Introduction to Computer Networks

CDNs (Content Delivery Networks) (§7.5.3)

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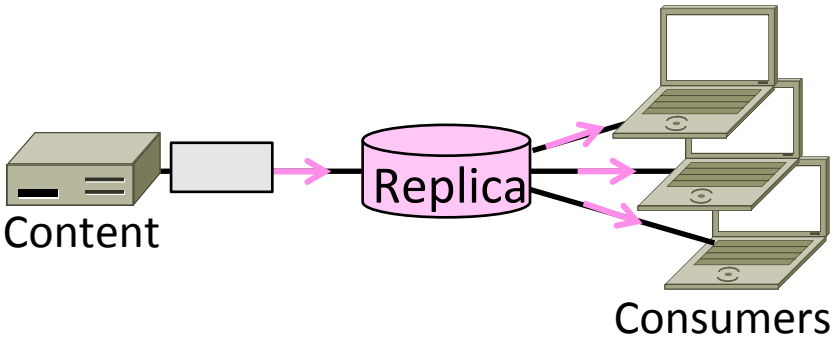
Topic

- CDNs (Content Delivery Networks)
  - Efficient distribution of popular content; faster delivery for clients

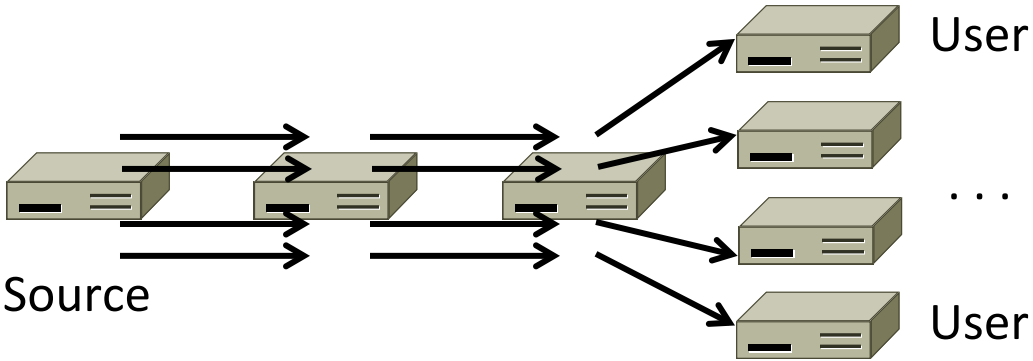


Context

- As the web took off in the 90s, traffic volumes grew and grew. This:
  1. Concentrated load on popular servers
  2. Led to congested networks and need to provision more bandwidth
  3. Gave a poor user experience
- Idea:
  - Place popular content near clients
  - Helps with all three issues above

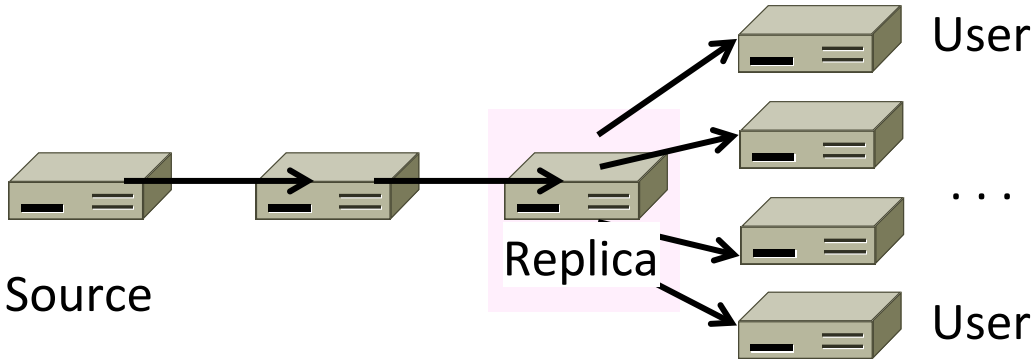
Before CDNs

- Sending content from the source to 4 users takes 4 x 3 = 12 “network hops” in the example



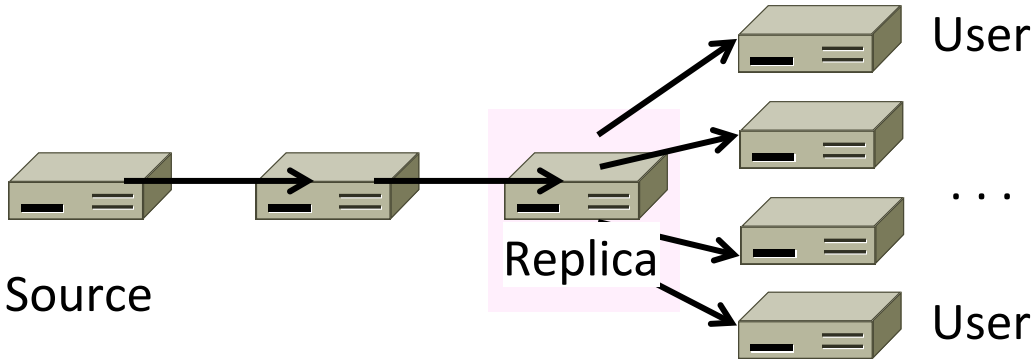
After CDNs

- Sending content via replicas takes only 4 + 2 = 6 “network hops”



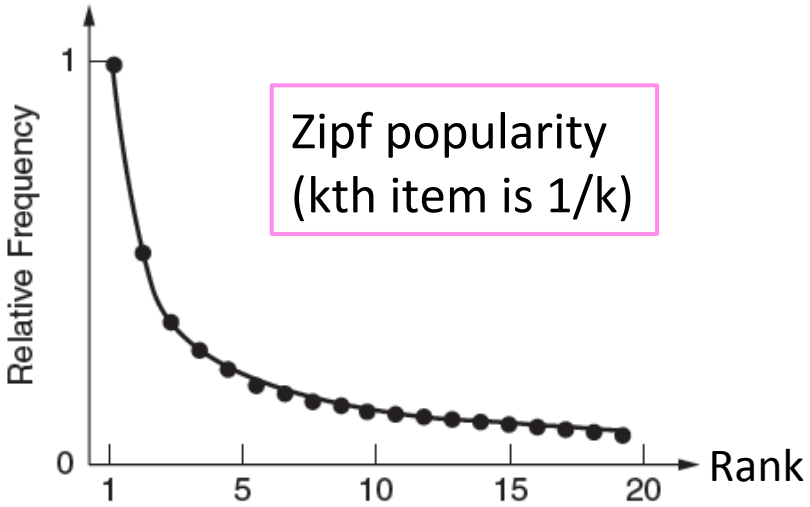
After CDNs (2)

- Benefits assuming popular content:
  - Reduces server, network load
  - Improves user experience (PLT)



Popularity of Content

- Zipf's Law: few popular items, many unpopular ones; both matter



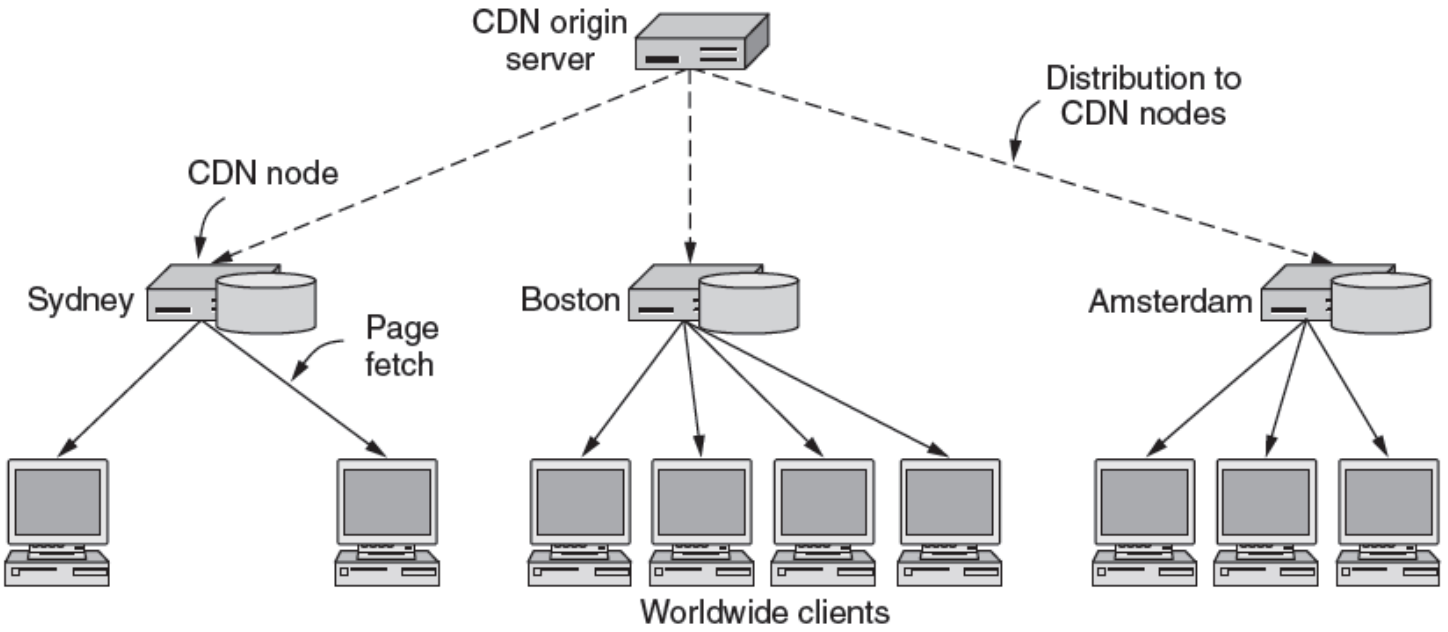
George Zipf (1902-1950)

Source: Wikipedia

How to place content near clients?

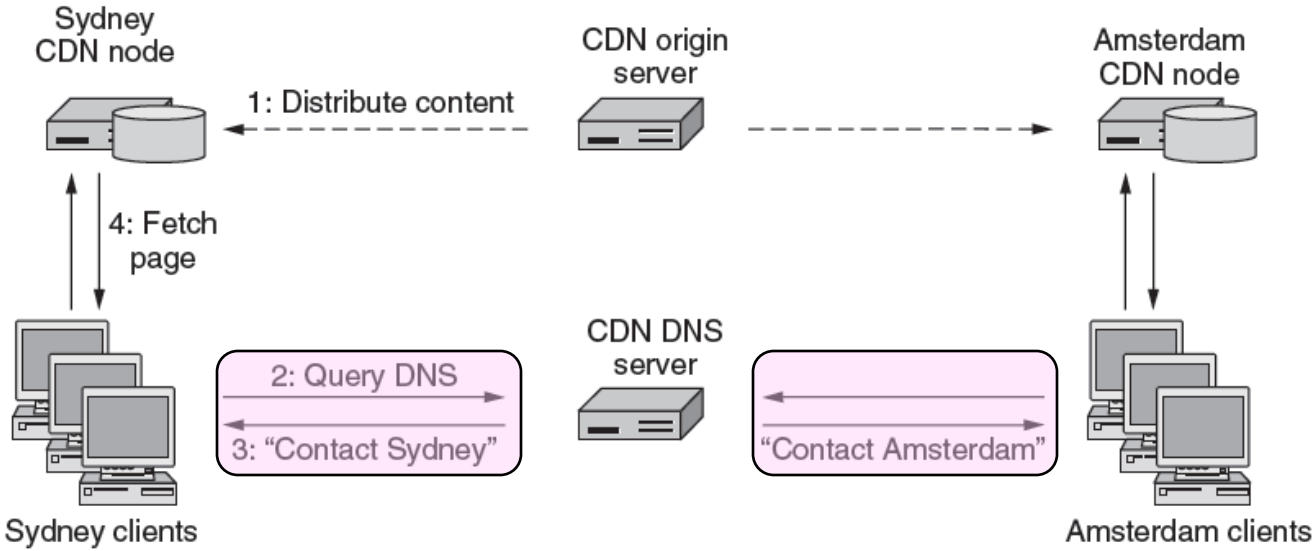
- Use browser and proxy caches
  - Helps, but limited to one client or clients in one organization
- Want to place replicas across the Internet for use by all nearby clients
  - Done by clever use of DNS

Content Delivery Network



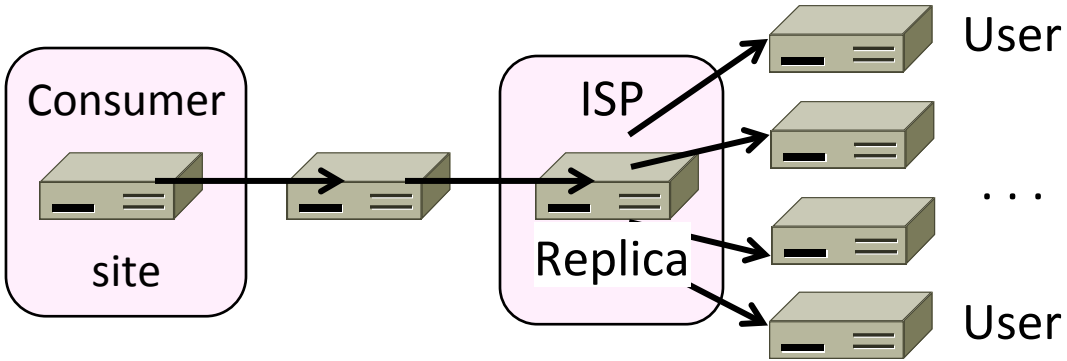
Content Delivery Network (2)

- DNS resolution of site gives different answers to clients
  - Tell each client the site is the nearest replica (map client IP)



Business Model

- Clever model pioneered by Akamai
  - Placing site replica at an ISP is win-win
  - Improves site experience and reduces bandwidth usage of ISP



What are companies doing with networking?

QUIC

- Why?
- What does it do?

QUIC: Why?

- Changing TCP is a pain and unlikely to happen

- If you can control the client/server then implement your own reliability over UDP

QUIC: What?

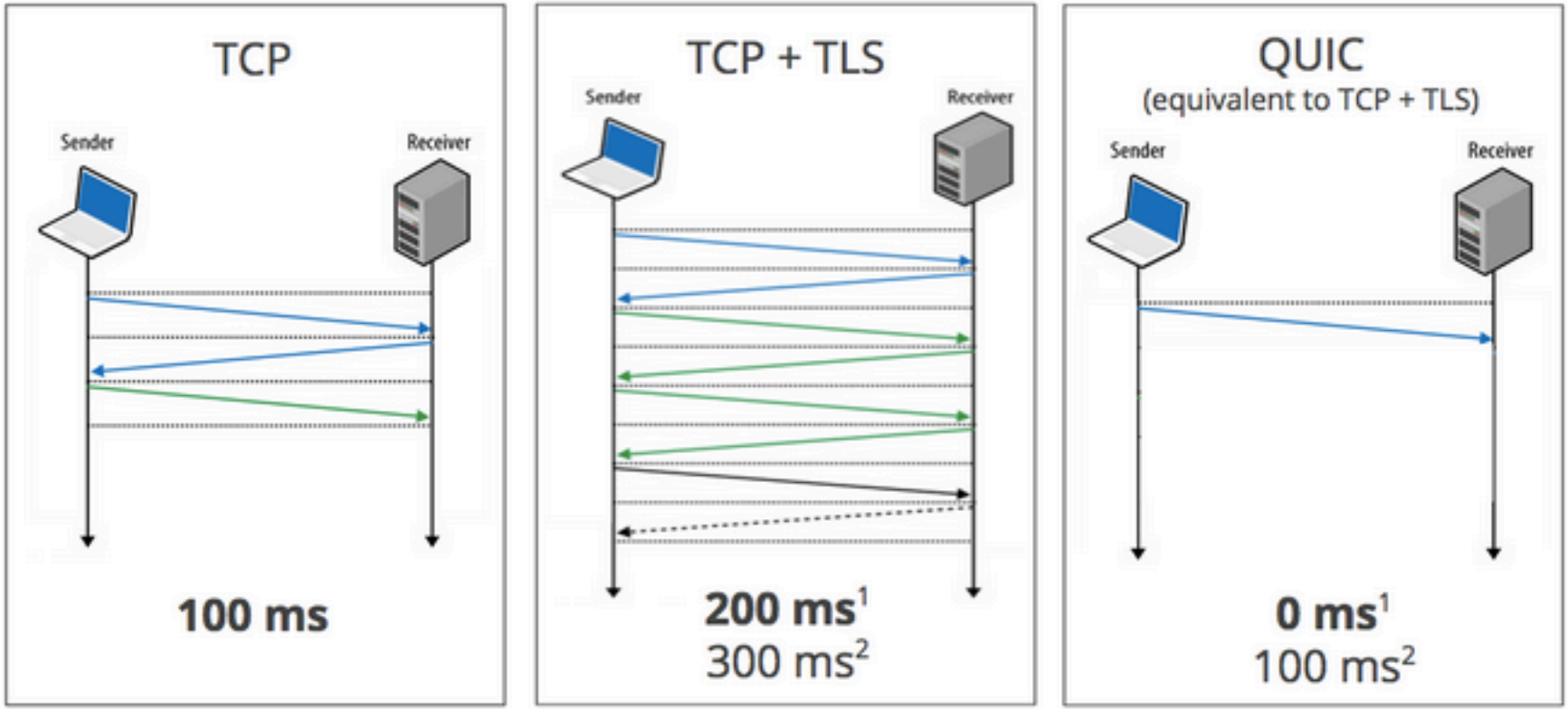
- Google controls the Chrome browser, Search/ Youtube server

- QUIC is a transport layer protocol implemented over UDP

QUIC: What does it do?

- lower-latency connection establishment
- improved congestion control and better loss recovery

Zero RTT Connection Establishment



1. Repeat connection
2. Never talked to server before

Improved congestion control and better loss recovery

- Packet sequence numbers are never reused → No confusion
- Use NACK to explicitly tell the sender which packets are loss
- Retransmit lost packets faster at the sender

Improved congestion control and better loss recovery

- QUIC outshines TCP under poor network conditions, shaving a full second off the Google Search page load time for the slowest 1% of connections
- Users report 30% fewer rebuffers when watching videos over QUIC.
- In 2015, roughly half of all requests from Chrome to Google servers are served over QUIC