Drafting Behind Akamai
(Travelocity-Based Detouring)

Ao-Jan Su, David R. Choffnes, Aleksandar Kuzmanovic and Fabián E. Bustamante

Department of EECS
Northwestern University

ACM SIGCOMM 2006
Drafting Behind Akamai

Find Me The Best Priced Trip!

Flight ○ Flight+Hotel ○ Hotel ○ Car

From: ORD

To: PSA

[ ] Compare surrounding airports

[ ] Exact dates ○ +/- 1 to 3 days ○ Flexible dates

Depart: 9/9/2006 ○ Anytime

Return: 9/18/2006 ○ Anytime

Detour
Motivation

- Growing number of overlay-based systems
  - Can’t change IP layer, so change the layers above
  - E.g., end system multicast, anycast, i3.

- Common need for such systems
  - Build a “view” of the underlying network relying on network measurements
Problem

- Independent measurements
  - Redundant
  - Non-scalable
  - Can cause problems
    - E.g., synchronization

- Proposals for common services
  - Knowledge plane
  - A routing underlay for overlays
  - Network weather service
Our Approach

- Reuse the view of the network gathered by long-running services
  - Significantly reduce the amount of measurements
  - Require no new infrastructure to be deployed
- CDNs (e.g., Akamai) improve web performance by
  - Performing extensive network & server measurements
  - Publishing the results through DNS

*Can overlay networks reuse measurements collected by production CDNs?*
CDN-Driven One-Hop Source Routing

Diagram showing the routing process with a source connected to replica 1, replica 2, and replica 3, and a destination. The diagram includes a DNS server and peers.
Roadmap

(or how feasible is all this?)

- How does Akamai work?
- How many web replicas does a client see?
- Impact of different web sites (e.g., Yahoo vs. NY Times)?
- What are the dynamics of DNS redirections?
- What drives redirections - network or server latency?
CDNs Basics

- Web client’s request redirected to ‘close’ by server
  - Client gets web site’s DNS CNAME entry with domain name in CDN network
  - Hierarchy of CDN’s DNS servers direct client to 2 nearby servers

Client requests translation for yahoo

Client gets DNS CNAME entry with domain name in Akamai

Multiple redirections to find nearby edge servers

Client is given 2 nearby web replica servers (fault tolerance)

Internet

Hierarchy of CDN DNS servers

Web replica servers

Customer DNS servers

LDNS

Web client
Measuring Akamai

- 2-months long measurement
- 140 PlanetLab nodes (clients)
  - 50 US and Canada, 35 Europe, 18 Asia, 8 South America, the rest randomly scattered
- Every 20 sec, each client queries an appropriate CNAME for
  - Yahoo, CNN, Fox News, NY Times, etc.
(or *how feasible is all this?*)

- How does Akamai work?
- **How many web replicas does a client see?**
- Impact of different web sites (e.g., Yahoo vs. NY Times)?
- What are the dynamics of DNS redirections?
- What drives redirections - network or server latency?
Server Diversity

Client 1
- Closer to Akamai network

Client 2
- Further away from Akamai network

Day

Night

Web replica IDs

Timestamp

DNS mapping

06/1/05 16:16

Drafting Behind Akamai
Multiple Akamai Web Sites

Different Akamai customers (web sites) get “different” networks

By choosing different Akamai customers, clients can always get different detouring paths

Yahoo and NYTimes are not hosted in U. Oregon

Amazon is not hosted on UMass and LBNL
Redirection Dynamics

Do redirection dynamics small enough for network control?

Redirection dynamics are sufficiently small for network control.
Roadmap

(or how feasible is all this?)

- How does Akamai work?
- How many web replicas does a client see?
- Impact of different web sites (e.g., Yahoo vs. NY Times)?
- What are the dynamics of DNS redirections?
- **What drives redirections - network or server latency?**
Redirections Reveal Network Conditions

More than 97% are better than average

More than 70% are among best 10% paths

Redirections are highly correlated to network conditions
Akamai-Driven One-Hop Source Routing

Redirections driven by network conditions

Potential for CDN-to-overlay mapping

Redirection dynamics sufficiently small for network control
Methodology

Estimate end-to-end latency (rtt) by adding rtt of 2 path segments

Akamai Low-Level DNS Server

Source

10 Akamai paths

List of Akamai servers

Direct Path

Destination
Akamai-Driven Source Routing

One example

- CDN-driven detouring (average of 2 one-hop path via 2 edge-servers)
- Potential gain
- 50% of Akamai one-hop paths outperform direct paths, with potential gain up to 150 ms
- Low overhead path pruning algorithm for the rest paths

CDF vs. Delay (ms)
Conclusions

- Akamai CDN gathers a fairly accurate view of the network
- This view can be reused by overlay networks
  - Significantly reducing the amount of measurements
  - Requiring no new infrastructure to be deployed

Let’s draft behind Akamai!

“One more thing…..”
Ono – CDN-based Detouring in BitTorrent

- An Azureus/BitTorrent plugin for you
- Locates quality Internet paths using low-cost DNS queries
- Enables Azureus clients to detour traffic through peers located along lower-latency (& potentially higher throughput) paths.

http://www.aqualab.cs.northwestern.edu/projects/Ono.html
Backup Slides
Server Diversity for Yahoo

Majority of PL nodes see between 10 and 50 Akamai edge-servers

Nodes far away from Akamai hot-spots

Good overlay-to-CDN mapping candidates
Do redirections reveal network conditions?

- Rank = r1+r2-1
  - 16 means perfect correlation
  - 0 means poor correlation

MIT and Amsterdam are excellent

Brazil is poor

Percentage of time Akamai's selection is better or equal to rank
Drafting Behind Akamai

Akamai-Driven Source Routing

Experiment: US (6), Europe (3), S. America (2), Asia (3)

Direct paths better than Akamai paths

Akamai and direct paths have similar performance

25% of Akamai paths better than direct paths
Path Pruning Result

- Direct path accounts for 78% of the gain
- BTAS better than FAS
- 2 hours update frequency before the performance declines