facebook

facebook

Ajaxifying, Caching and Pipelining Facebook Website

Changhao Jiang

The Velocity Conference
Dec 7th, 2010, Beijing, China

The beginning - 2004

[theface book]

home search global social net invite faq logout

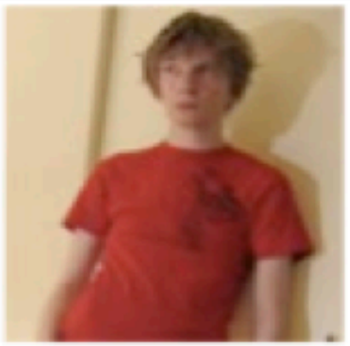
quick search go

My Profile [edit]
My Friends
My Groups
My Parties
My Messages
My Account
My Privacy

Summer Jewish Adventure

Brian Moore's Profile — Puget Sound

Picture



Send Brian a Message
Poke Him!

Connection

You are in a relationship with Brian.

Information

Account Info:

Name:	Brian Moore
Member Since:	May 21, 2005
Last Update:	July 19, 2005

Basic Info:

School:	Puget Sound '09
Status:	Student
Sex:	Male
Residence:	Todd 311
Birthday:	09/02/1986
Home Town:	Shorewood, WI 53211
High School:	Shorewood Hi '05

Contact Info:

Email:	bmoore@ups.edu

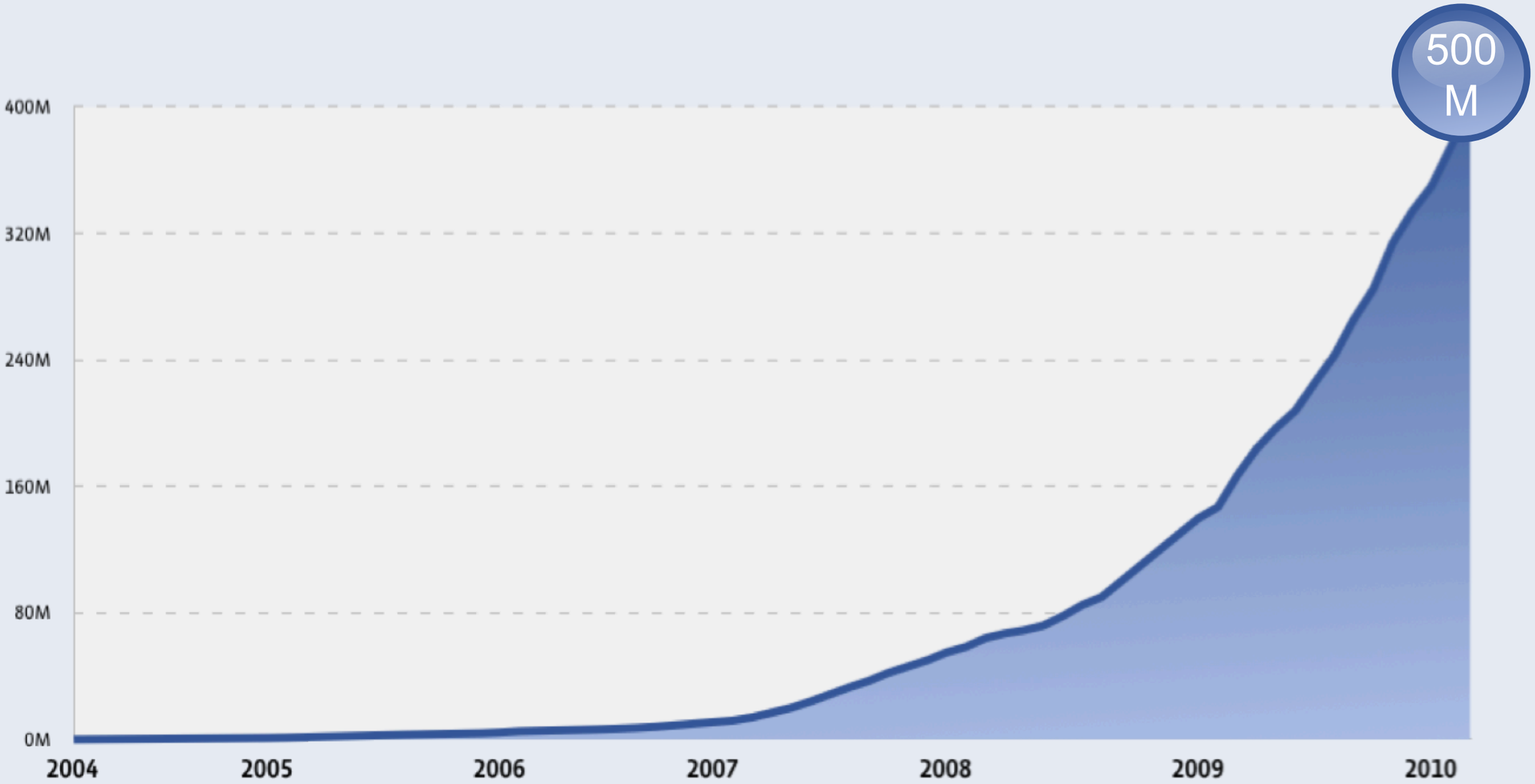
Today


facebook
Search
Home
Profile
Account
Changhao Jiang
Edit My Profile
News Feed
Messages 1
Events 2
Friends 63
国语黑帮 (mandarin s...
Facebook
Happy Parents
Groups Team
非死不可
More
Application Requests 11
Game Requests 11
Photos
More
Friends on Chat
News Feed
Top News · Most Recent
Share: Status Question Photo Link Video
Steven Grimm e
I'm fiddling with the configuration of /data/git/tfb on shared dev servers and /home/engshare/git/tfb today, both to get rid of their connection to my personal account (about bloody time!) and to hopefully make /home/engshare/git/tfb less susceptible to the random corruption issues we've seen in the past.
Follow along on task #266767 if you care about the details. If you are simply a consumer of one of those directories you shouldn't notice any difference. Drop me a note if you see something screwy.
3 hours ago · Like · Comment · Subscribe
Elliot Lynde likes this.
Girish Patangay Thanks for letting us know. I'll give the merge tool a try (which uses the repo in data) later when I get online.
about an hour ago · Like
Write a comment...
Yongyan Liú
Go snowboard! Tried double diamond unintentionally this afternoon...
18 hours ago via iPhone · Like · Comment · Share
Zheng Shao, Peng Luo and 2 others like this.
View all 9 comments
Dong Guo go together next time!
7 hours ago · Like
Yongyan Liú @Abhi, we went to heavenly yesterday. I was trying to went back to California lodge following round-a-bout, a blue one. It takes me too long until it's completely dark. The only way
Events
See All
What are you planning?
Bobby and Ann's Housewarming
Sunday, December 5 at 2:00pm
RSVP: Yes · No · Maybe
"H1B"乐队party与演唱会
Saturday, December 11 at 6:30pm
RSVP: Yes · No · Maybe
Sponsored
Create an Ad
Software Engineer, Tools
Are you passionate about helping those around you be more effective? If so click here.
Facebook is hiring
Questions
See All
Will mirrorless cameras dethrone DSLR?
Asked by Xin Qi
What are your favorite cheap (< $10) restaurants in San Francisco and why?
Asked by Philip Fung
As an admin of a "page", how can I post status updates using my normal Facebook username instead of...
Asked about Facebook
Chat (33)

Mission

Give people the power to share and make the world more open and connected

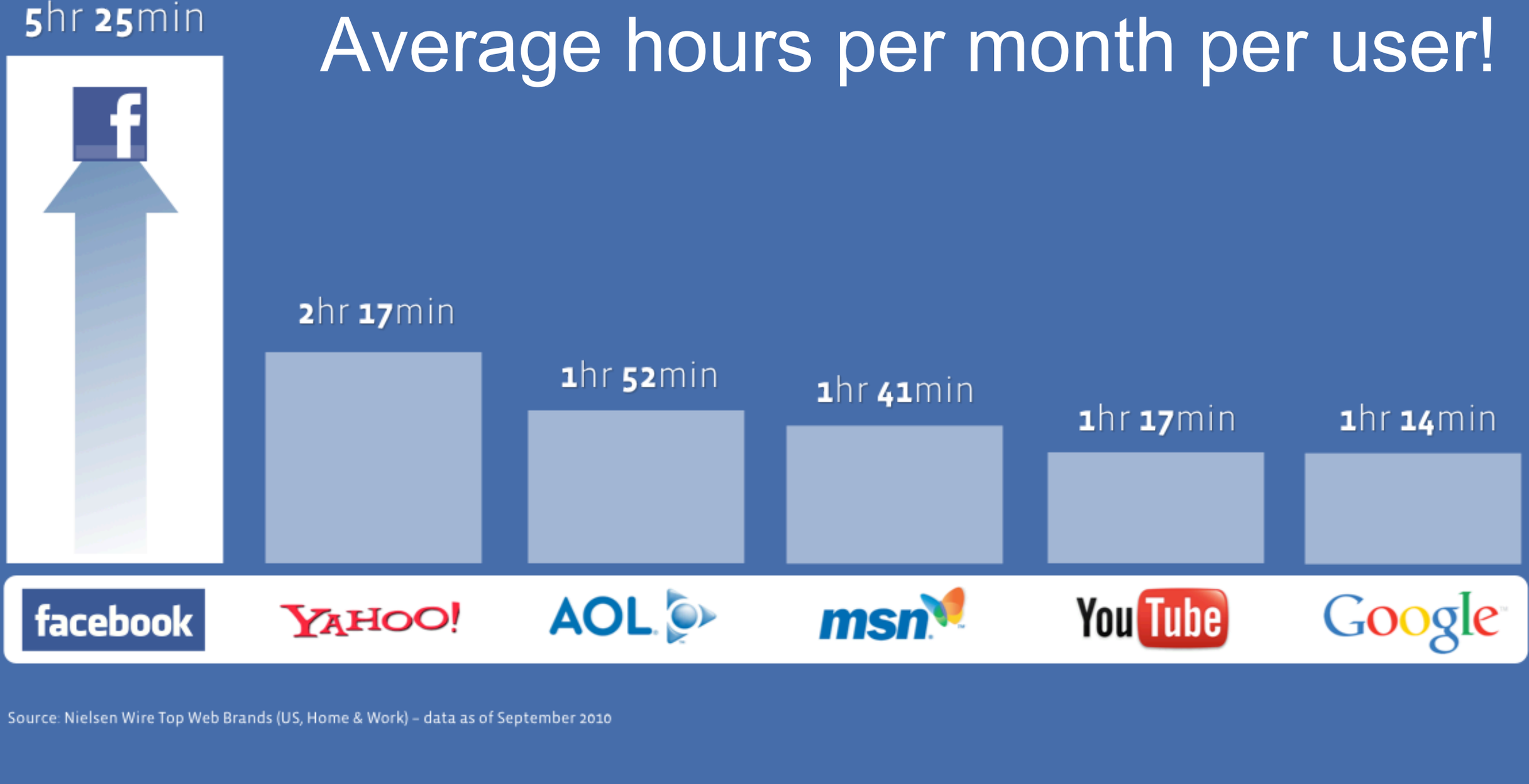
500M Users


500
M
400M
320M
240M
160M
80M
0M
2004
2005
2006
2007
2008
2009
2010

Today’s reality

facebook

Average hours per month per user!

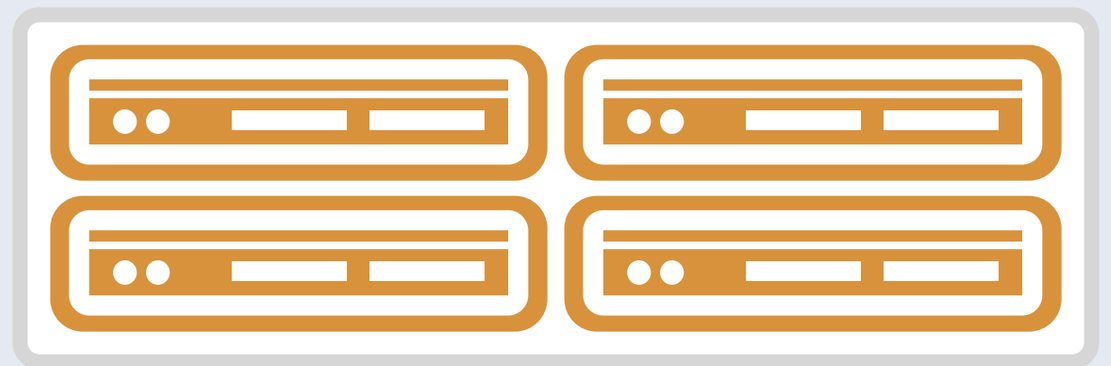


Source: Nielsen Wire Top Web Brands (US, Home & Work) – data as of September 2010

Site speed is critical to Facebook!

What do we measure?

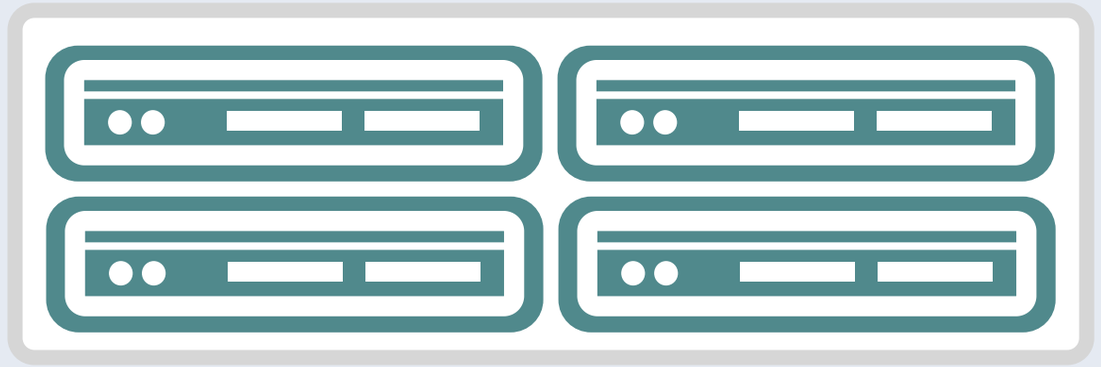
Facebook



CDN

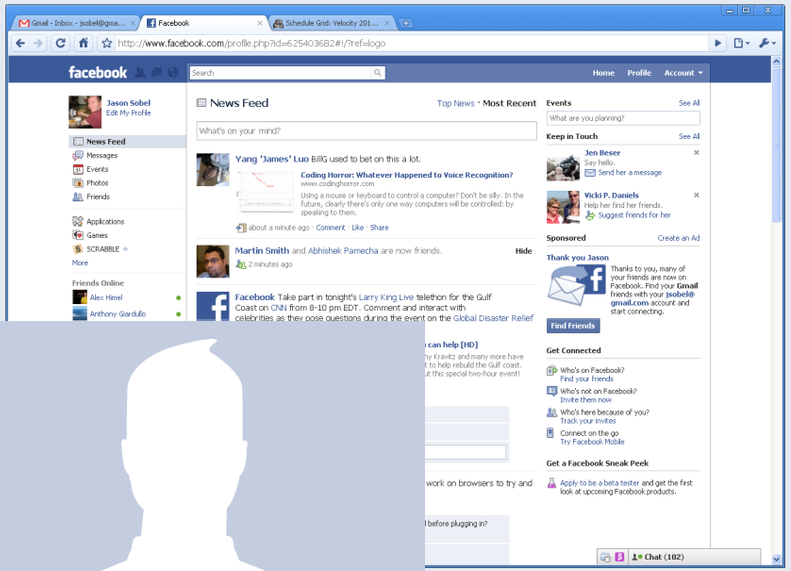
What do we measure?

server time

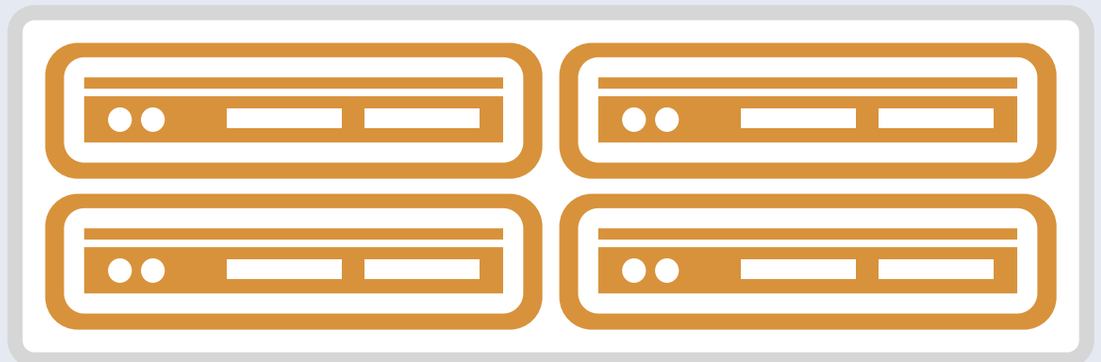


Facebook

client/render time



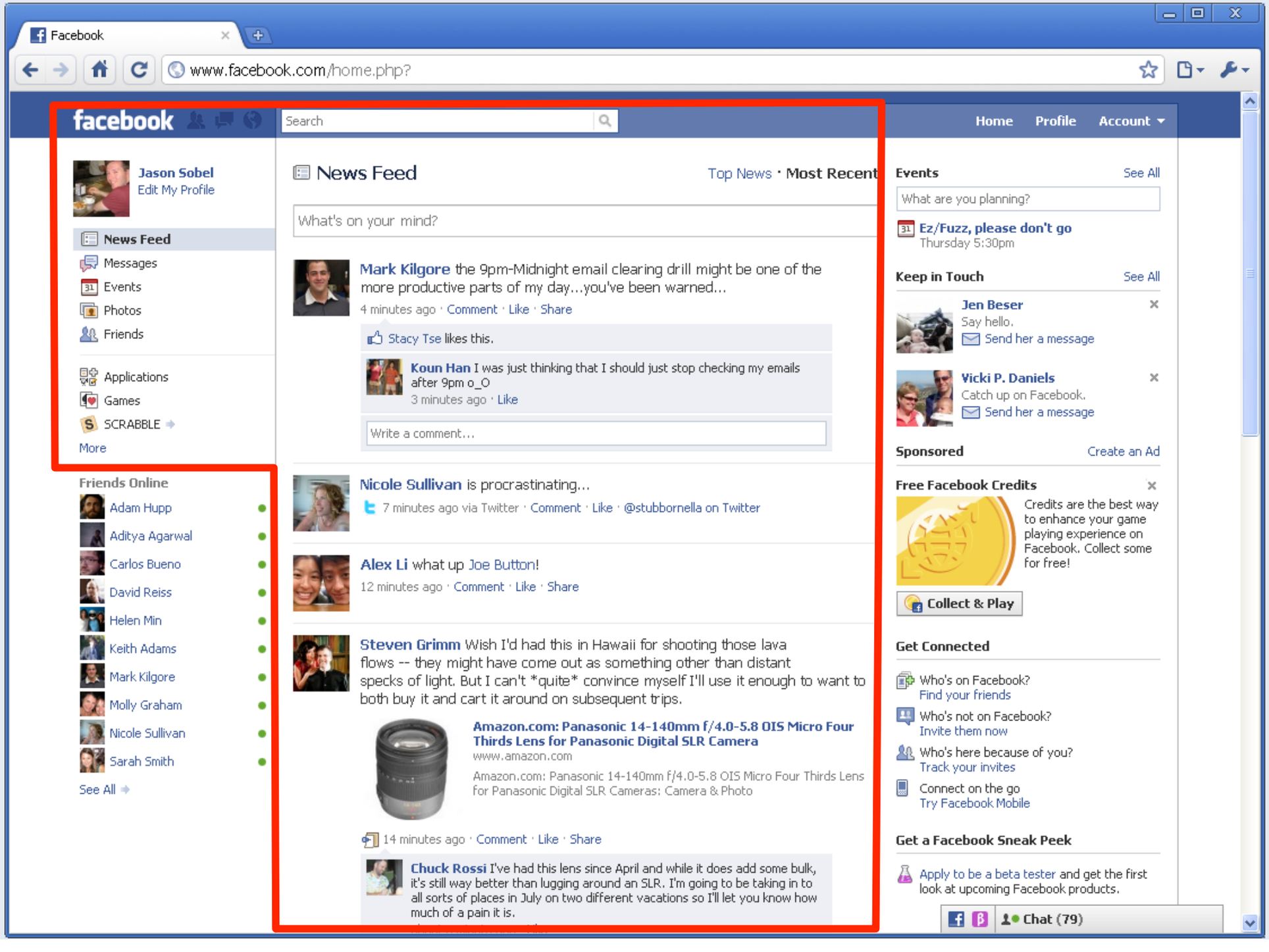
network time



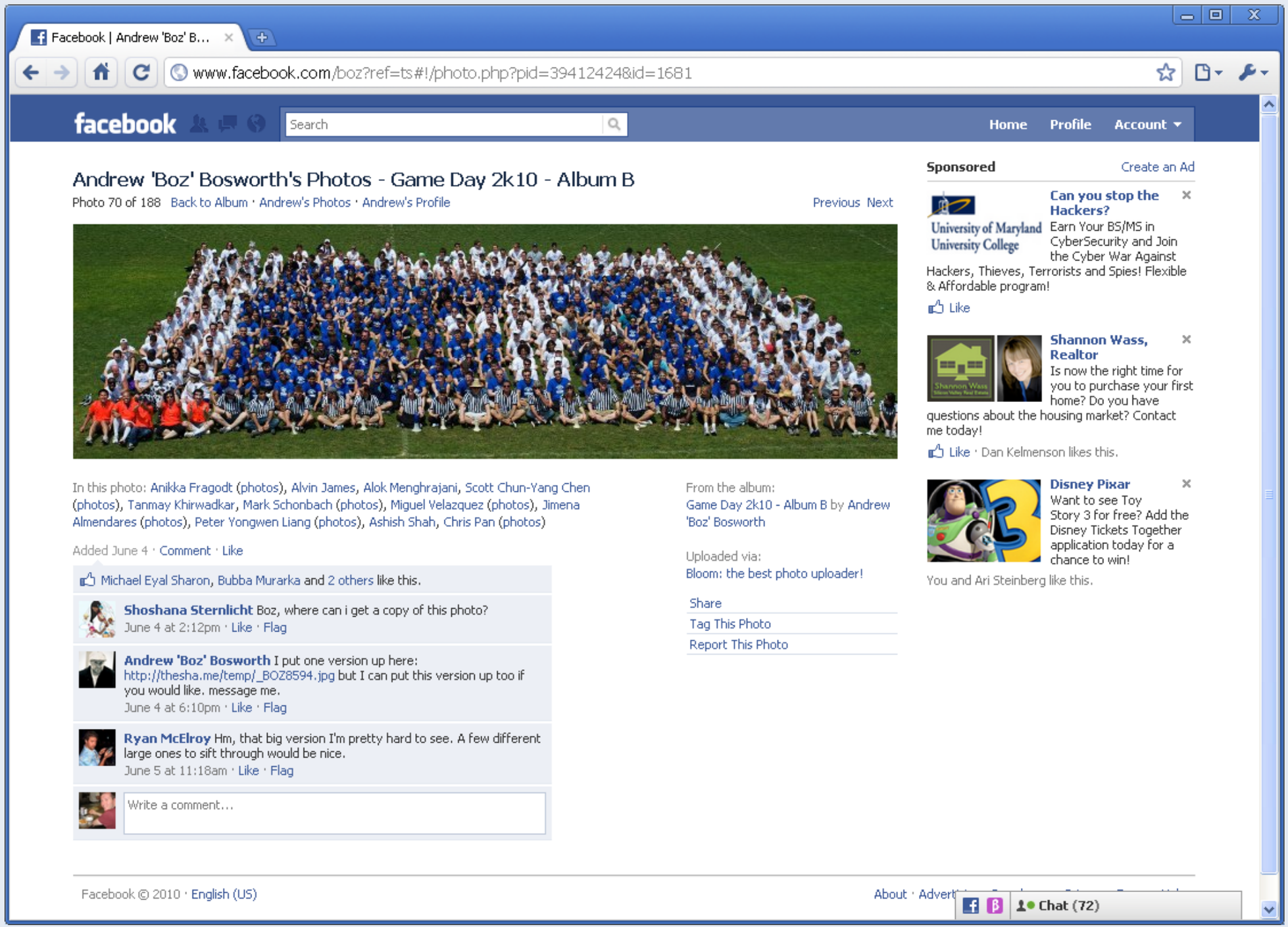
CDN

Time-to-Interact (TTI)

Time-to-Interact (TTI)



Time-to-Interact (TTI)



Three frontend optimizations at Facebook

Quickling transparently ajaxifies the whole web site

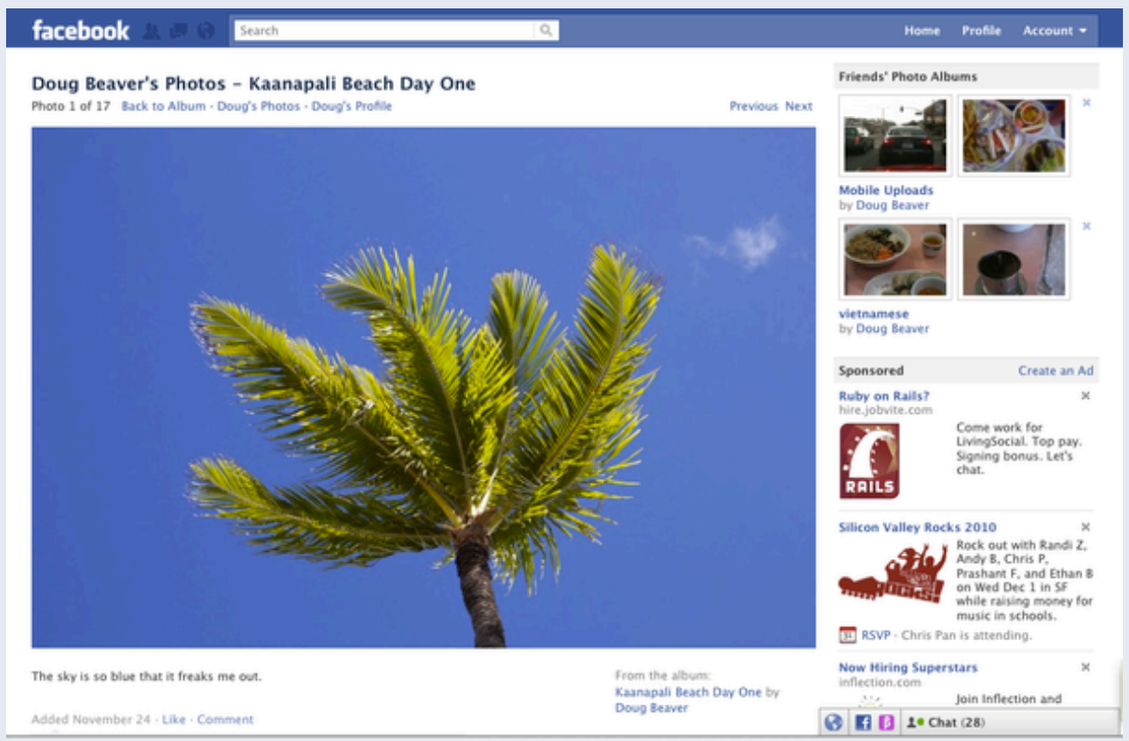
PageCache caches user-visited pages in browser

BigPipe pipelines Facebook website

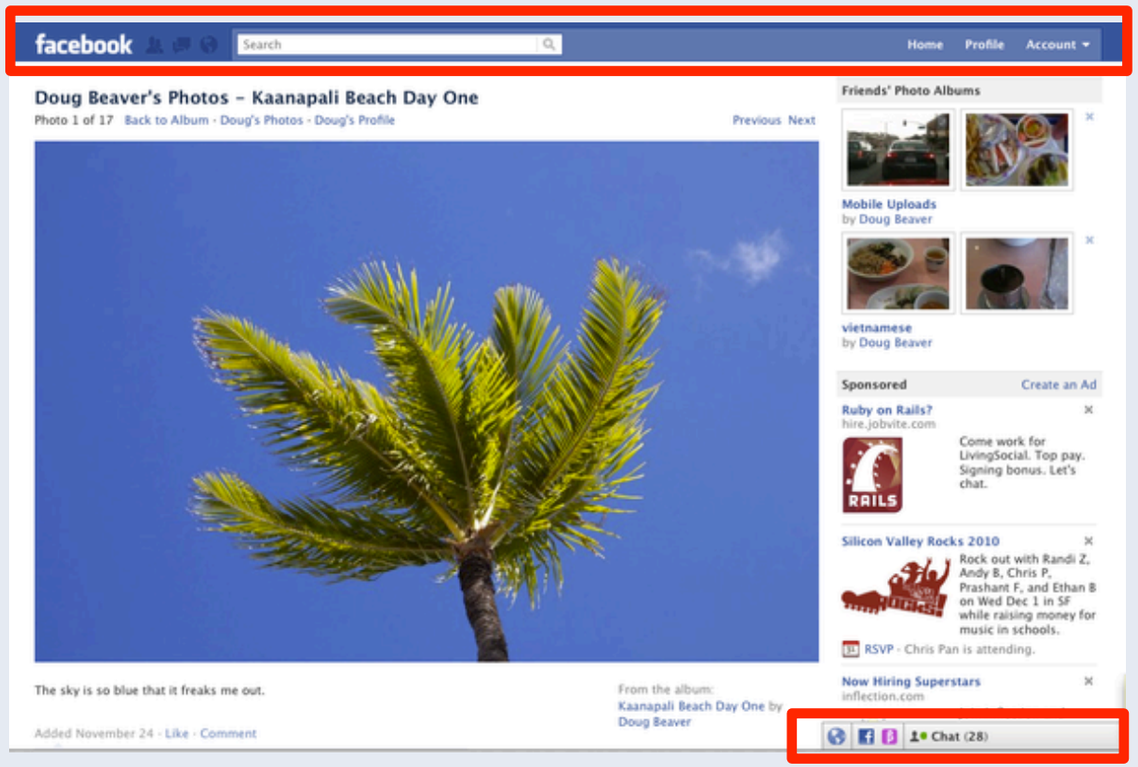
facebook

Quickling: Ajaxify the Facebook site

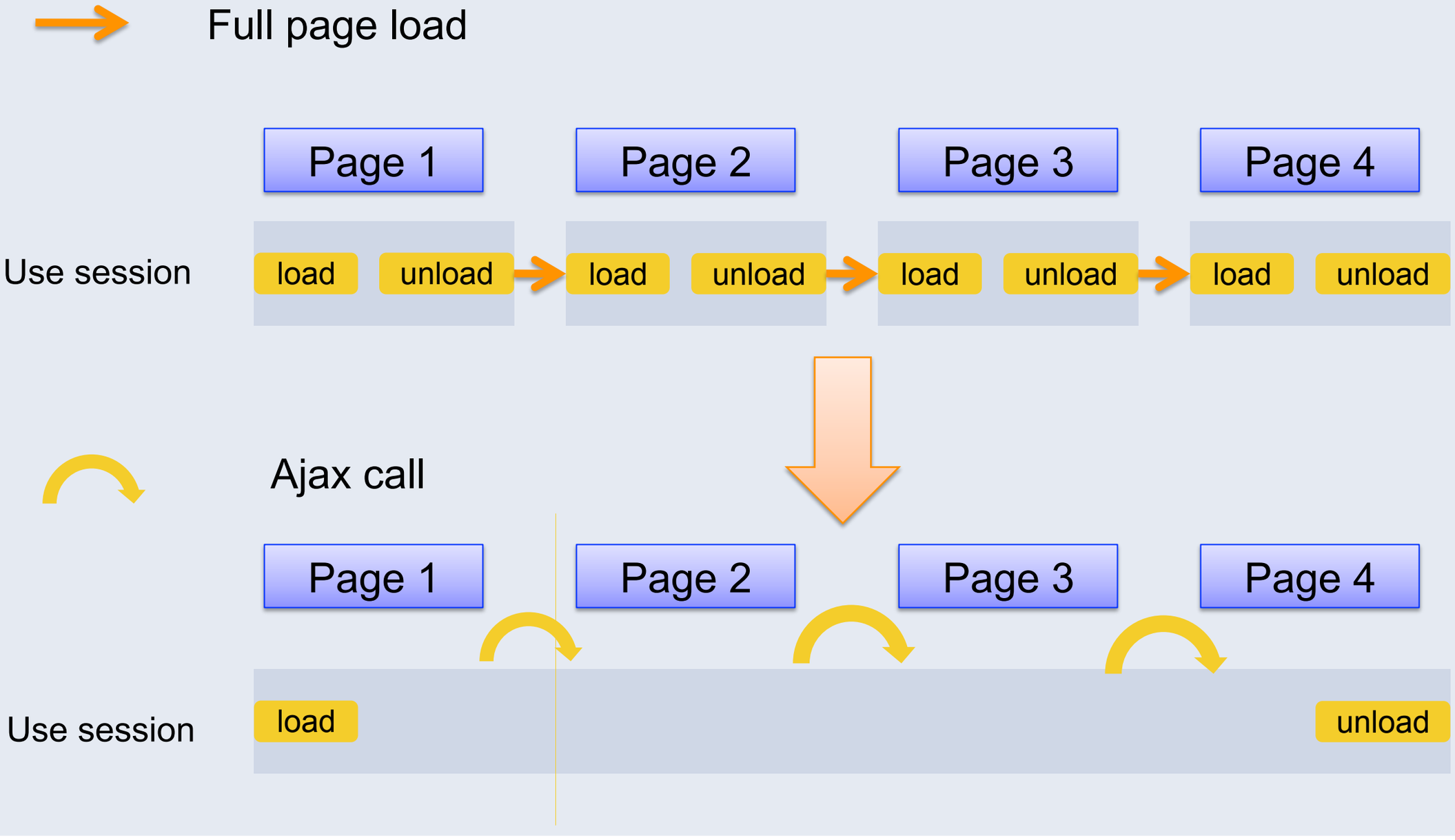
Motivation: remove redundant work



Motivation: remove redundant work



Remove redundant work via Ajax



How Quickling works?

1. User clicks a link or back/forward button

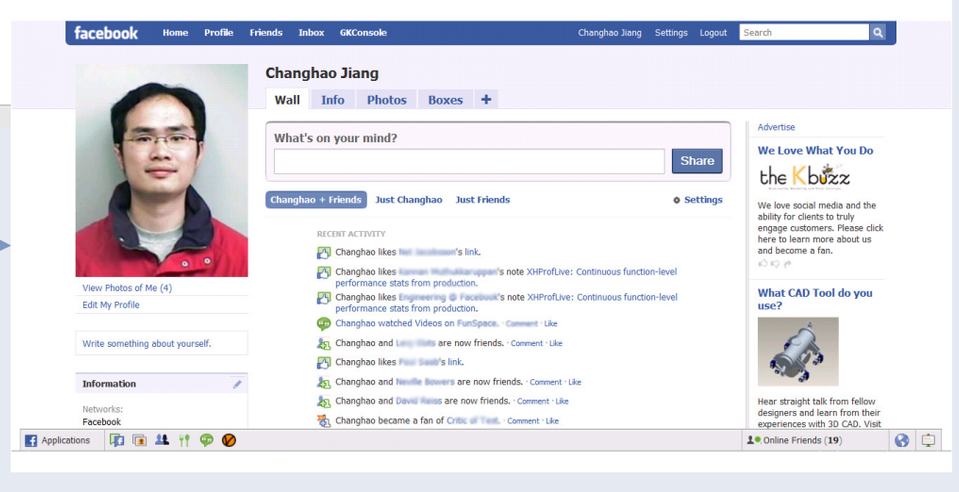
2. Quickling sends an ajax to server

3. Response arrives

4. Quickling blanks the content area

5. Download javascript/CSS

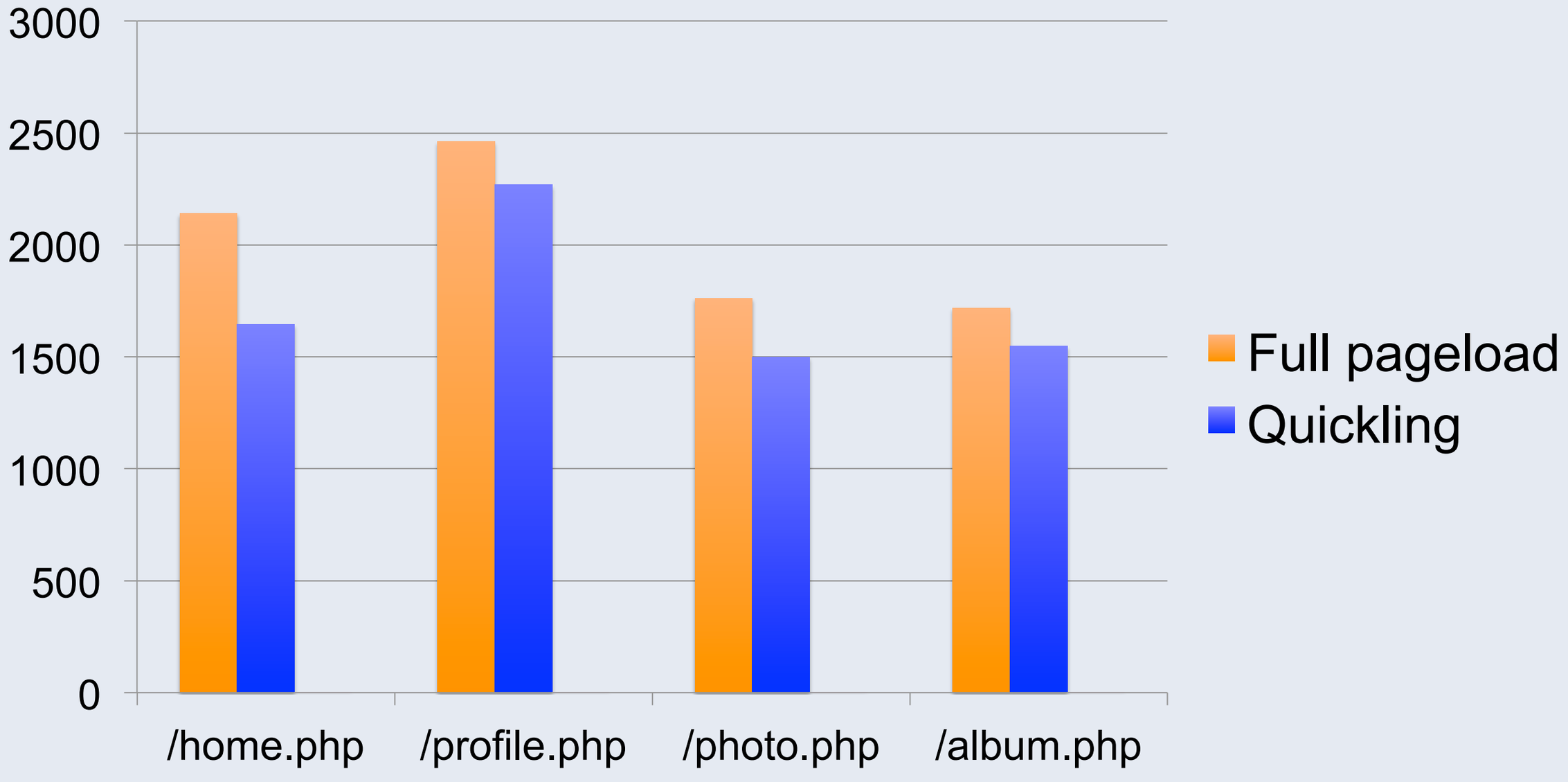
6. Show new content



Implementation details

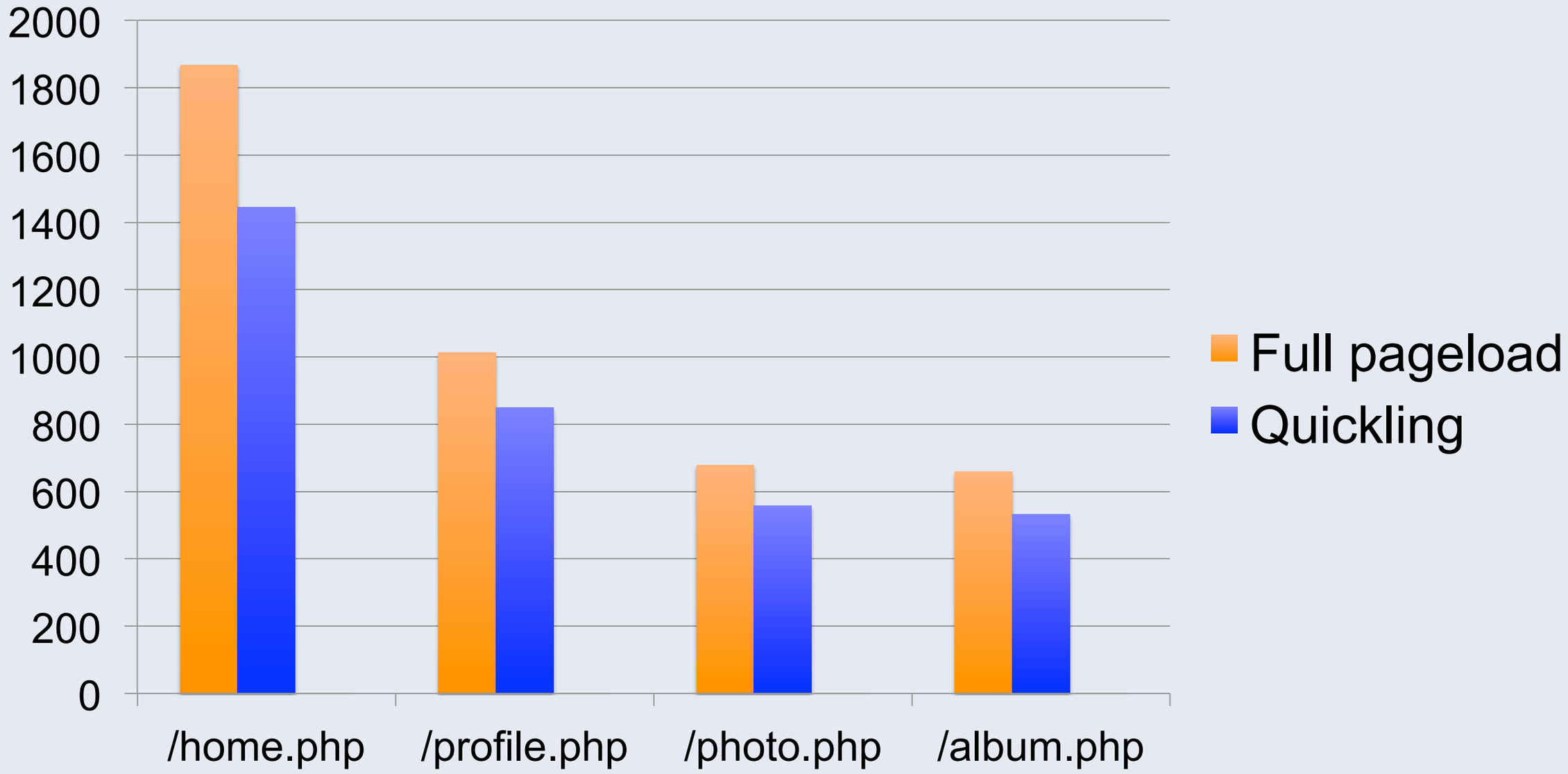
- Link Controller
- HistoryManager
- Bootloader
- Busy Indicator
- CSS Unloading
- Permanent link support
- Resetting timer functions

User perceived latency (TTI) reduction



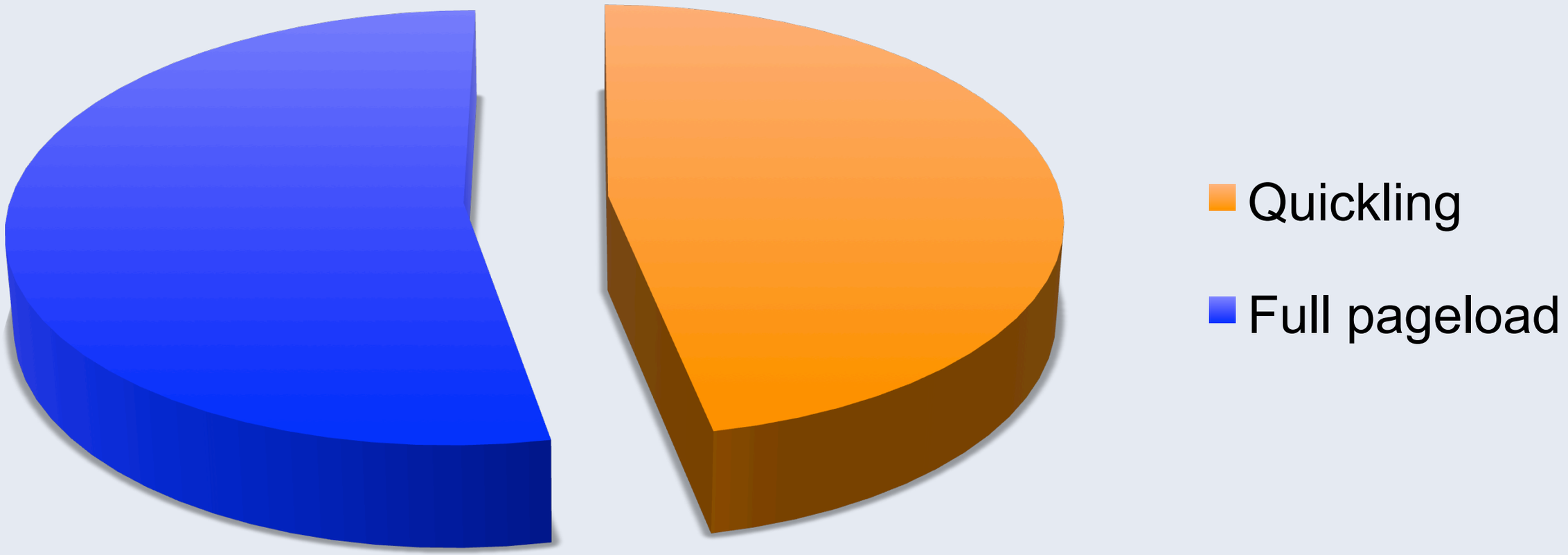
10% ~ 30% reduction in TTI

Server page generation time reduction



Quickling requests are 20% ~ 30% cheaper

45% of page hits are Quickling requests



Quickling conclusion:

- Reduce user perceived latency by more than 10%
- Save 10% of Facebook's data center cost!

facebook

PageCache: Cache visited pages at client side

Motivation – temporal locality

- Some pages are likely to be revisited soon
  - E.g. home page (re)visited every 3 page hits:
  - ***home*** *-> profile -> photo ->* ***home*** *-> notes ->* ***home*** *-> photo -> photo*
- Cache them!

How PageCache works?

1. User clicks a link or back button

2. Quickling sends the ajax to server

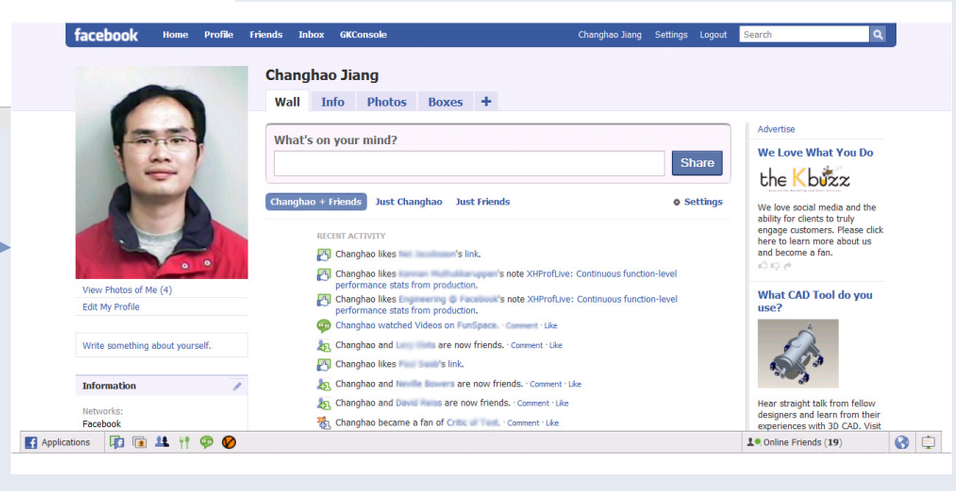
3. Response arrives

3.5 Save response in cache

4. Quickling blanks the content area

5. Download javascript/CSS

6. Show new content



Challenges

- Real time updates
  - Page content needs to be as fresh as possible
- Cache consistency
  - Cached page should be consistent after state-modifying operations

Issue(1): Incremental updates

Cached version

Restored version

Issue(1): Incremental updates

Poll server for incremental updates via AJAX calls

- Provides an ‘onpagecacheRegister’ API to developers:
  - Invoked when a page is restored from cache.
  - Used to send AJAX to server for incremental updates, refresh ads, etc.
  - Blank the content area before incremental updates arrive to avoid flash of stale contents.

Issue(2): In-page writes

Cached version

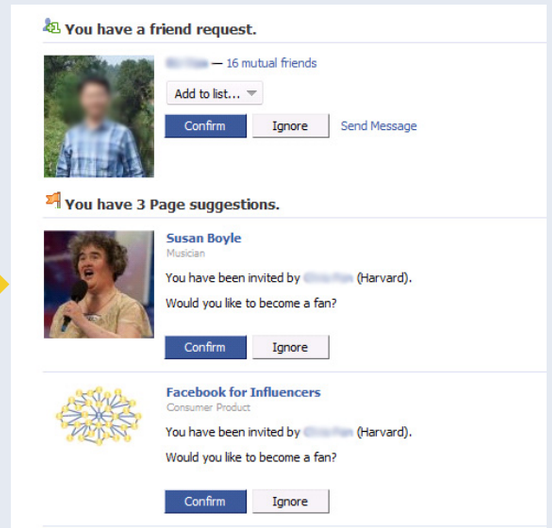
Restored version

Issue(2): In-page writes

Record and replay

- Automatically record all state-changing operations in a cached page
  - All AJAX calls using ‘POST’ method, or those explicitly specified ‘replayable’ will be added to cached content.
- Automatically replay those operations when cached page is restored.
  - Cached AJAX handler callback functions already contain all the contextual information about the recorded operations due to JavaScript closure.

Issue(3): Cross-page writes



Cached version

State-changing op

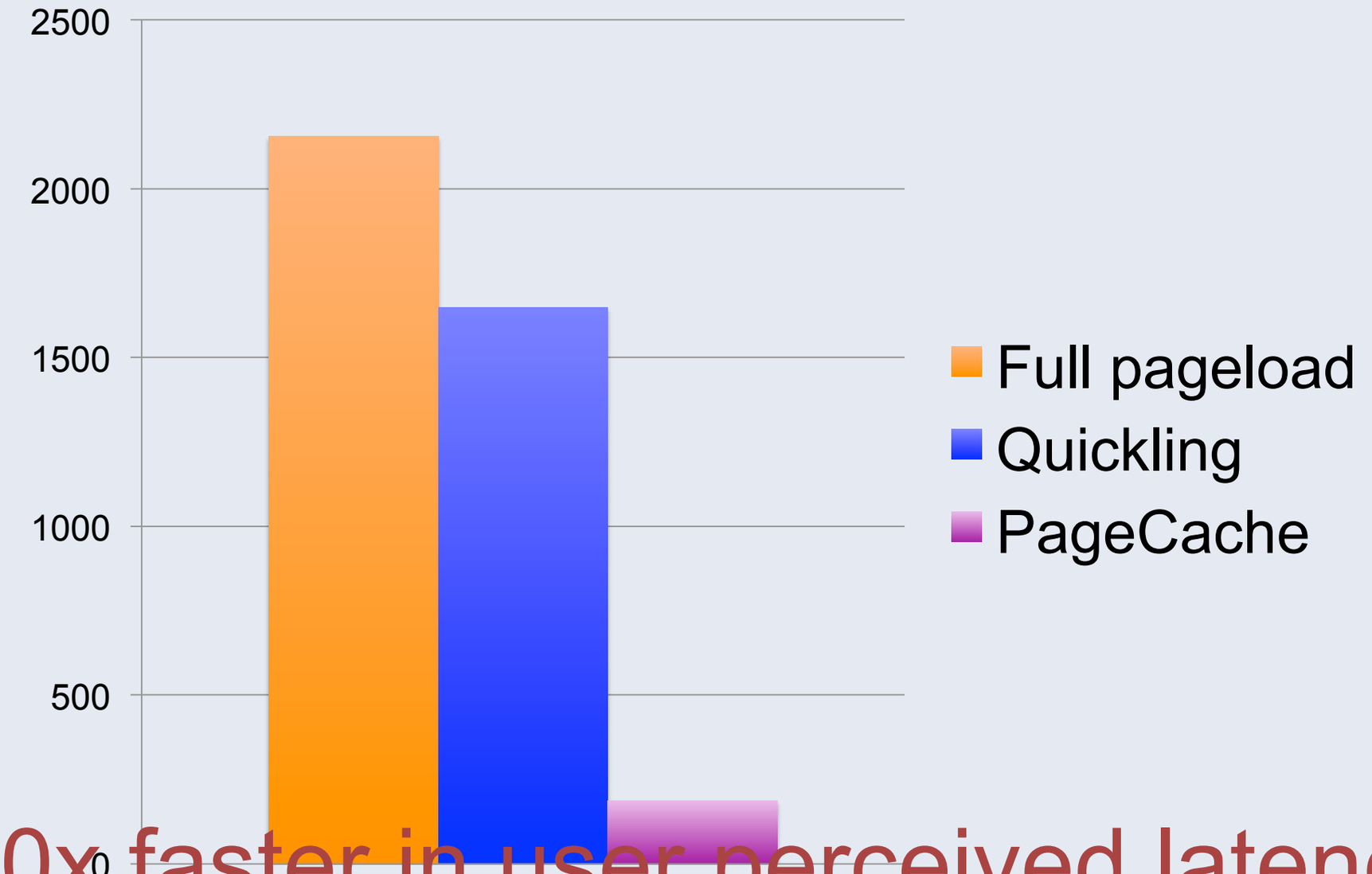
Restored version

Issue(3): Cross-page writes

Server side invalidation

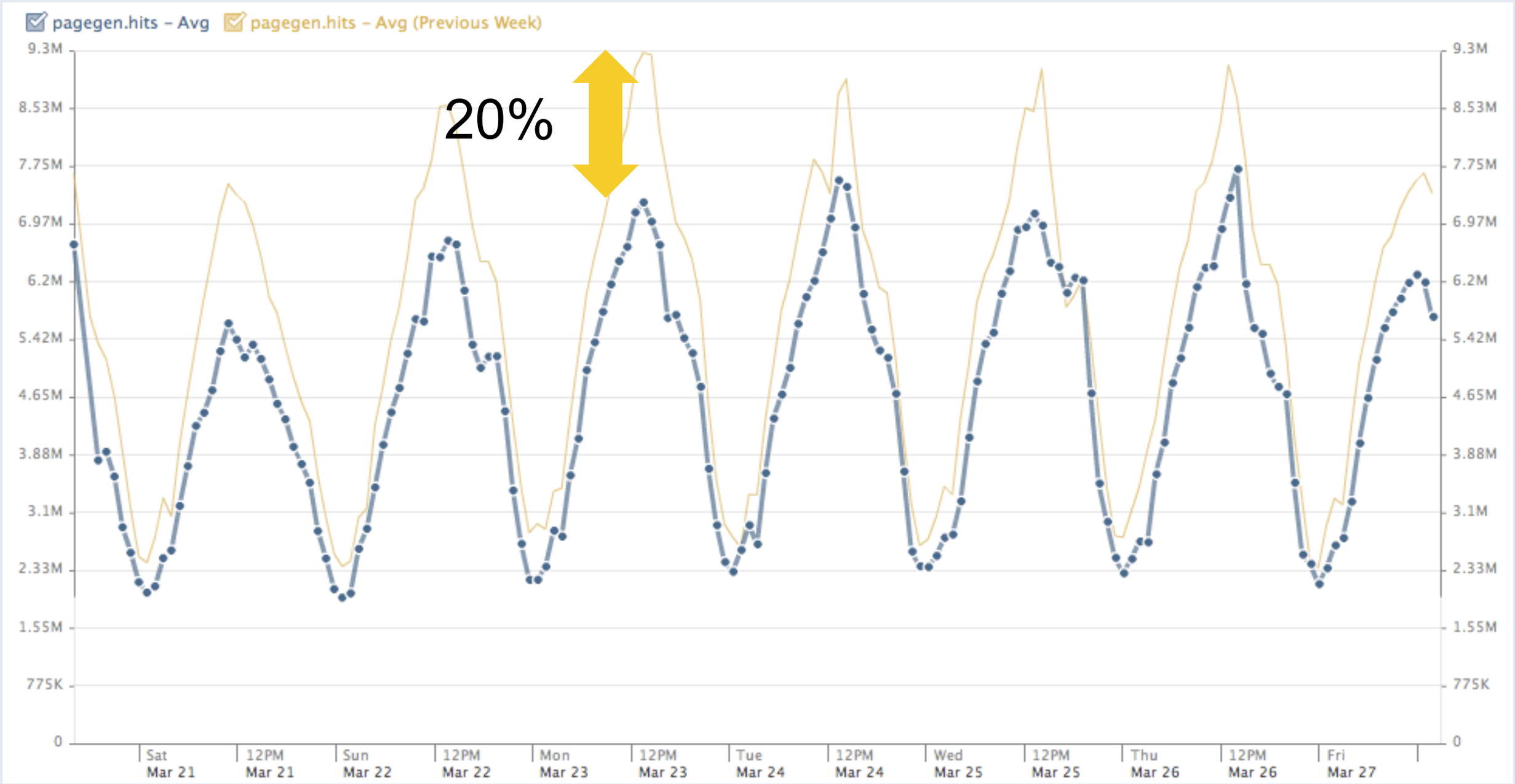
- Instrument server-side database API, whenever a write operation is detected, send a signal to the client to invalidate the cache.
- The signal (a.k.a. cache invalidation message) contain information about what persistent data has changed.
- Upon receiving cache messages, the client side can flush the whole cache or refresh only those affected page components via AJAX.

User perceived latency (TTI) reduction



10x faster in user perceived latency

Server cost reduction



~20% savings on page hits to home page

PageCache conclusion:

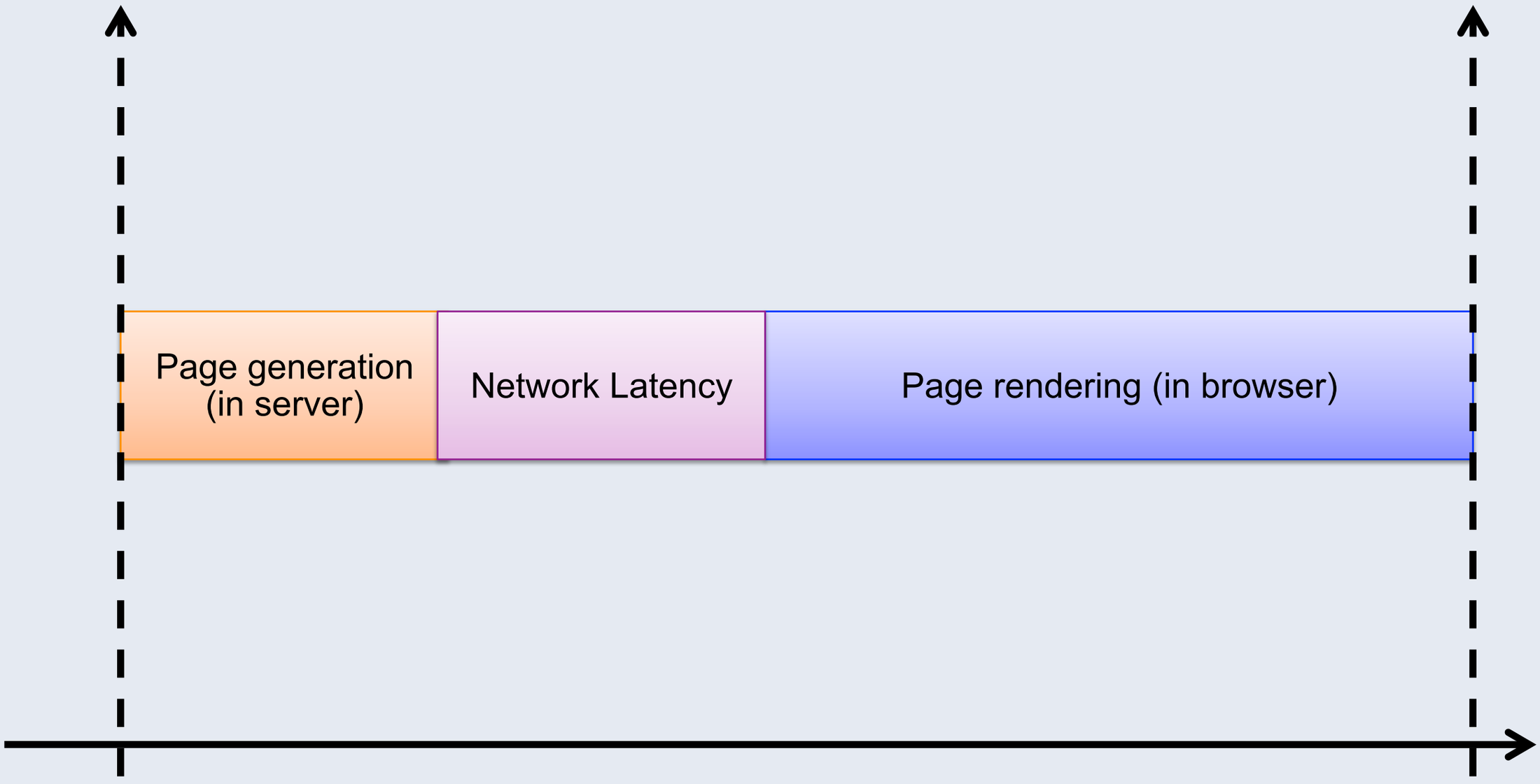
- 10X speedup in user perceived speed!
- Save 2% of Facebook's data center cost!

facebook

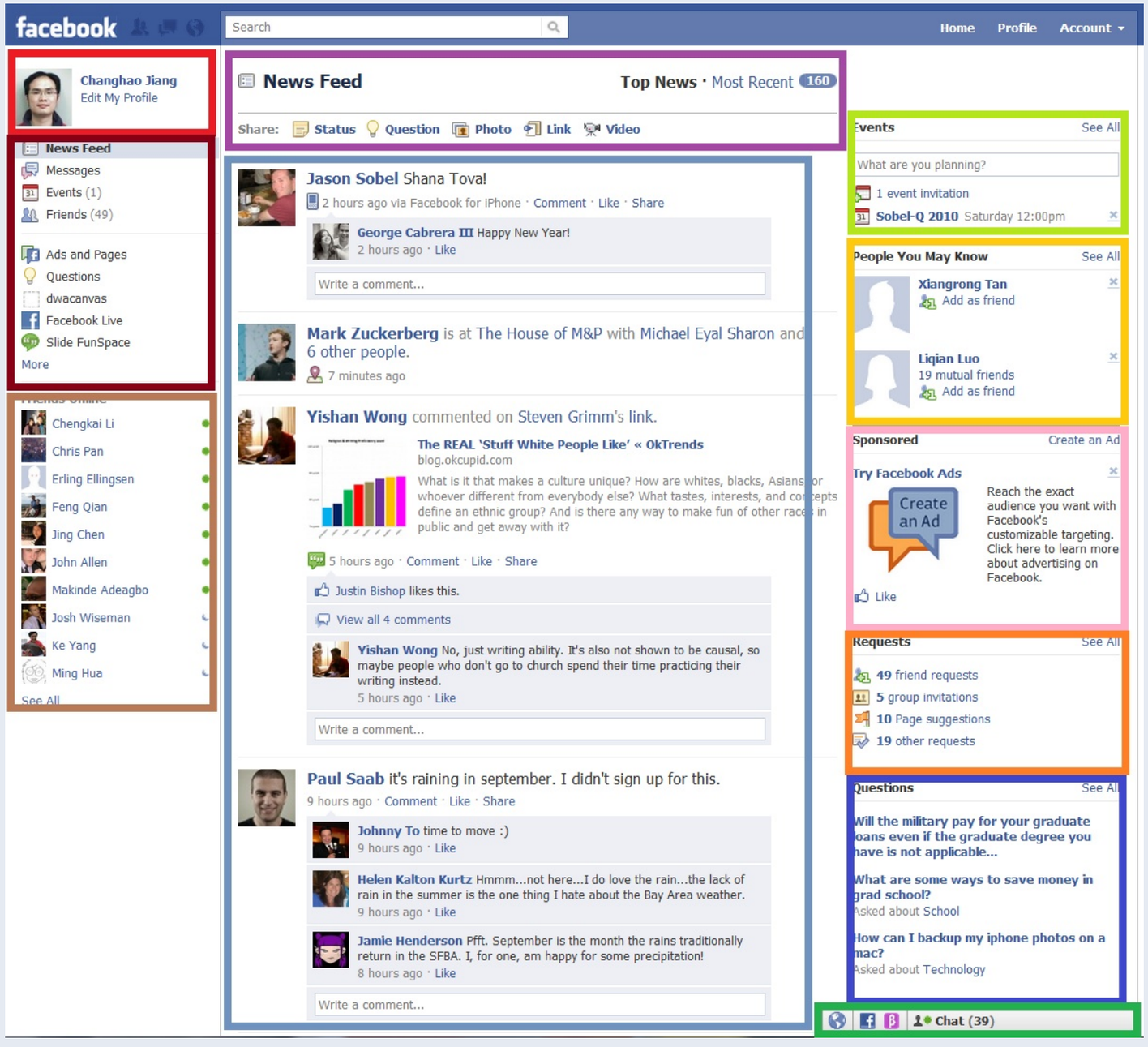
BigPipe: pipeline Facebook website

Facebook page

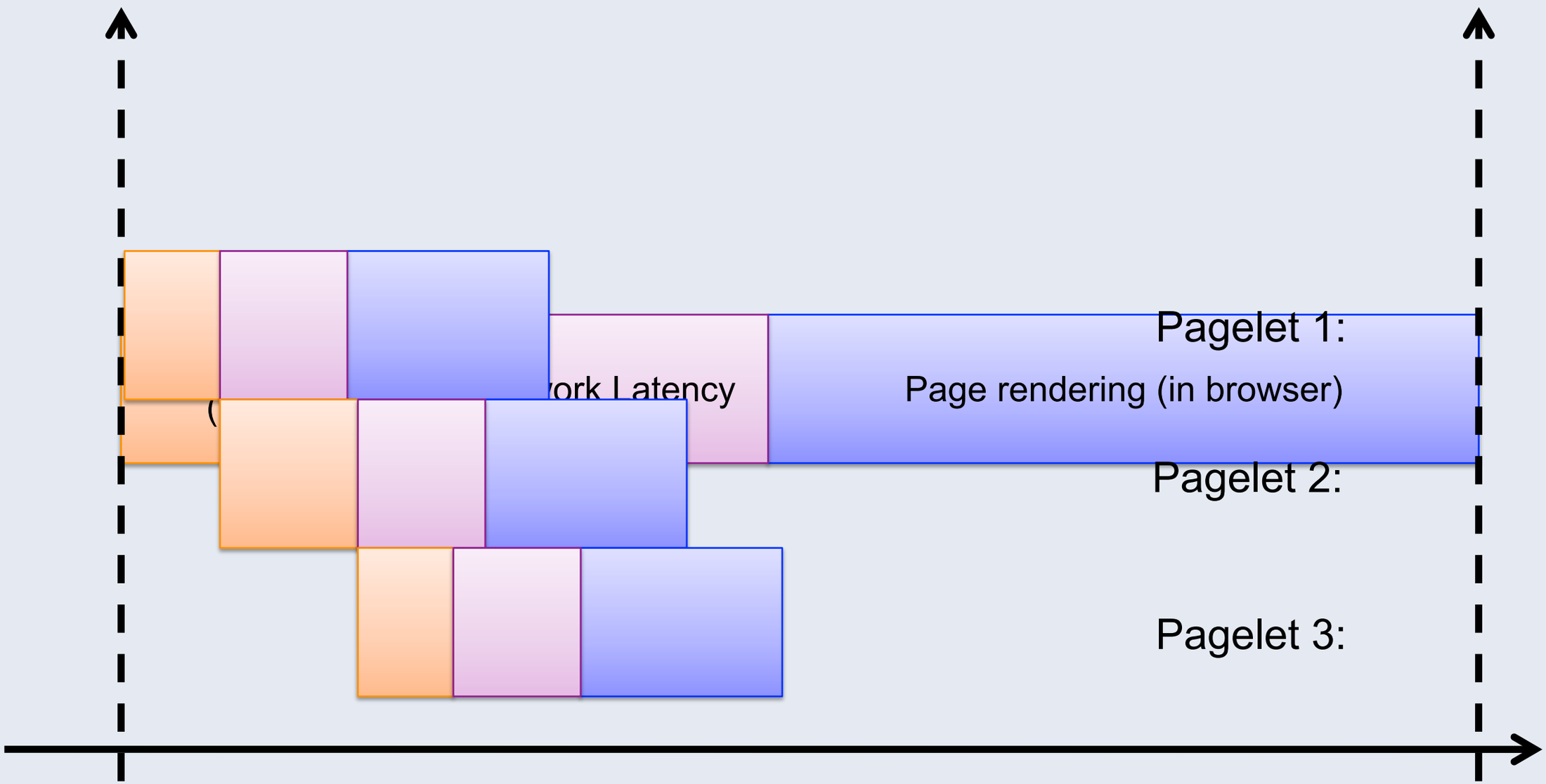
User perceived latency



Pagelets


facebook
Search
Home
Profile
Account
Changhao Jiang
Edit My Profile
News Feed
Messages
Events (1)
Friends (49)
Ads and Pages
Questions
dwacanvas
Facebook Live
Slide FunSpace
More
Chengkai Li
Chris Pan
Erling Ellingsen
Feng Qian
Jing Chen
John Allen
Makinde Adeagbo
Josh Wiseman
Ke Yang
Ming Hua
See All
News Feed
Top News · Most Recent 160
Share: Status Question Photo Link Video
Jason Sobel Shana Tova!
2 hours ago via Facebook for iPhone · Comment · Like · Share
George Cabrera III Happy New Year!
2 hours ago · Like
Write a comment...
Mark Zuckerberg is at The House of M&P with Michael Eyal Sharon and 6 other people.
7 minutes ago
Yishan Wong commented on Steven Grimm's link.
The REAL 'Stuff White People Like' « OkTrends
blog.okcupid.com
What is it that makes a culture unique? How are whites, blacks, Asians or whoever different from everybody else? What tastes, interests, and concepts define an ethnic group? And is there any way to make fun of other races in public and get away with it?
5 hours ago · Comment · Like · Share
Justin Bishop likes this.
View all 4 comments
Yishan Wong No, just writing ability. It's also not shown to be causal, so maybe people who don't go to church spend their time practicing their writing instead.
5 hours ago · Like
Write a comment...
Paul Saab it's raining in september. I didn't sign up for this.
9 hours ago · Comment · Like · Share
Johnny To time to move :)
9 hours ago · Like
Helen Kalton Kurtz Hmmm...not here...I do love the rain...the lack of rain in the summer is the one thing I hate about the Bay Area weather.
9 hours ago · Like
Jamie Henderson Pfft. September is the month the rains traditionally return in the SFBA. I, for one, am happy for some precipitation!
8 hours ago · Like
Write a comment...
Events
See All
What are you planning?
1 event invitation
Sobel-Q 2010 Saturday 12:00pm
People You May Know
See All
Xiangrong Tan
Add as friend
Liqian Luo
19 mutual friends
Add as friend
Sponsored
Create an Ad
Try Facebook Ads
Create an Ad
Reach the exact audience you want with Facebook's customizable targeting. Click here to learn more about advertising on Facebook.
Like
Requests
See All
49 friend requests
5 group invitations
10 Page suggestions
19 other requests
Questions
See All
Will the military pay for your graduate loans even if the graduate degree you have is not applicable...
What are some ways to save money in grad school?
Asked about School
How can I backup my iphone photos on a mac?
Asked about Technology
Chat (39)

User perceived latency



Facebook

file:///C:/Documents%20and%20Settings/jsobel/Desktop/Home_UEX_Test/Home_UEX_Test/home_0_700_b.html

Search

Home Profile Account

Facebook

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Search

Home Profile Account

News Feed

Top News · **Most Recent**

Facebook

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News Feed

Top News · Most Recent

What's on your mind?

Facebook

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Search

Home Profile Account

News Feed

Messages

Events

Photos

Friends (2)

Applications

Games

More

News Feed

Top News · Most Recent

What's on your mind?

Facebook © 2010 English (US)

About Advertising Developers Careers Terms • Find Friends Privacy Mobile Help Center

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Home Profile Account

- News Feed
- Messages
- Events
- Photos
- Friends (2)

- Applications
- Games

More

News Feed

Top News · **Most Recent**

What's on your mind?

Ming Hua Food demonstration~~Venison Salad by Chef Graham Brown

5 minutes ago · Comment · Like · Share

Facebook Culinary Team Today's Snack @ Ten Fiddy: Nacho Bar

8 minutes ago · Comment · Like

Ashley Watkins likes this.

Write a comment...

Ning Zhang any suggested kid-friendly events?

31

kids party

Saturday at 10:00am

TBD

31 minutes ago · Comment · Like · Share · RSVP to this event

Robin Zhang **Yongyan Liu:** happy birthday!

45 minutes ago · Comment · Like · See Wall-to-Wall

Wenrui Zhao **Yongyan Liu:** Happy birthday!

49 minutes ago · Comment · Like · See Wall-to-Wall

Facebook

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Search

Home Profile Account

Robin Zhang
Edit My Profile

- **News Feed**
- Messages
- Events
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- Friends (2)

Applications
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News Feed

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Events See All

What are you planning?

Mervin Zhou's birthday Today
Yongyan Liu's birthday Today

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Yongyan Liu's birthday Today

Sponsored Create an Ad

Connect With More Friends

Thanks to you, many of your friends are now on Facebook. Find your **Windows Live Hotmail** friends with your [redacted] account and start connecting.

Windows Live Hotmail Password

Find Friends

Requests See All

2 friend requests
1 mafia wars request
1 测你的心理年 request
3 other requests

Facebook

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3 other requests

Get Connected

Who's on Facebook?
Find your friends

Who's not on Facebook?
Invite them now

Who's here because of you?
Track your invites

Connect on the go
Try Facebook Mobile

Facebook

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Events

See All

What are you planning?

Mervin Zhou's birthday Today
Yongyan Liu's birthday Today

Sponsored

Create an Ad

Connect With More Friends

Thanks to you, many of your friends are now on Facebook. Find your **Windows Live Hotmail** friends with your [redacted] account and start connecting.

Windows Live Hotmail Password

Find Friends

Requests

See All

2 friend requests
1 mafia wars request
1 测你的心理年 request
3 other requests

Get Connected

Who's on Facebook?
Find your friends

Who's not on Facebook?
Invite them now

Who's here because of you?
Track your invites

Connect on the go
Try Facebook Mobile

Facebook

file:///C:/Documents%20and%20Settings/jsobel/Desktop/Home_UEX_Test/Home_UEX_Test/home_0_700_b.html

Search

Home Profile Account

Robin Zhang
Edit My Profile

- **News Feed**
- Messages
- Events
- Photos
- Friends (2)

Applications
Games
More

Friends Online


Adam Hupp


Ari Steinberg


Jing Chen


Jonathan Liu


Li Zhang


Peter X. Deng


Tom Occhino


Tom Whitnah


Yongyan Liu


Yun-Fang Juan

See All

News Feed

Top News · **Most Recent**

What's on your mind?

Ming Hua Food demonstration~~Venison Salad by Chef Graham Brown

5 minutes ago · Comment · Like · Share

Facebook Culinary Team Today's Snack @ Ten Fiddy: Nacho Bar
8 minutes ago · Comment · Like

Ashley Watkins likes this.

Write a comment...

Ning Zhang any suggested kid-friendly events?

31

kids party
Saturday at 10:00am
TBD

31 minutes ago · Comment · Like · Share · RSVP to this event

Robin Zhang **Yongyan Liu:** happy birthday!
45 minutes ago · Comment · Like · See Wall-to-Wall

Wenrui Zhao **Yongyan Liu:** Happy birthday!
49 minutes ago · Comment · Like · See Wall-to-Wall

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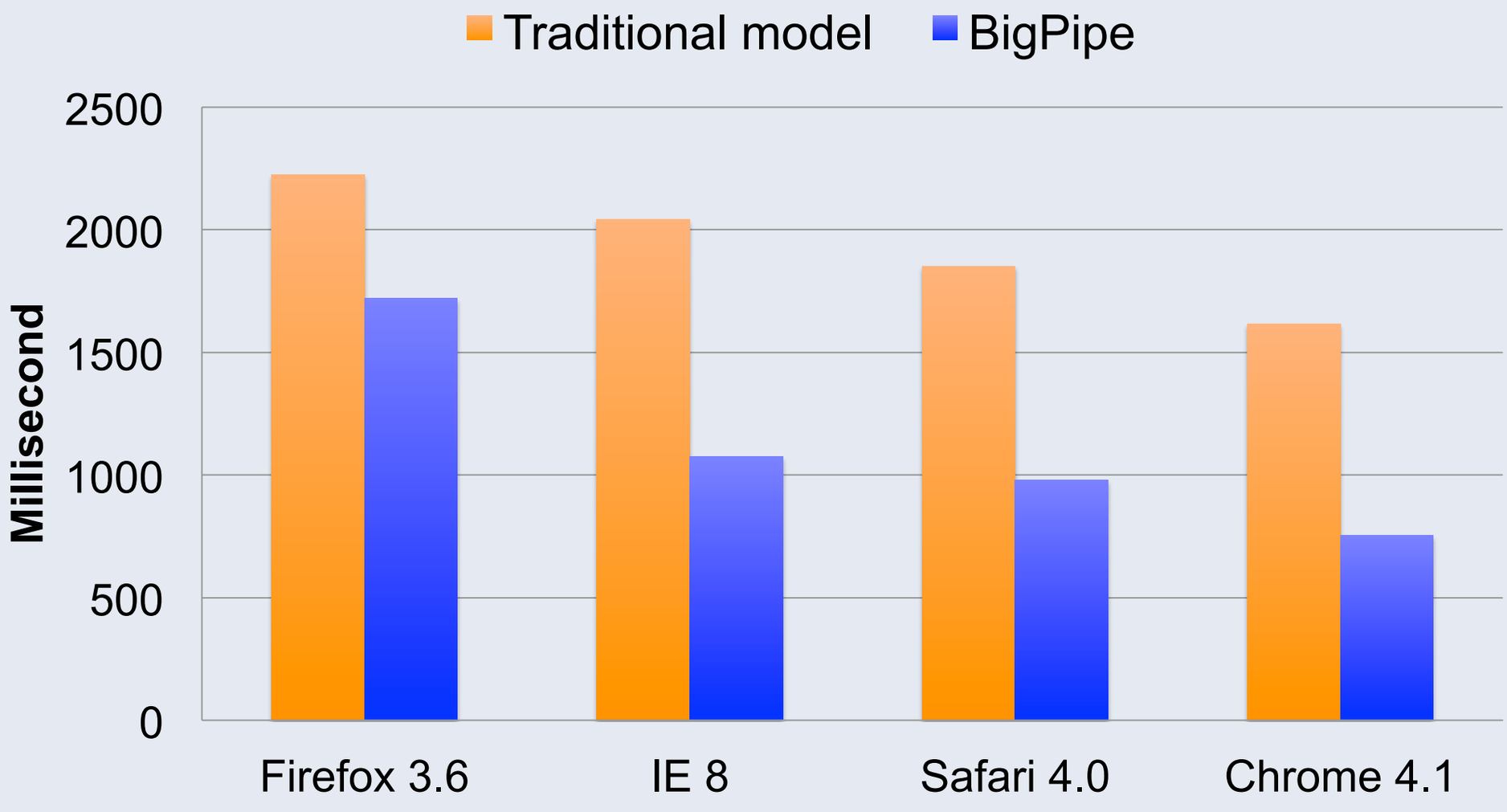
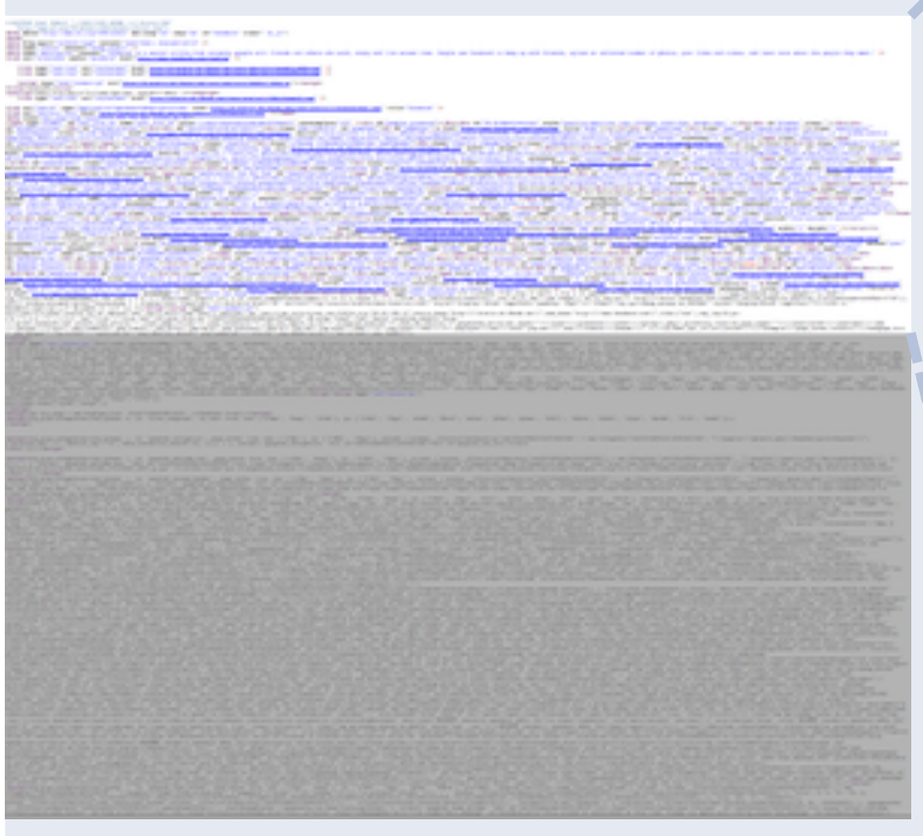
Chat (39)

TTI improvement



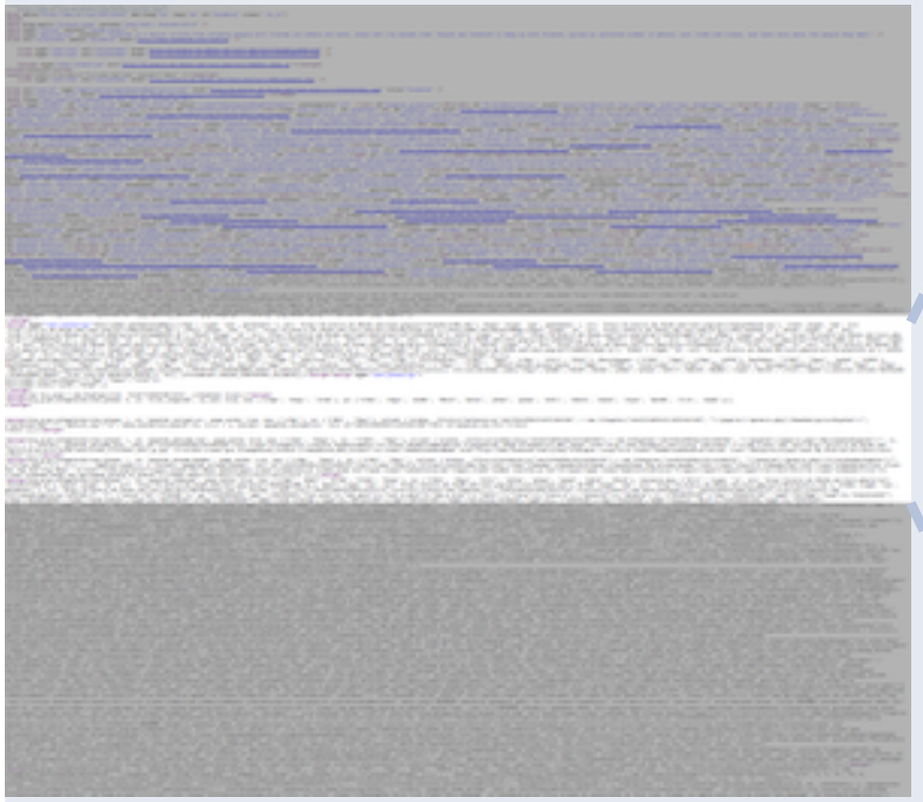
2X improvement in user perceived latency for almost all browsers.

BigPipe first response



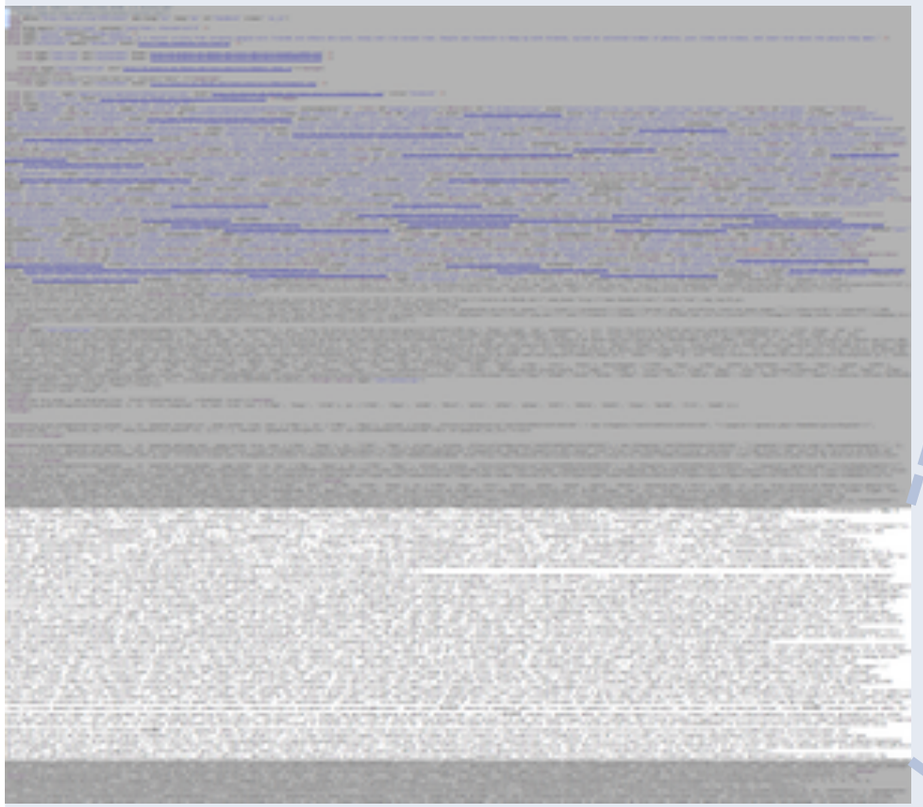
```
<html>
<head> <script src="<big pipe js>" />…</
head>
<body>
…
<div id="left_column">
<div id="pagelet_navigation"></div>
</div>
<div id="middle_column">
  <div id="pagelet_composer></div>
  </div>
…
```

Pagelet response 1



```
<script type="text/javascript">
 big_pipe.onPageletArrive({
     "id"     : "pagelet_navigation",
     "css"    : [ <list of css resources>],
     "js"     : [ <list of JavaScript resources>],
     "content" : <html>
     "onload": [JavaScript init code]
     …
});
</script>
```

Pagelet response 2



```
<script type="text/javascript">
  big_pipe.onPageletArrive({
      "id"     : "pagelet_composer",
      "css"    : [ <list of css resources>],
      "js"     : [ <list of JavaScript resources>],
      "content" : <html>
      "onload": [JavaScript init code]
      …
});
</script>
```

Pagelet example

```
class AdsPagelet extends PageletResponse
{
    public function init () {
        // initialize pagelet
    }

    public function prepare() {
        // data fetching
    }

    public render() {
        // generate pagelet response.
    }
}
```

Pagelet programming model

- Self contained
  - HTML, JavaScript, CSS, onloadRegister
- Advanced features:
  - Pagelet hierarchy
  - Phased rendering
  - Cross-pagelet dependencies
    - data dependency
    - display dependency
    - JavaScript dependency

BigPipe programming model

```
// Step 1: create BigPipe instance

$big_pipe = BigPipe::getInstance(BigPipeType::PIPELINE);

// Step 2: Specify page layout and pagelet place holders.

$big_pipe->setPage(
      '<div id="left_column">
         <div id="pagelet_navigation"></div>
       </div>
       <div id="middle_column">
         <div id="paglet_composer"></div>
         <div id="pagelet_stream"></div>
       </div>');

// Step 3: add pagelets  to the pipe

$big_pipe->addPagelet(
      new UIPagelet()
            ->setSrc('/pagelet/composer.php')
            ->setWrapperId('pagelet_composer'));
…

// Step 4: generate pagelets flush them out.

echo $big_pipe->render();
```

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BigPipe generation modes

- Single flush mode
  - Support search-engine crawlers
  - Support clients without JavaScript
- Pipeline mode
  - Generate and flush pagelets sequentially (default mode)
- Parallel mode
  - Generate pagelets in parallel and flush them out-of-order

BigPipe programming model

- Encapsulation
  - Hide implementation details
- Intuitive
  - Easy to understand mental model for developers
- Flexible
  - Different modes good for different use case.

BigPipe advanced features

- AjaxPipe
  - Use iframe to pipeline Ajax response
  - Used by Facebook home page's dashboards (photo, groups, etc)
- WidgetPipe
  - Pipeline multiple widgets ("like" button) on third party websites

facebook

Thank you!