

AAAA Records

You can find hostname _____ at IPv6 address x:x::x

You don’t need to ask again for at least _____ seconds (Time to Live, TTL)

DNS Example

https://www.youtube.com/watch?v=SrlmC80u_GE

Buying a Domain Name

DNS Registrars are agents of the TLD controller who are allowed to sell/rent hostnames, for a recurring fee.

Some goes to the registrar, some to the TLD, some to ICANN.

Some registrars don’t even take a cut because they sell other services like server hosting

Using the DNS: Example resolving www.example.com

1. GoTo one of the Root Name Servers
    a. Ask: Where can I find the TLD Server for .com?
    b. Answer: You can find the .com TLD Server at IP: x.x.x.x

Using the DNS: Example resolving www.example.com

1. GoTo one of the Root Name Servers
    a. Ask: Where can I find the TLD Server for .com?
    b. Answer: You can find the .com TLD Server at IP: x.x.x.x
2. GoTo the .com TLD Server
    a. Ask: where can I find info about example.com?
    b. Answer: You should ask their name servers at IP: y.y.y.y

Using the DNS: Example resolving www.example.com

1. GoTo one of the Root Name Servers
    a. Ask: Where can I find the TLD Server for .com?
    b. Answer: You can find the .com TLD Server at IP: x.x.x.x
2. GoTo the .com TLD Server
    a. Ask: where can I find info about example.com?
    b. Answer: You should ask their name servers at IP: y.y.y.y
3. GoTo the example.com Name Servers
    a. Ask: Are there any A or AAAA records for www.example.com?
    b. Answer: www.example.com found in A record, IP: z.z.z.z

NS Records

What hostnames to go for DNS info on this zone

Sent along with A or AAAA records so you know how to reach them

Start of Authority SOA Records

Contains:

- The NameServer which created this SOA record
- An email contact address for DNS issues
- Minimum TTL
- Serial Number of latest address information

MX Records

What server to send email to?

CNAME Records

A record that says, look for me elsewhere

CNAME facebook.com fb.com

TXT Records

Can hold any arbitrary text

Used to prove to a search engine or certificate authority that you control the DNS for a hostname

PTR Record

A reverse-DNS record used to announce that an IP address is bound to this hostname.

You cannot look up IP addresses to see hostnames unless they give a PTR record.

dig -x 8.8.8.8

SRV Records

Like an MX record, but for another service

If you are service X, contact me at hostname Y on port Z

CAA records

Lists which Certificate Authorities are allowed to issue certificates for a particular domain. (More on this when we learn TLS)