WebCloud:
Enabling more direct content exchange between web clients

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Motivation

Previously (pre-2005), web content -- in the form of web pages, images, audio, and video --- was primarily created by a small minority of Media and corporations, and was delivered to a large audience of web users.

Thus, network workload was

- From the "center" (media)
- To the "edge" (users)

Recent trends such as the rise in popularity of online social networking; the ease of content creation using digital devices like smart phones, cameras, and camcorders; and the ubiquity of Internet access have democratized content creation.

Today, Internet users are creating content that makes up a significant fraction of Internet traffic.

How is new content being delivered?

Traditional "centralized" architectures
- Akamai, Limelight
- Facebook serves most of its own content

Akamai

Mismatch between infrastructure and workload

Workload is naturally decentralized
- Every Facebook upload goes via CA
- Works today with photos, but videos?

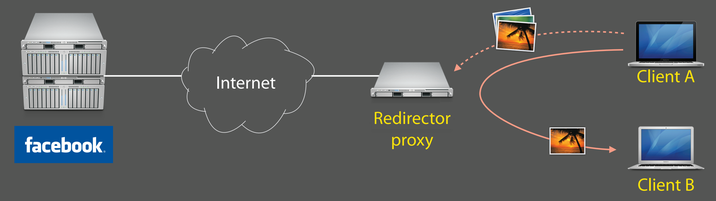
Limelight NETWORKS

facebook

Can we move towards more *decentralized* web distribution architectures?

Design

We propose WebCloud, a content distribution system designed to support the workloads present in existing online social networking websites.



Key insight: leverage the local storage and bandwidth resources of the users themselves to help serve content to other users. (i.e., p2p content distribution for the web)

Saves bandwidth: due to the geographic locality that often exists between friends in online social networks, content exchanges often stays in the ISP

Scalable: each additional user provides additional resources

Implementation

Goal: make it work with today's sites, browsers

Idea: Introduce a middlebox to allow browsers to communicate

To build WebCloud, we need two components:

Client-side changes

Need to turn web browser into server
- Implement WebCloud in JavaScript
- Add it to the site's pages

Use LocalStorage to store content :
- Persistent cache, up to 5MB/site
- Easily programmatically accessed
- Treated like LRU cache

Use WebSockets/XHR to communicate :
- Allow bidirectional communication
- Online client always connected to middlebox

Middlebox

Add redirector proxies in each ISP:
- Like Akamai, but stores no content
- Maintains open connection to clients

Clients connect to proxy:
- Inform of locally stored content

Client request content from proxy:
- Proxy checks other local clients
- If Found:
  - fetches content from other client
- Otherwise:
  - fetches content from original site

Evaluation

Implemented WebCloud to serve Facebook photos

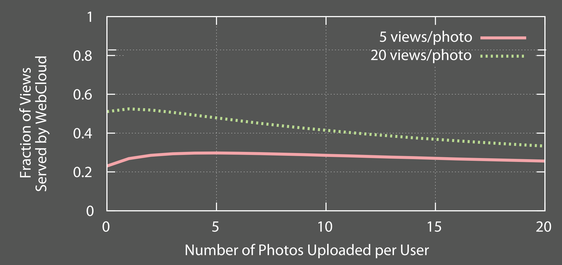
Is there additional latency?

Accessed from	Served from		
	Facebook	LAN	Cable modem
LAN	668 ms	63 ms	398 ms
Cable modem	690 ms	153 ms	532 ms

No, in fact, always faster than getting from Facebook

All simulations ran in Boston, like deployment

What WebCloud hit rate can we expect?



Simulate using crawled Facebook data
- New Orleans Network, 65K users, 1.8M Links
- 1.1M comments on 816K photos

Simulated 1 week deployment
- Between 23% and 58% hit rate

Does it work with today's browsers/sites?

Deployed WebCloud within Northeastern College of Computer Science
- 17 users for 10 days

Total of 2,060 photos viewed
- 26% serveed from WebCloud

Works from Firefox, Safari, Chrome
- Average browser could store 56 photos

Mobile Users

Implemented a prototype WebCloud app for iOS
- Tested with 3,513 requests when connected via 3G

iPhone's battery lasted an estimated 23 hours
- Even under the heaviest workload, the most-loaded user uploaded a total of 71.9MB, when the average user uploaded only 2.0MB