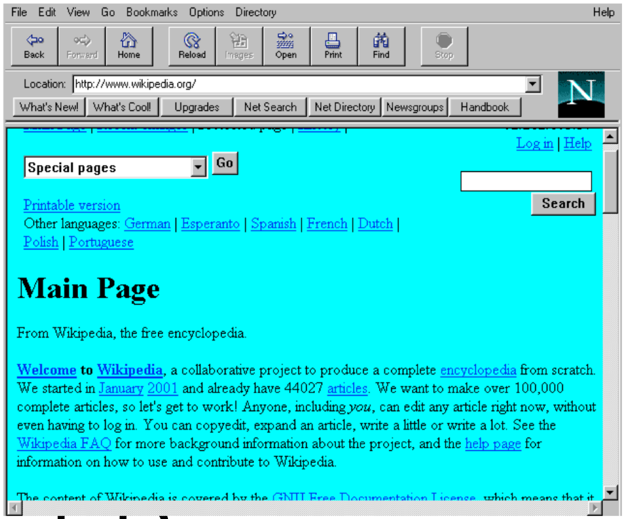
What are CDNs?
CDNs make the Web scale.

Evolution of Serving Web Content

- In the beginning…
  - …there was a single server
  - Probably located in a closet
  - And it probably served blinking text



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Main Page

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- What are the problems with this model?
  - Site reliability
    - Unplugging cable, hardware failure, natural disaster
  - Scalability
    - Flash crowds (aka Slashdotting)
  - Latency

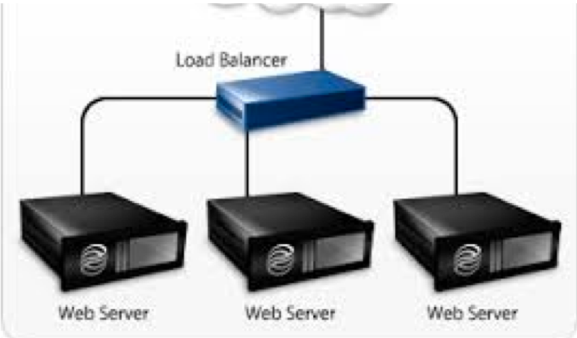
Replicated Web service

- Use multiple servers

- Advantages
  - Better scalability
  - Better reliability

- Disadvantages
  - How do you decide which server to use?
  - How do you know the address of each replicated server?
  - How to do synchronize state among servers?

Load Balancers



- Device that multiplexes requests across a collection of servers
  - All servers share one public IP
  - Balancer transparently directs requests to different servers
- How should the balancer assign clients to servers?
  - Random / round-robin
  - Load-based

Load balancing: Are we done?

- Advantages
  - Allows scaling of hardware independent of IPs
  - Relatively easy to maintain
- Disadvantages
  - Still a single point of failure
  - Scalability (must support traffic for n hosts)
  - State (must keep track of previous decisions)

What properties do we want in our servers?

- Scalability
- Low latency
- Fault tolerance
- Ease of use (Single IP address)

Content Delivery Networks (ISP + Content Provider + Infrastructure approach)

What is a CDN?

A CDN is a global cluster of caches that can serve as a local cache for static objects.

- Geographically distributed
- Ensures that replicas are always available

Do CDNs solve the problem?

- Scalability ✓
- Fault tolerance ✓
- Low latency ✓
- Ease of use (Single IP address) ✗

DNS comes to the rescue

- When client requests for foo.jpg:
  - DNS server directs client to the closest CDN server that contains foo.jpg

- Two ways in which the redirection is done
  - Redirecting by directly changing DNS records
  - Changing the URL in the Web page

Example 1: DNS redirects.

Lets say, I want to host www.foo.com on a CDN

Step 1: Register www.foo.com with the CDN

Step 2: CDN sends back a CNAME (say cdnfoo.com)

Example 1: DNS redirects (cont…)

Step 3

Register this CNAME with *my* DNS authoritative name server

http://ww.foo.com IN CNAME cdnfoo.com

Step 4

The client is redirected to cdnfoo.com

Step 5 The CDN periodically refreshes the content

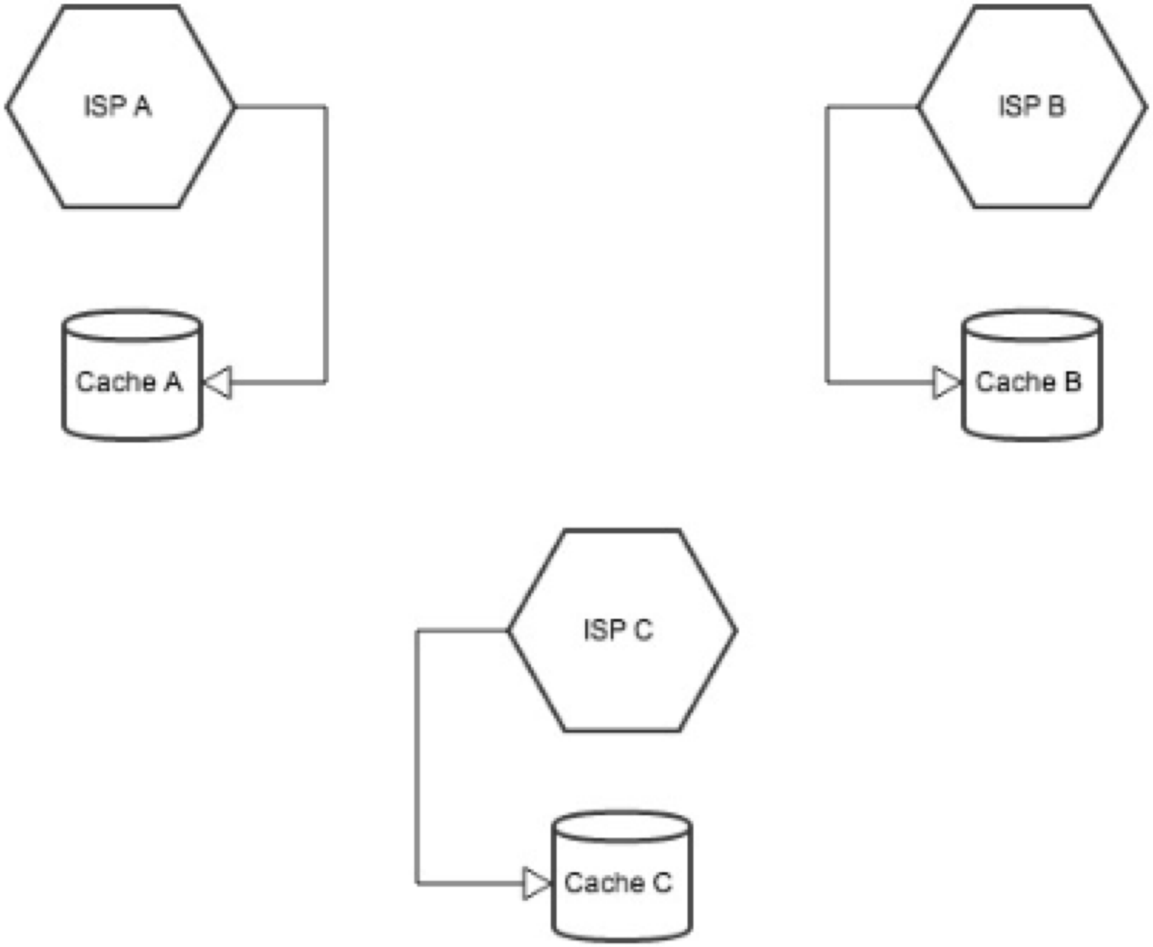
Example 2: Changing URL

Lets say, I want to host the file foo.jpg which is originally at the address www.foo.com/foo.jpg

Step 1: Change the URL embedded in the file to CDNs url.

```
<html>
    <a href = cdnfoo.com/foo.jpg> foo </a>
</html>
```

Redirecting to the closest CDN

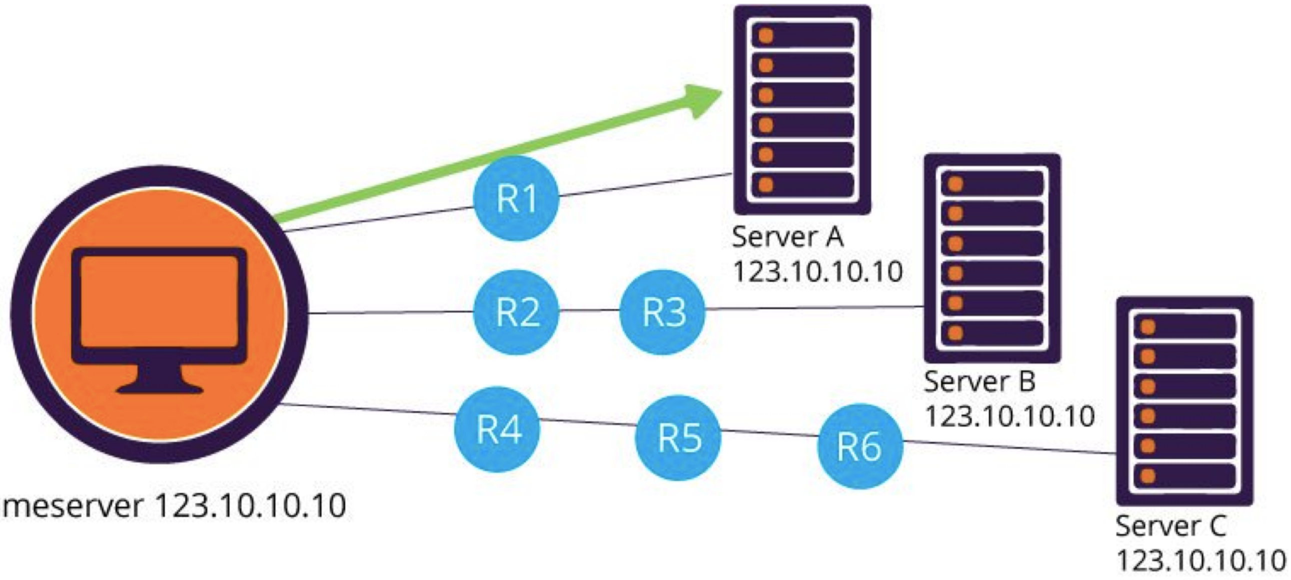


Redirection Take 1: Using logic at the Authoritative Name Server

- The CDN’s Name server
  - Gets the location of the DNS resolver
  - Finds the server closest to the DNS resolver and sends this information to the resolver
  - How will the name server know the location of the closest DNS resolver?

Redirection Take 2: Using anycast

- Use the same IP address for all CDN servers
- Use BGP to redirect to the correct CDN server



Akamai case study

- Deployment
  - **325K**+ servers, 1450+ networks, 135 countries
  - Many servers inside ISPs, who are thrilled to have them
  - 3.2 billion revenue and up
- Customers
  - 250K+ domains: all top 60 eCommerce sites, all top 30 M&E companies, 9 of 10 to banks, 13 of top 15 auto manufacturers
- Overall stats
  - 100 terabits/second,
  - 85% of the worlds traffic are within a single hop to a CDN
- Other CDNs: Cloudfare, Google Cloud CDN…