Building Confederated Web-based Services with Priv.io

Liang Zhang Alan Mislove
Northeastern University

Online social networks

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- Sharing is "**FREE**" for users
  - User does NOT pay for content sharing
- Who funds the service? -- Advertising
  - Monetizes your content for ads
  - But, we have privacy settings on Facebook!?

Privacy in OSNs

- Privacy control on OSNs
  - Control information flows within the site
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  - Privacy leakage
    - e.g., Facebook data bug leaked 6 million users' info
  - Big brother is watching YOU...
    - e.g., NSA, GCHQ

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  - Big brother is watching YOU...
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- **Can we protect user privacy *from the provider*?**

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- Our insight: **Leverage cloud computing** to host user content
  - Users store encrypted data on cloud provider of choice
  - But, how much would it cost?

Using the Cloud

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Storage
Bandwidth
Requests
Computation

Using the Cloud

Storage	$0.095/GB/month for storage
Bandwidth	$0.12/GB for outgoing bandwidth
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- If we ignore computation,
  - **Cost for 99% users is less than $1**
  - Using real world data (Facebook, Twitter, Flickr)
  - More details in paper

Priv.io

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  - User provides storage, bandwidth via cloud providers
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Drafting the Articles of Confederation
York Town, Pennsylvania 1777
13c USA

- Result: Priv.io, a **confederated** service
  - Each user retains control over his/her own data
  - Confederated means users are free to leave

Outline

- ~~Motivation~~
- Priv.io design
- Security, privacy and limitation
- Evaluation

Sharing on Facebook

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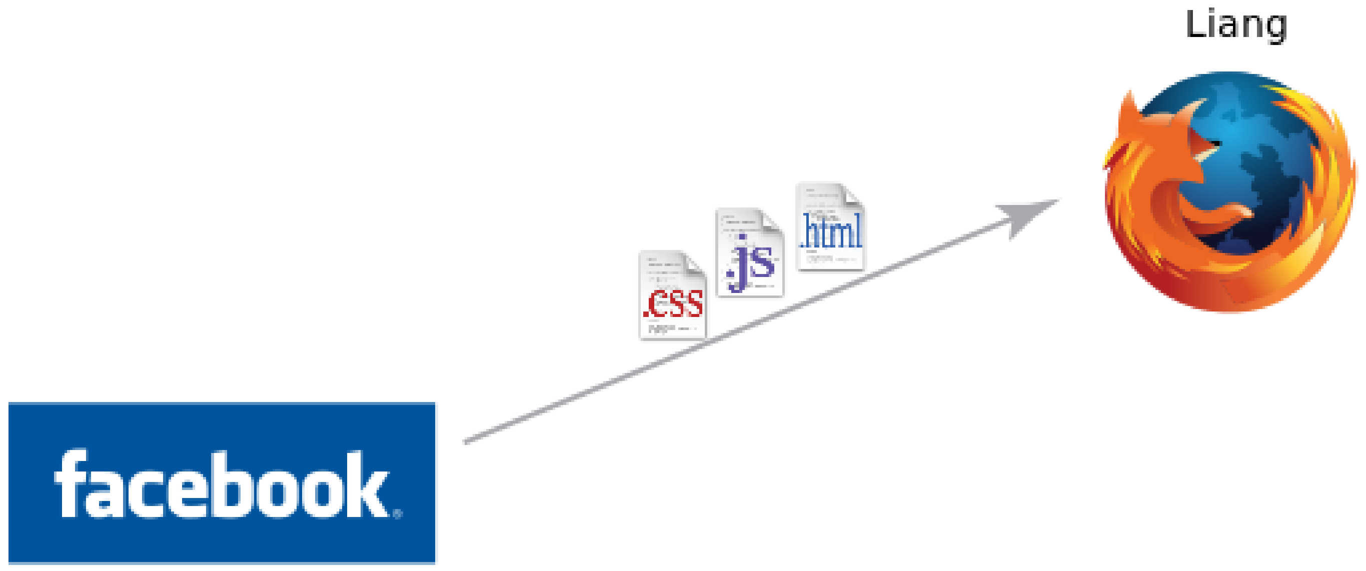

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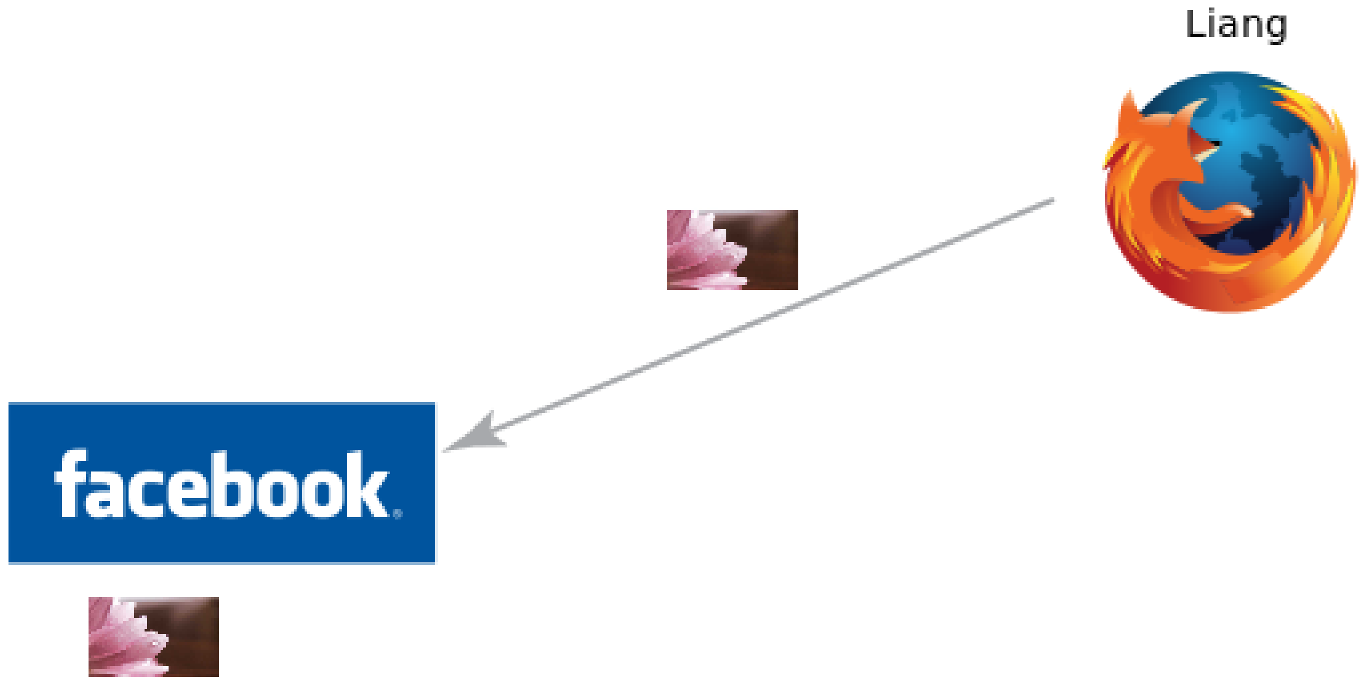

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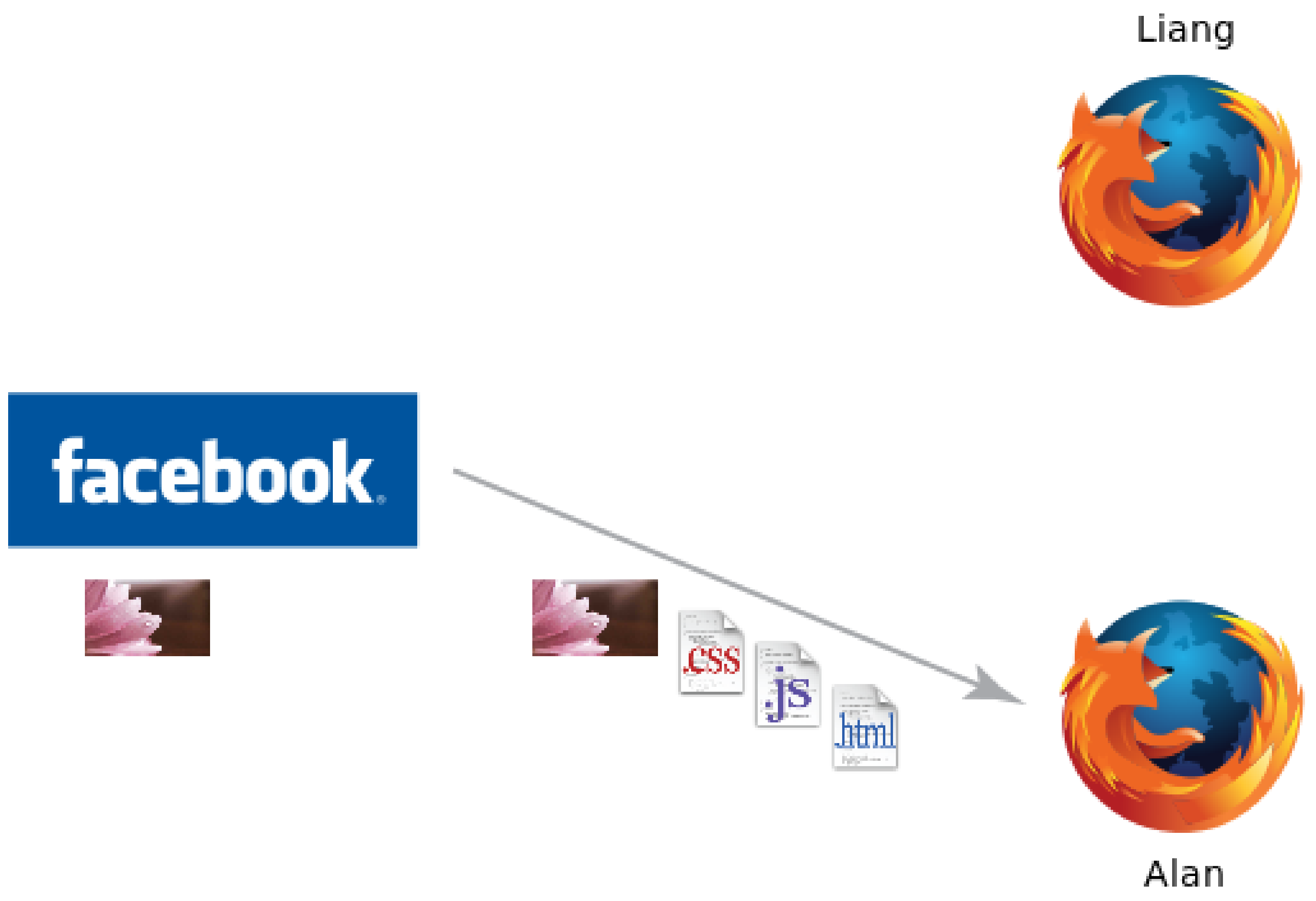

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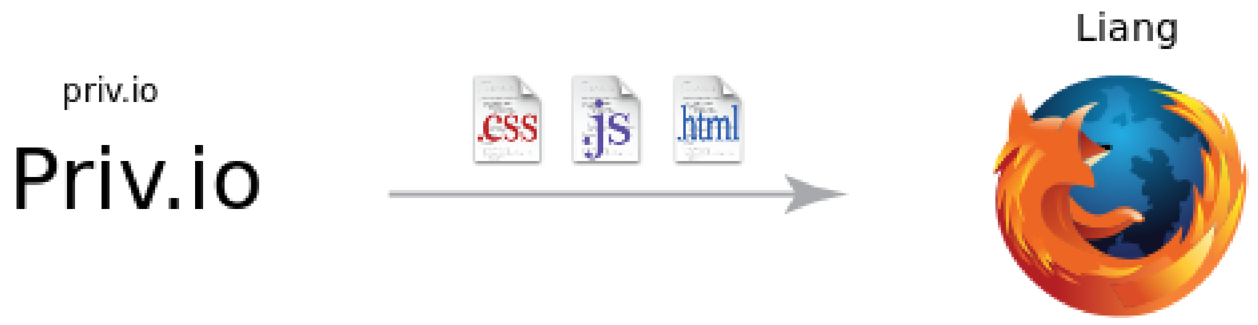

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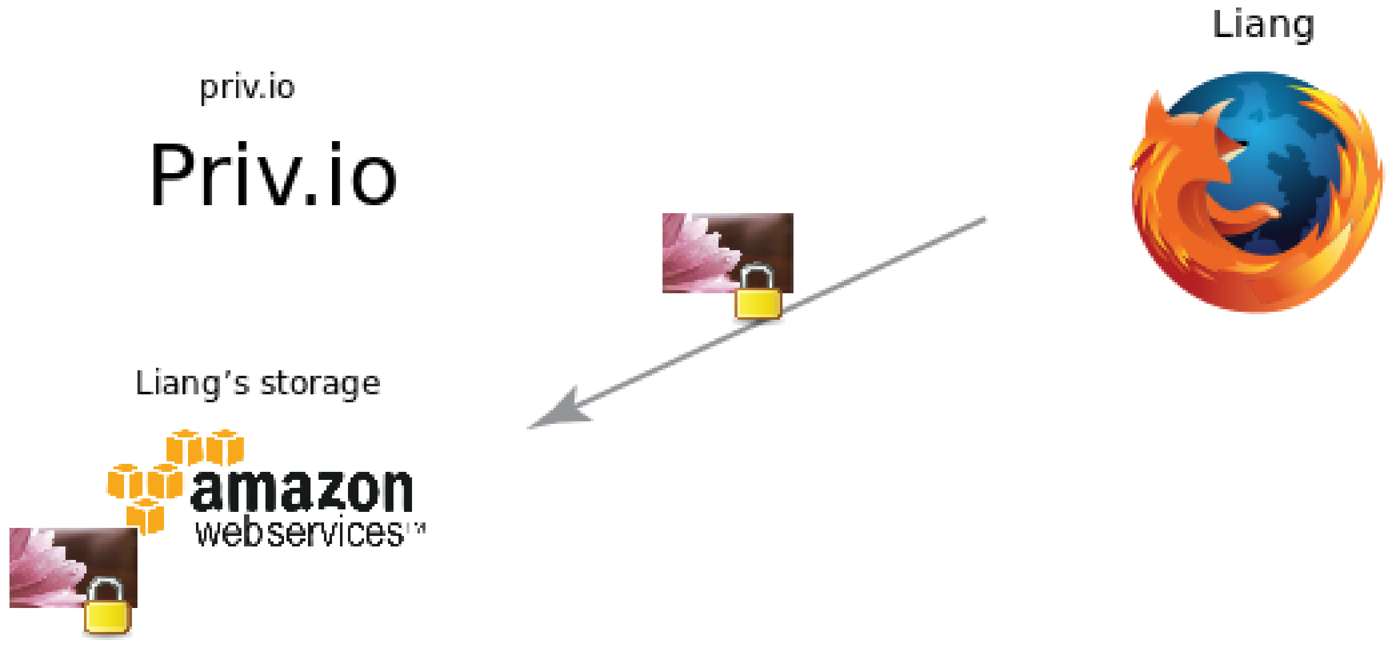

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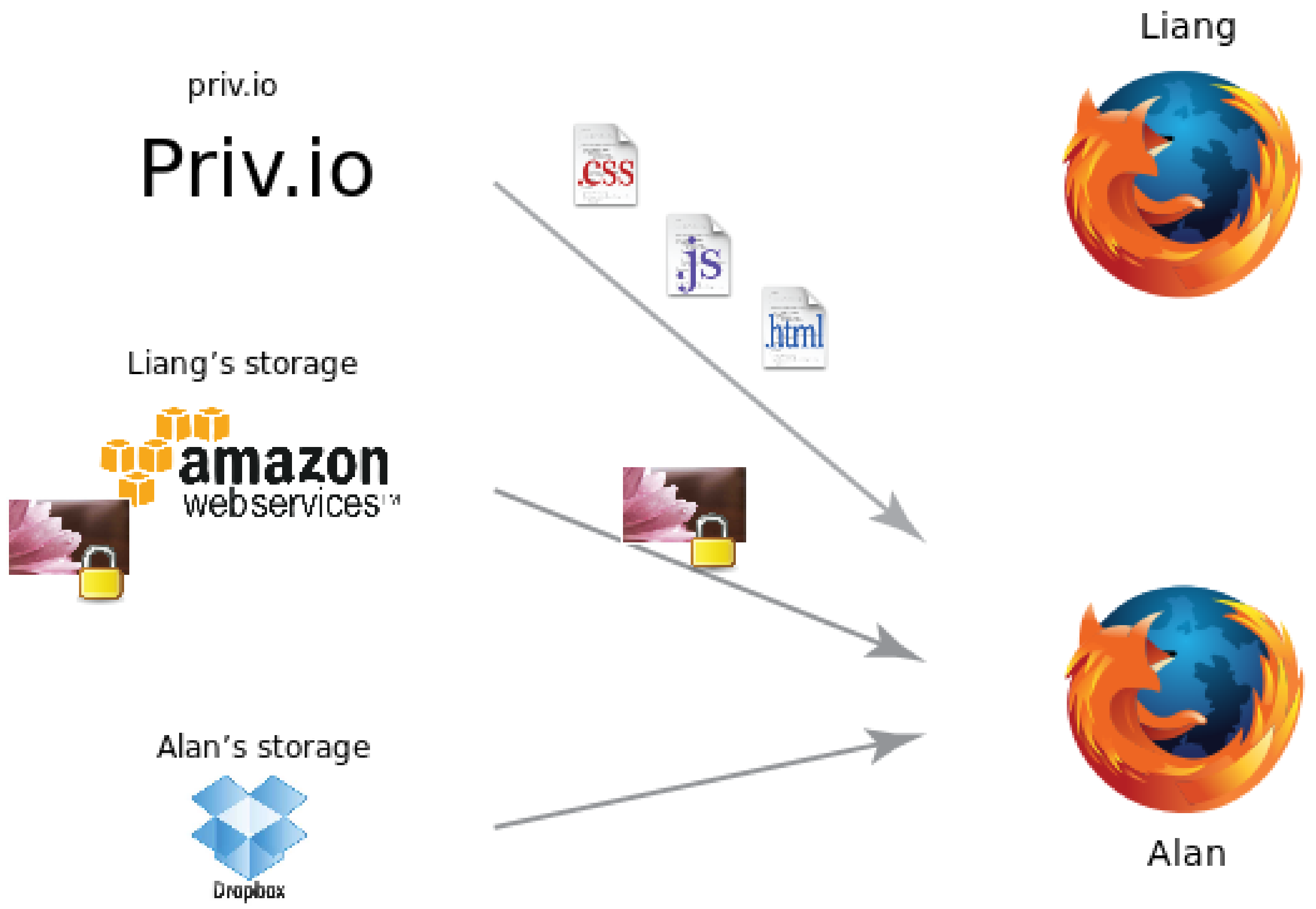
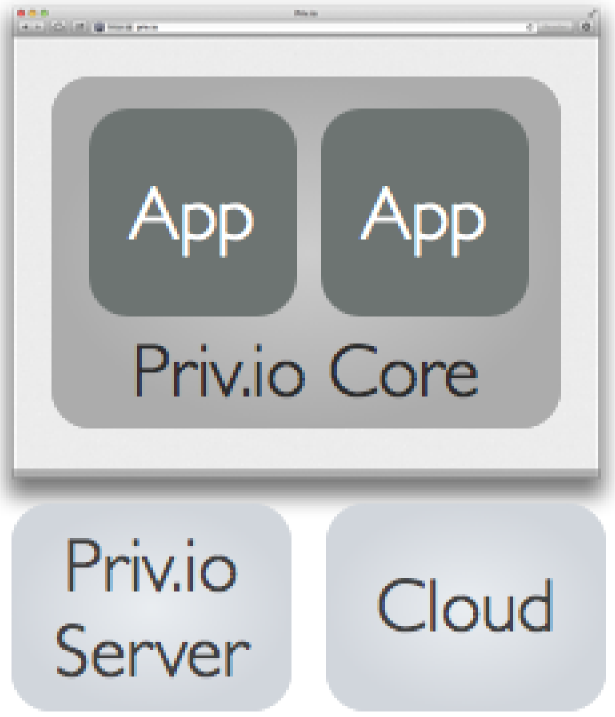


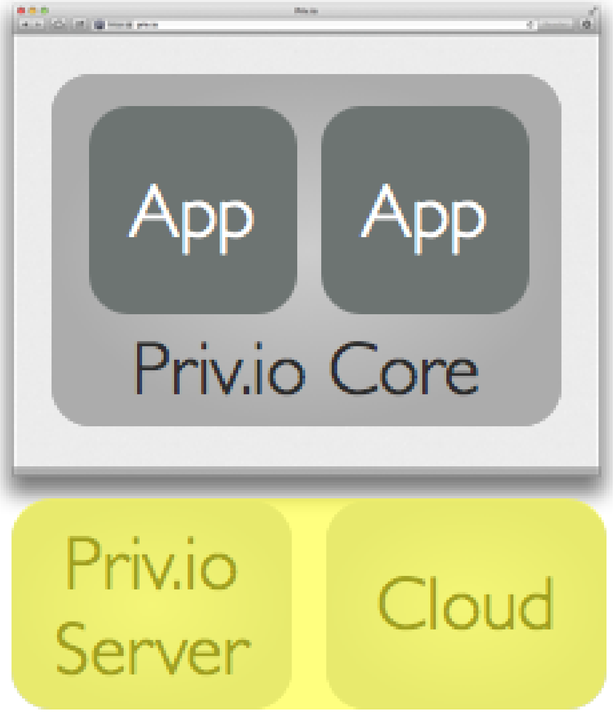
Priv.io overview

- **Social platform** for building web apps
  - e.g., Google Doc, Facebook, Twitter
- Architecture
  - Servers
    - Server side support
    - User-contracted cloud providers
  - Priv.io Core
    - Kernel of the system
  - Priv.io Applications
    - User facing functionality



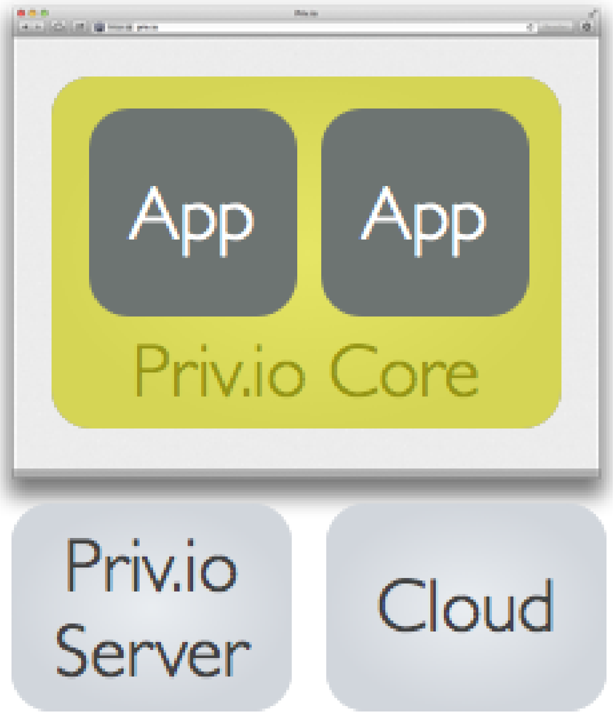
Servers

- Priv.io server
  - Bootstraps Priv.io
    - Serves static content
  - Uses DNS to map cloud providers
    - e.g., liang.priv.io => liang.priv.io.s3.amazonaws.com
    - Hide users traces
- Cloud providers
  - Assumption: Accessible with REST API
  - Storage
    - Two credentials: owner **read**/**write**, friends **read**
    - Providers today: Amazon, Google, Azure, Dropbox



Priv.io core

- Run applications
  - Ensures **security**, **privacy**
- Resource management
  - Access user provided resources
  - Easy encryption/decryption (ABE, AES)
- Content sharing
  - Create, manage friendship
  - Access own, friends storage
- Expose services to applications **via API**



Priv.io application model

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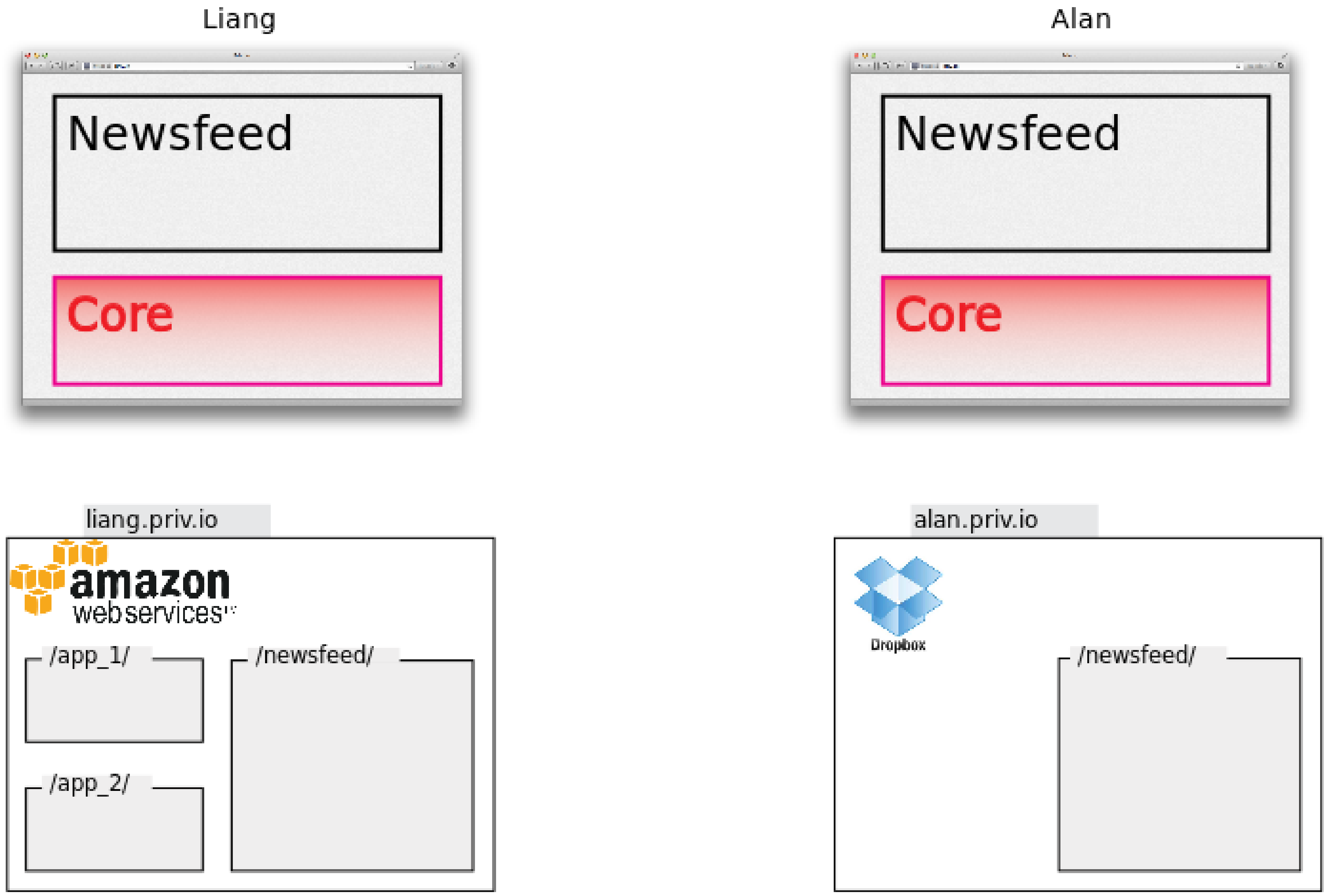

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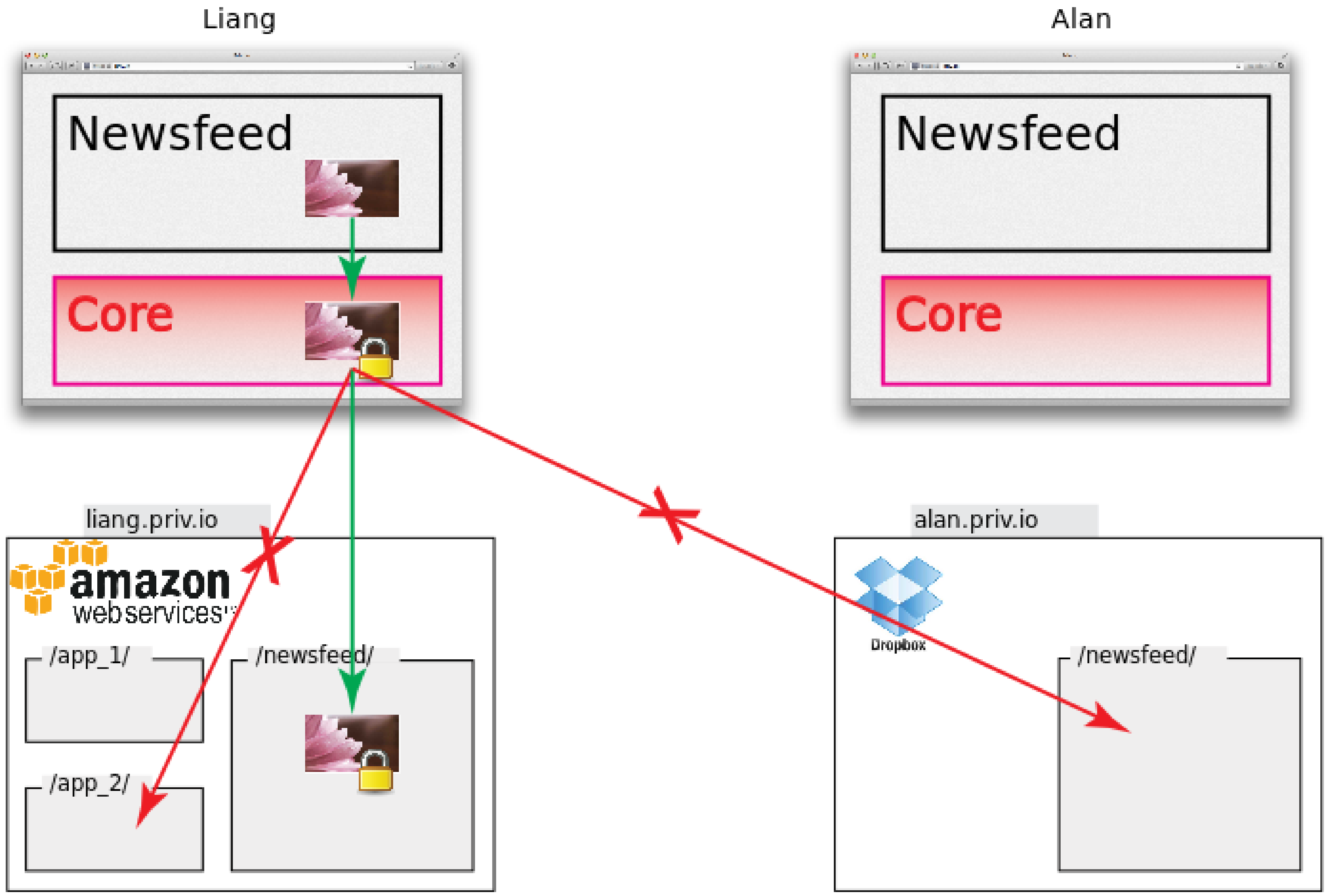

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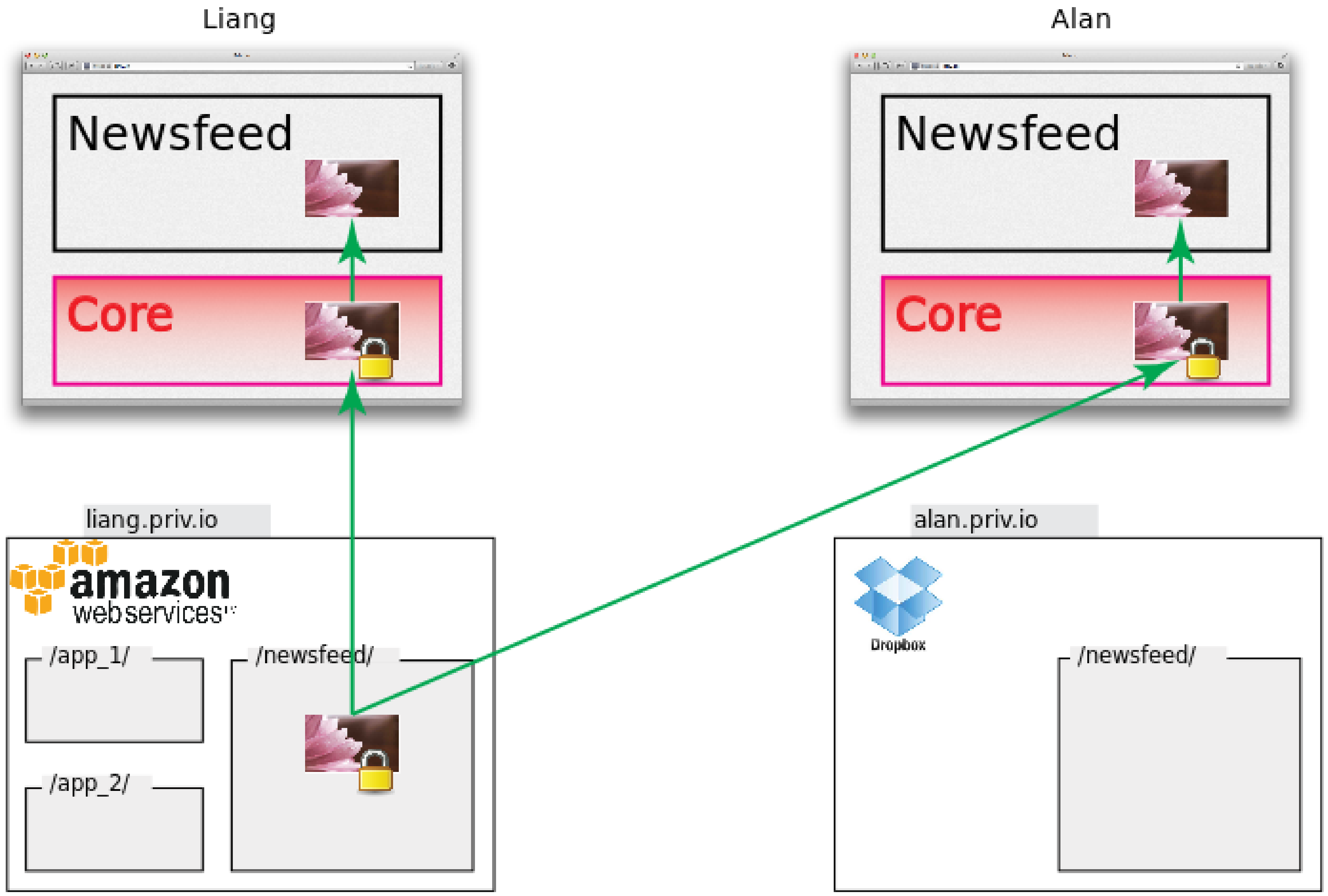

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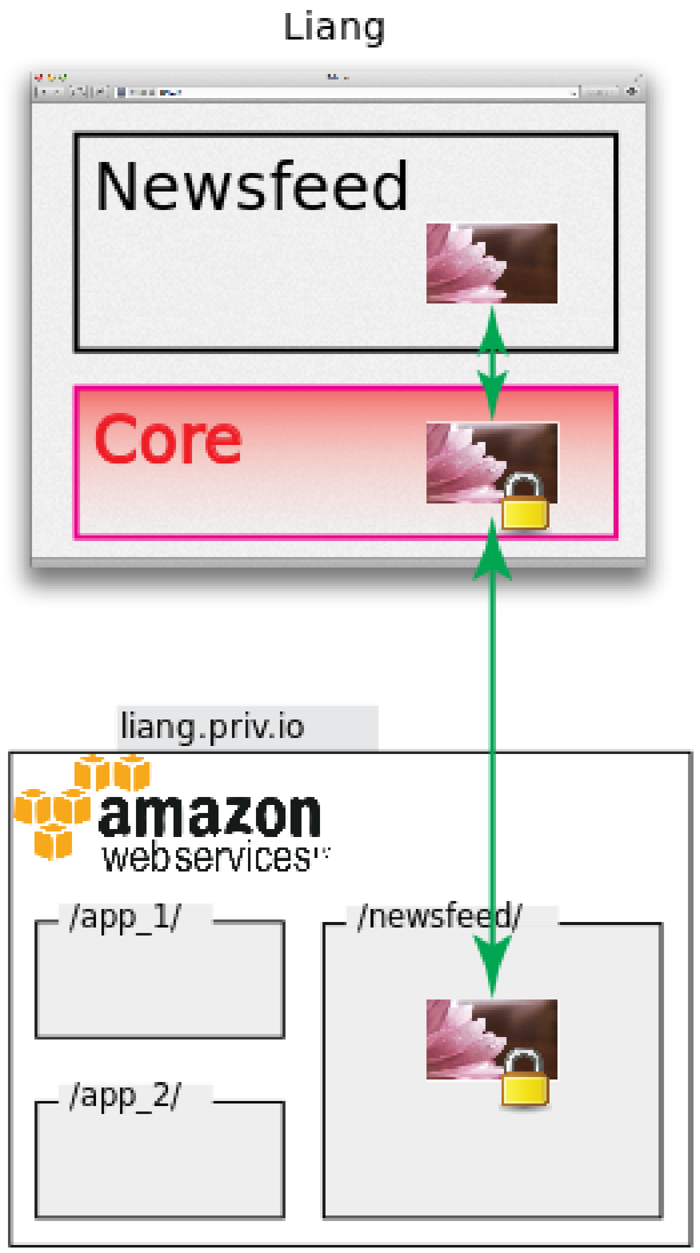
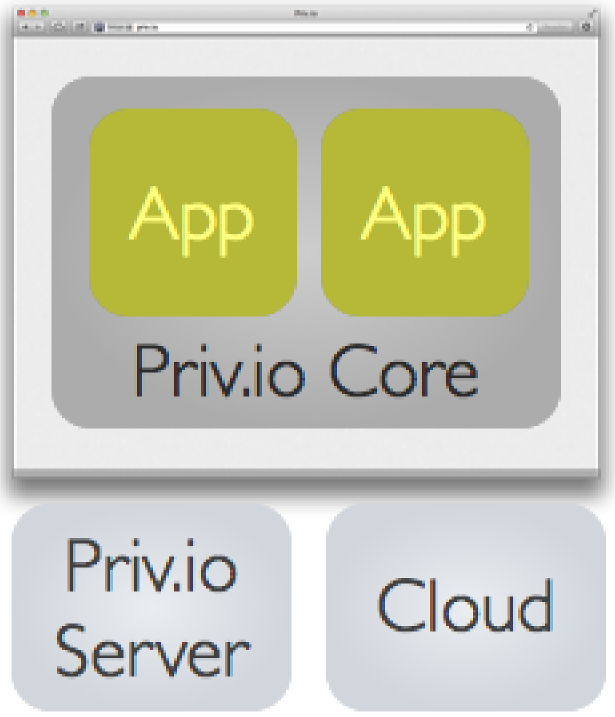


Priv.io API

Permission
  requestPermissions
User Information
  getUsername, getFriends
Storage
  store, retrieve
Communication
  send, receive, delete

Priv.io application

- Implemented in HTML5
  - Runs in users' browsers
  - Each app gets its own iframe
- Various applications
  - Less social interaction: Google doc
  - More social interaction: Facebook newsfeed
- Hosting applications
  - Applications are served on Priv.io server
  - Access via subdomain, e.g., newsfeed.app.priv.io



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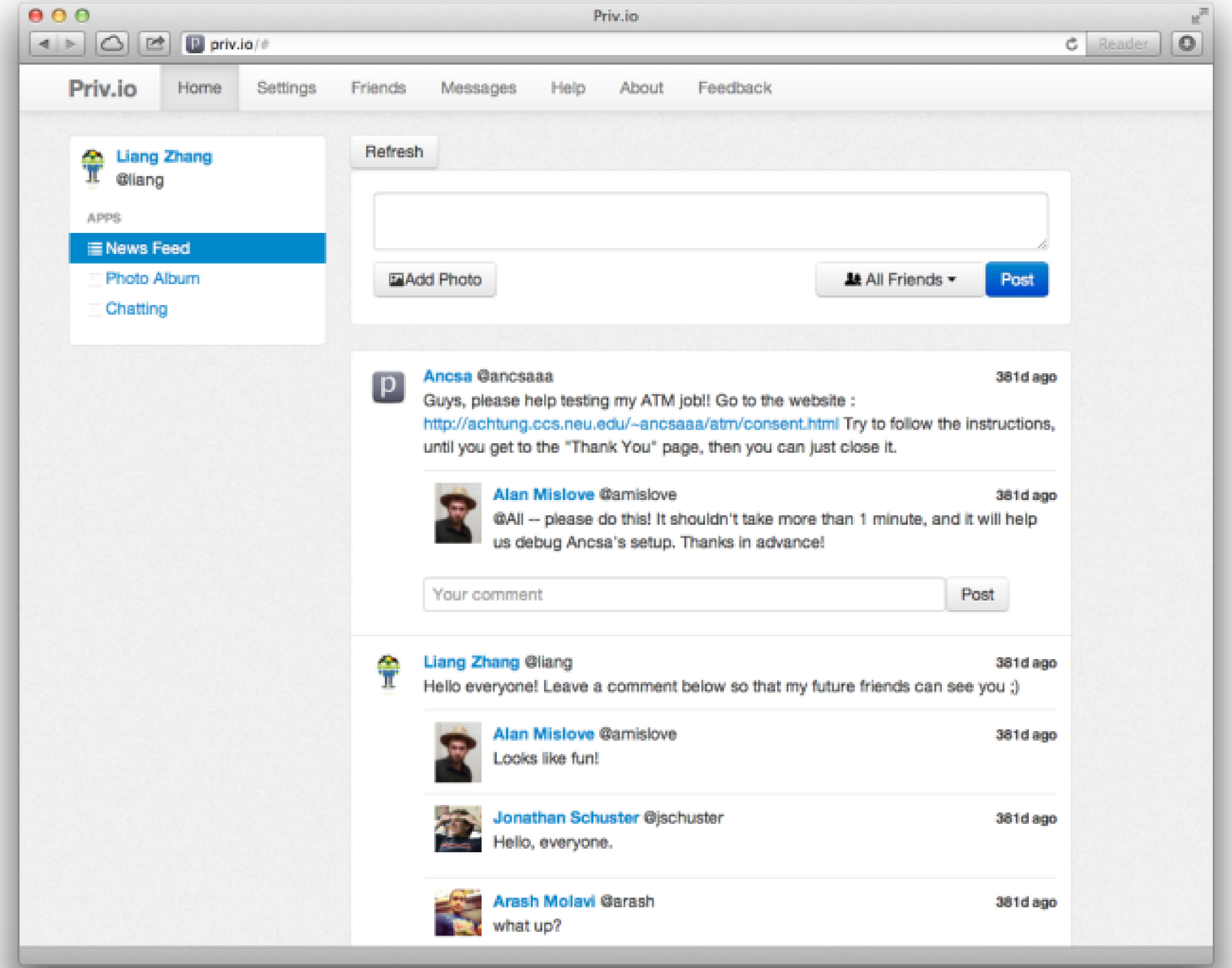

Liang Zhang
@liang

Ancsa @ancsaaa 381d ago
Guys, please help testing my ATM job!! Go to the website : http://achtung.ccs.neu.edu/~ancsaaa/atm/consent.html Try to follow the instructions, until you get to the "Thank You" page, then you can just close it.

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Your comment
Post

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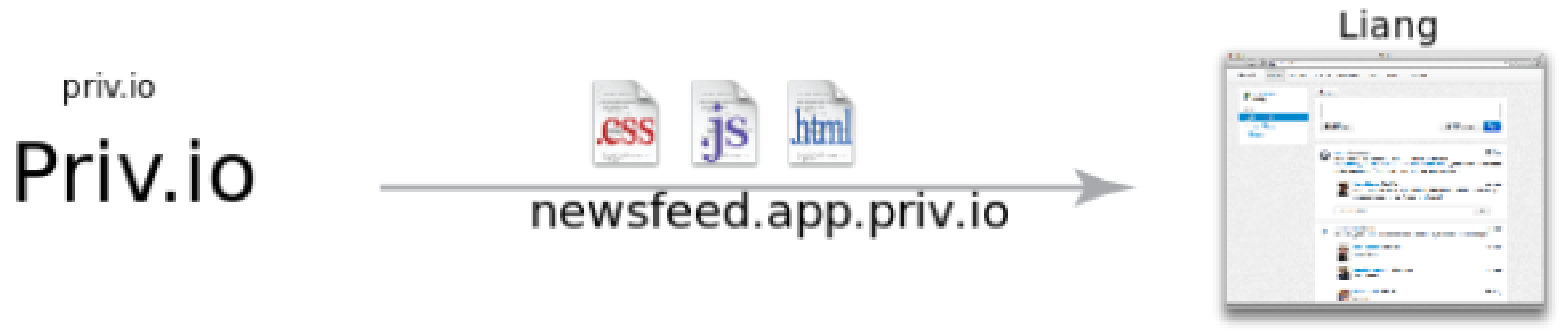

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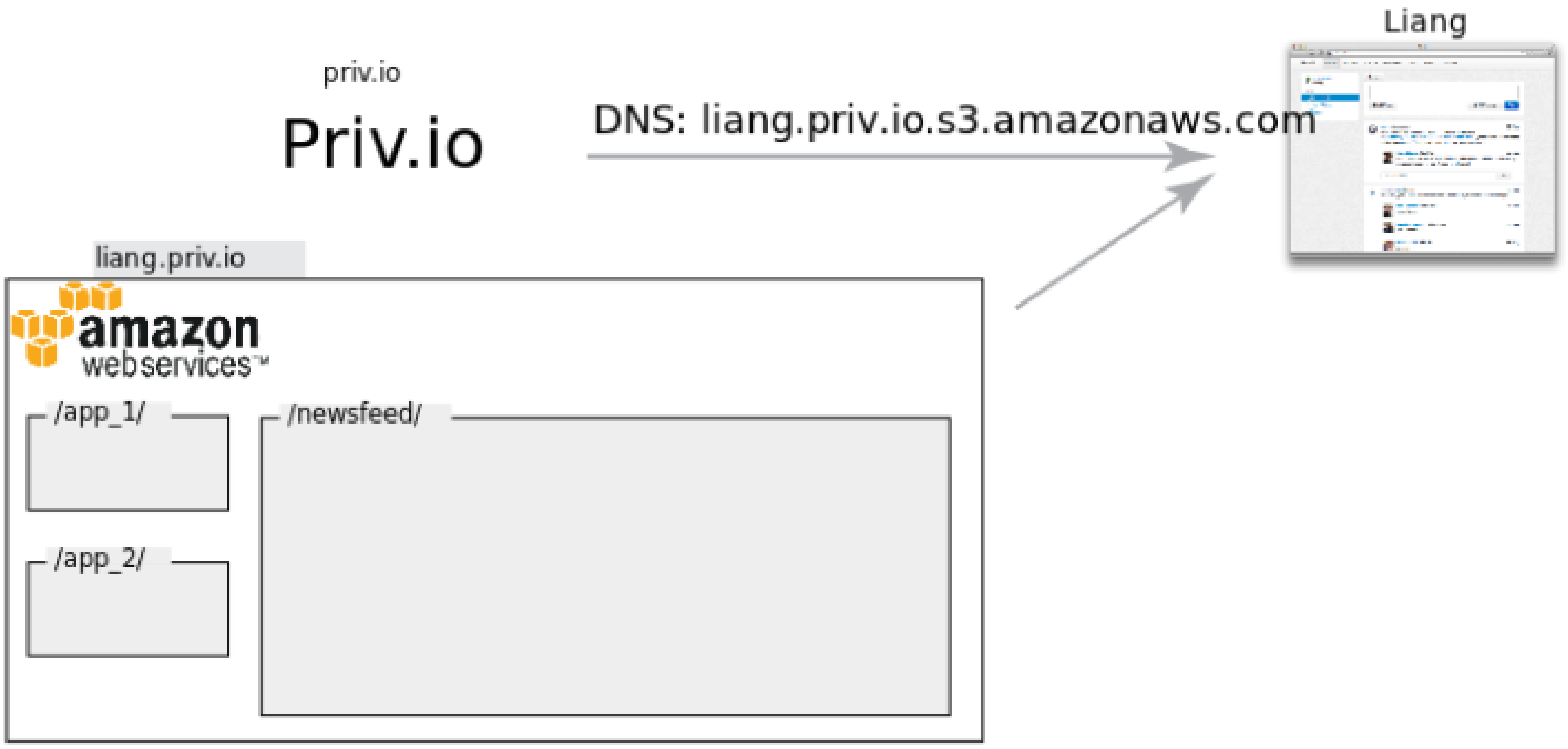

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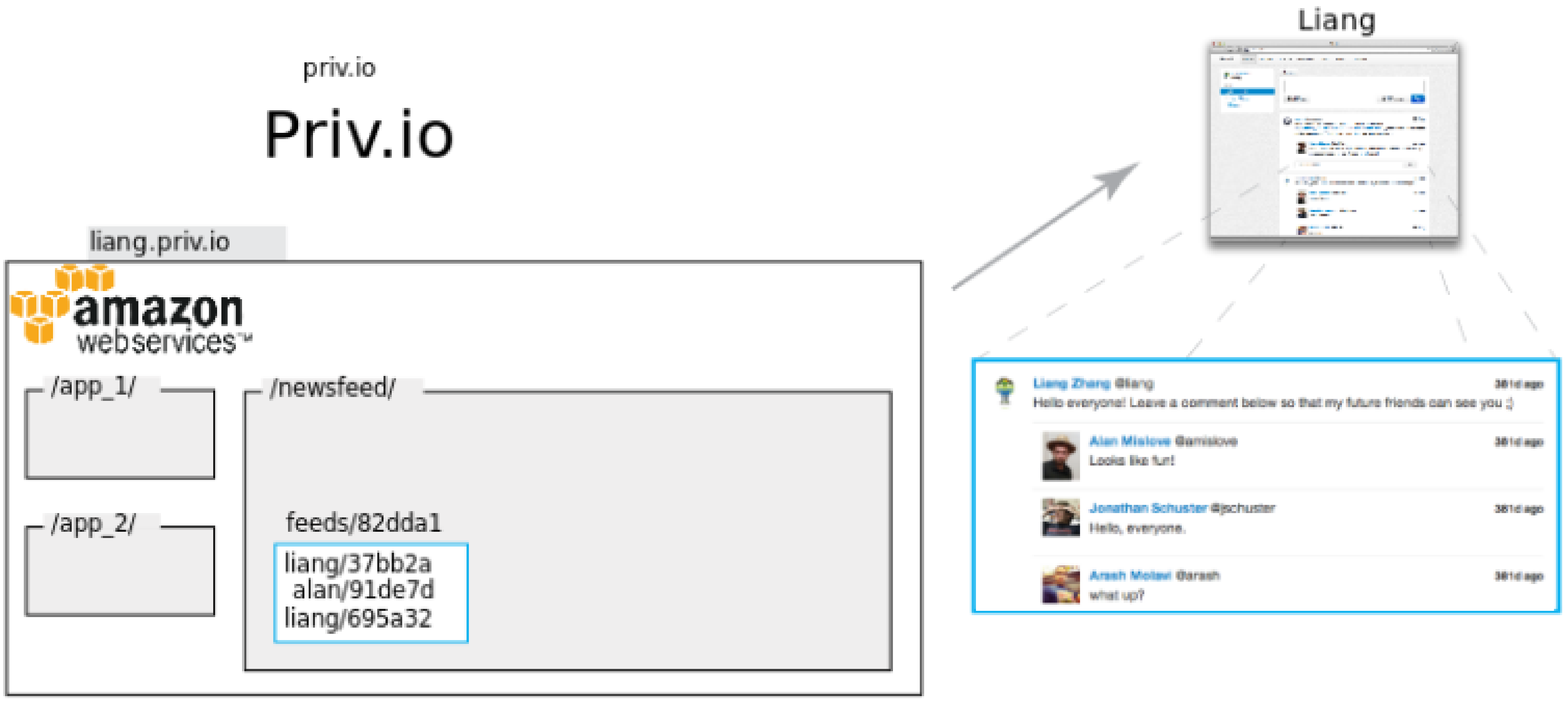

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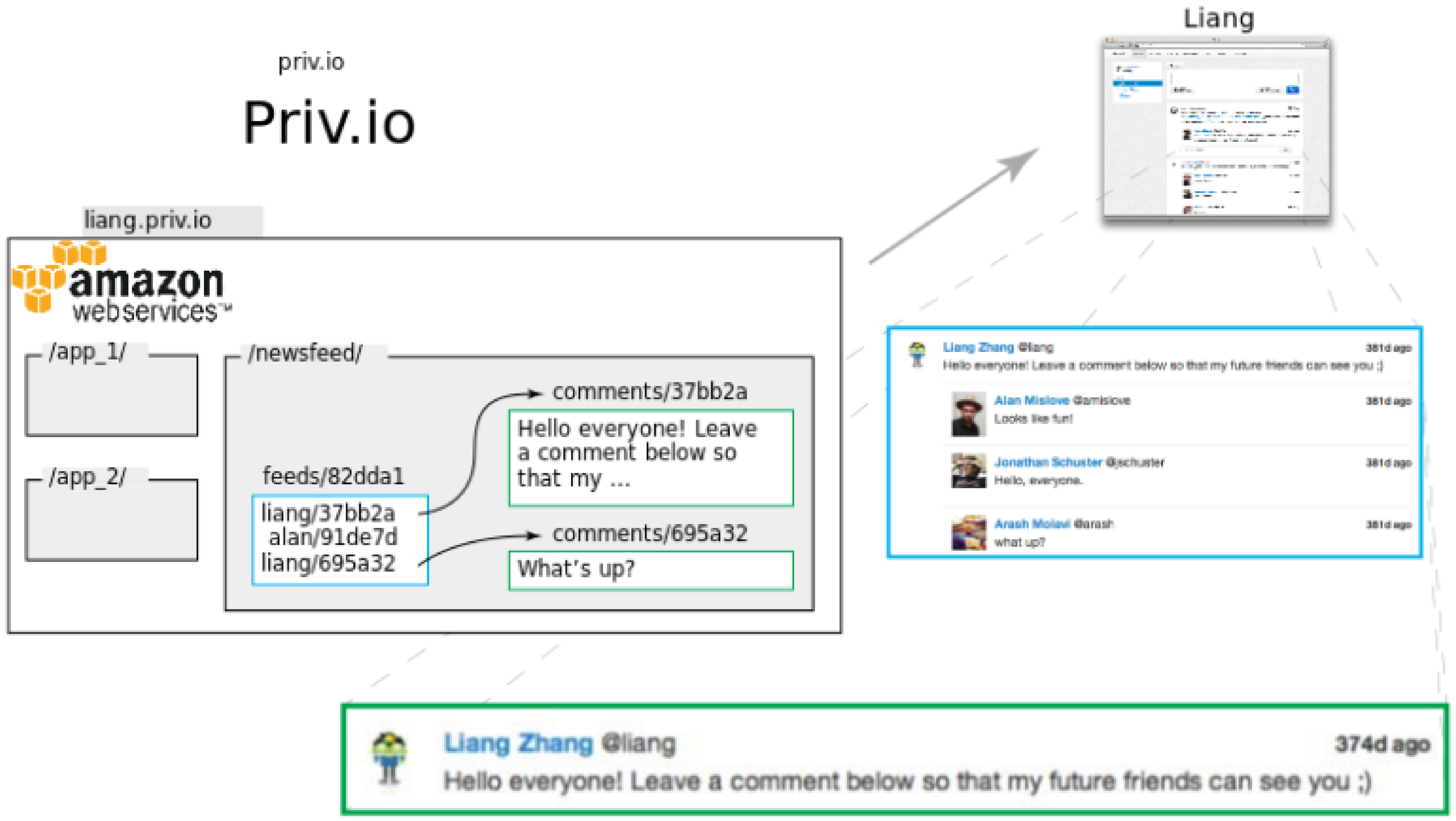

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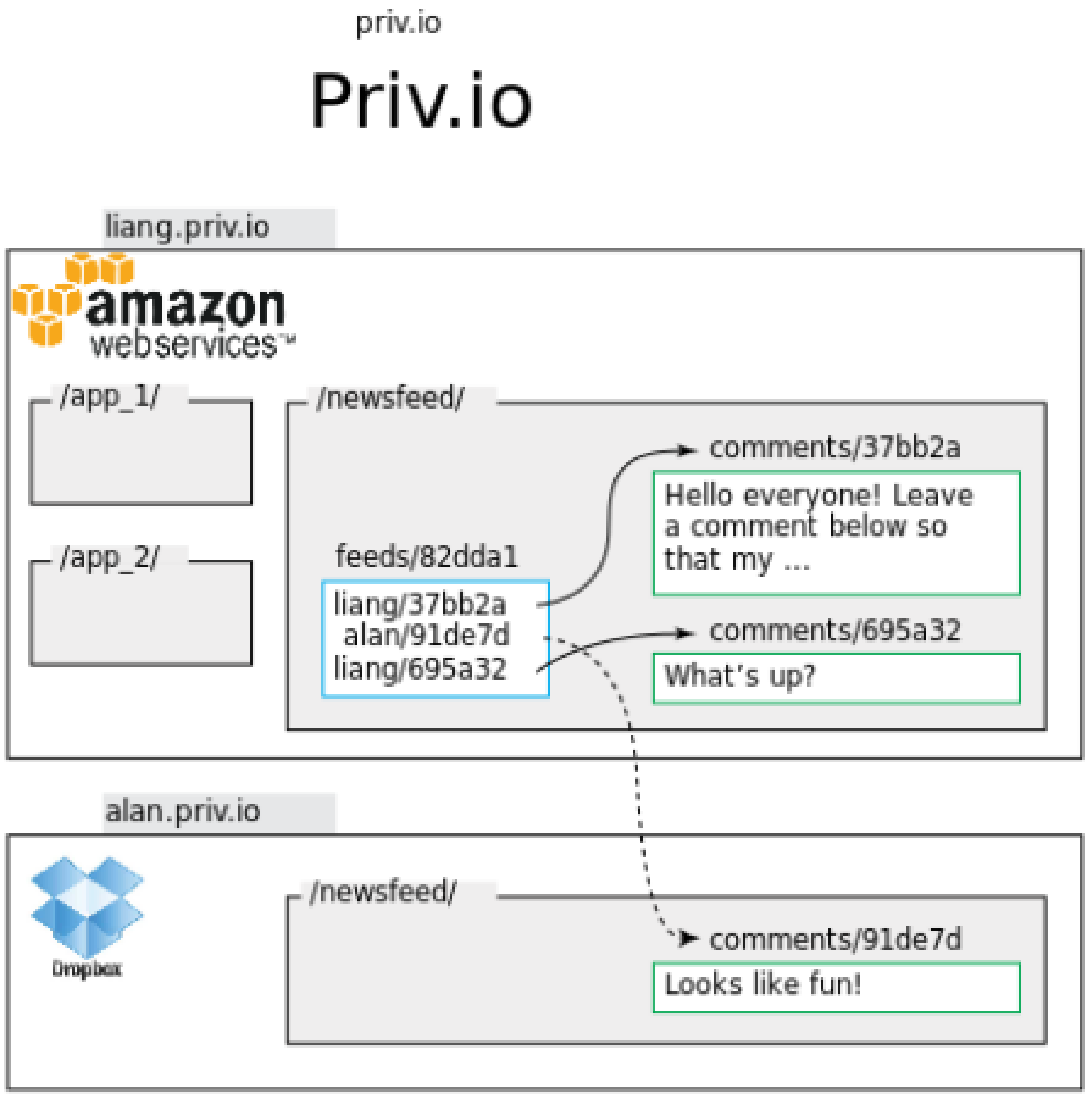

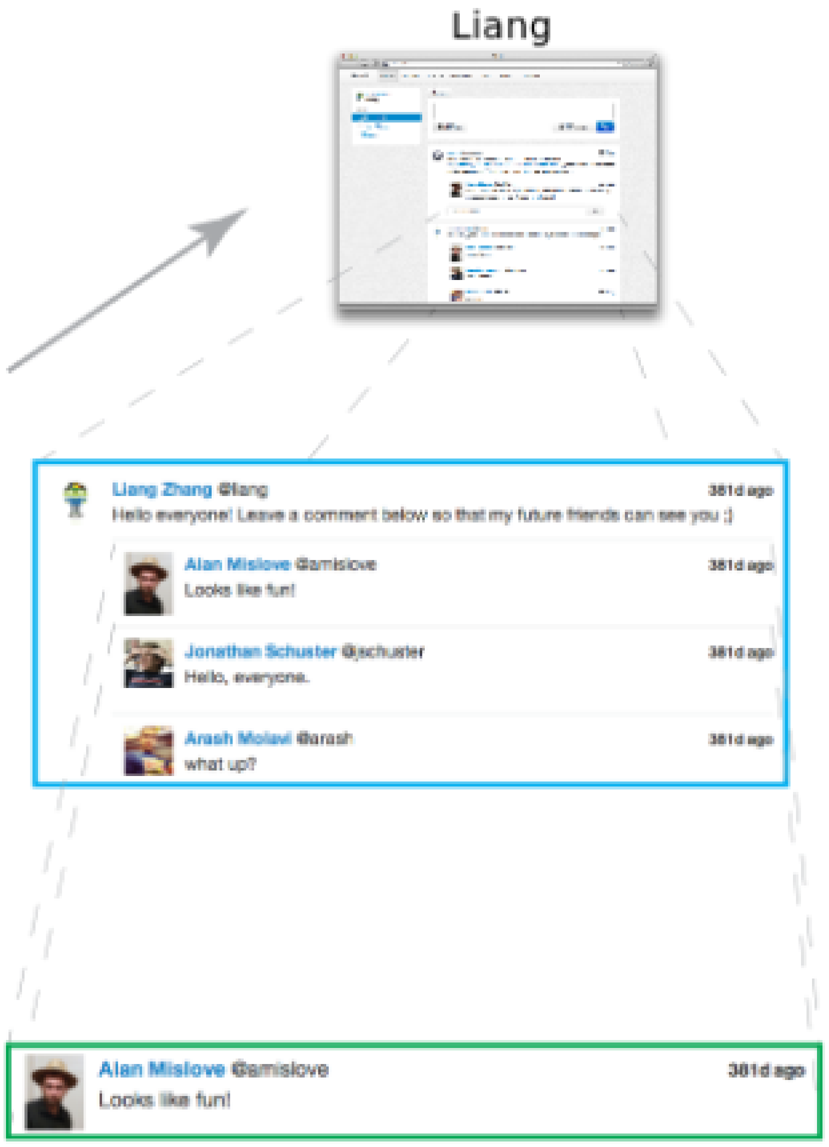

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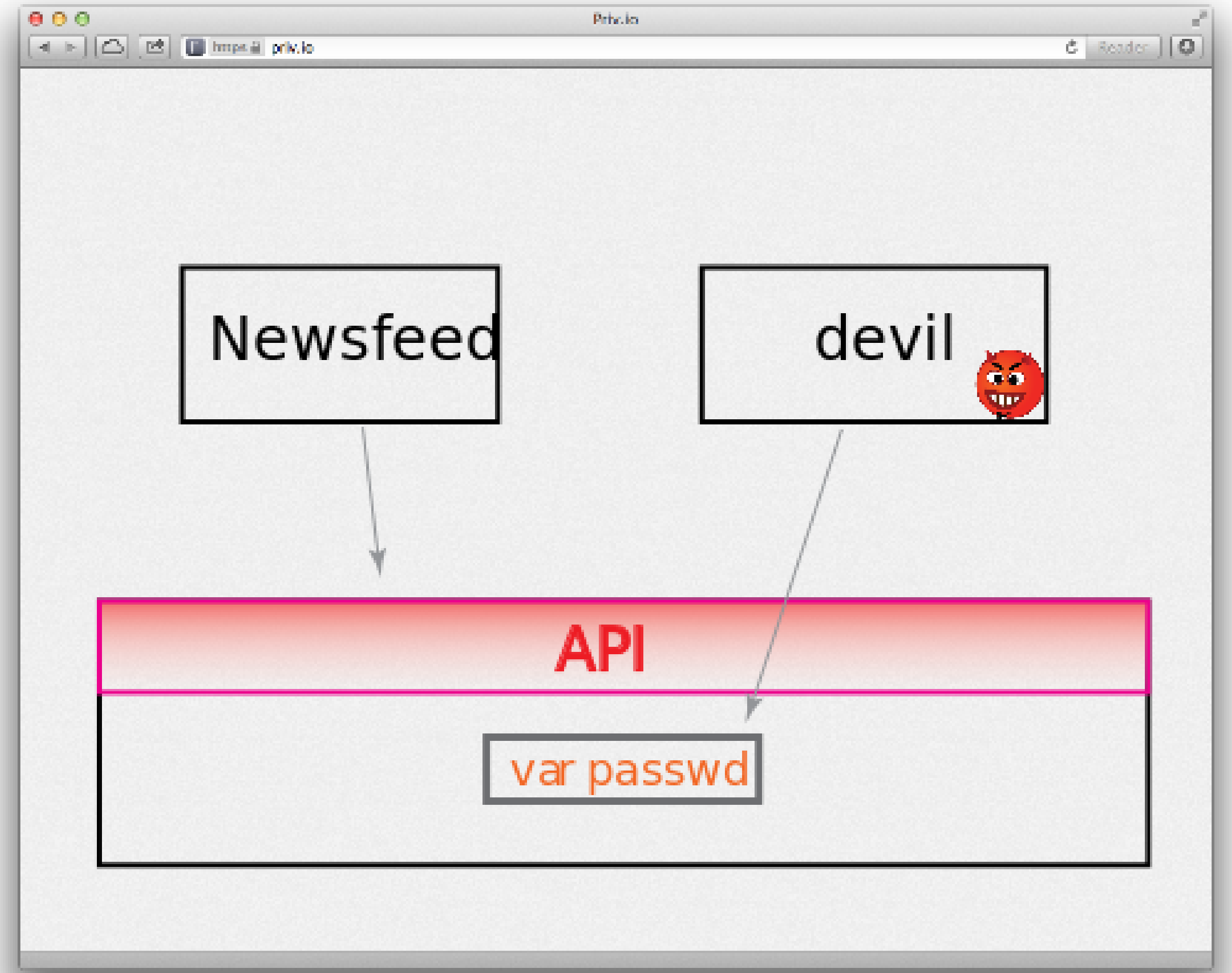

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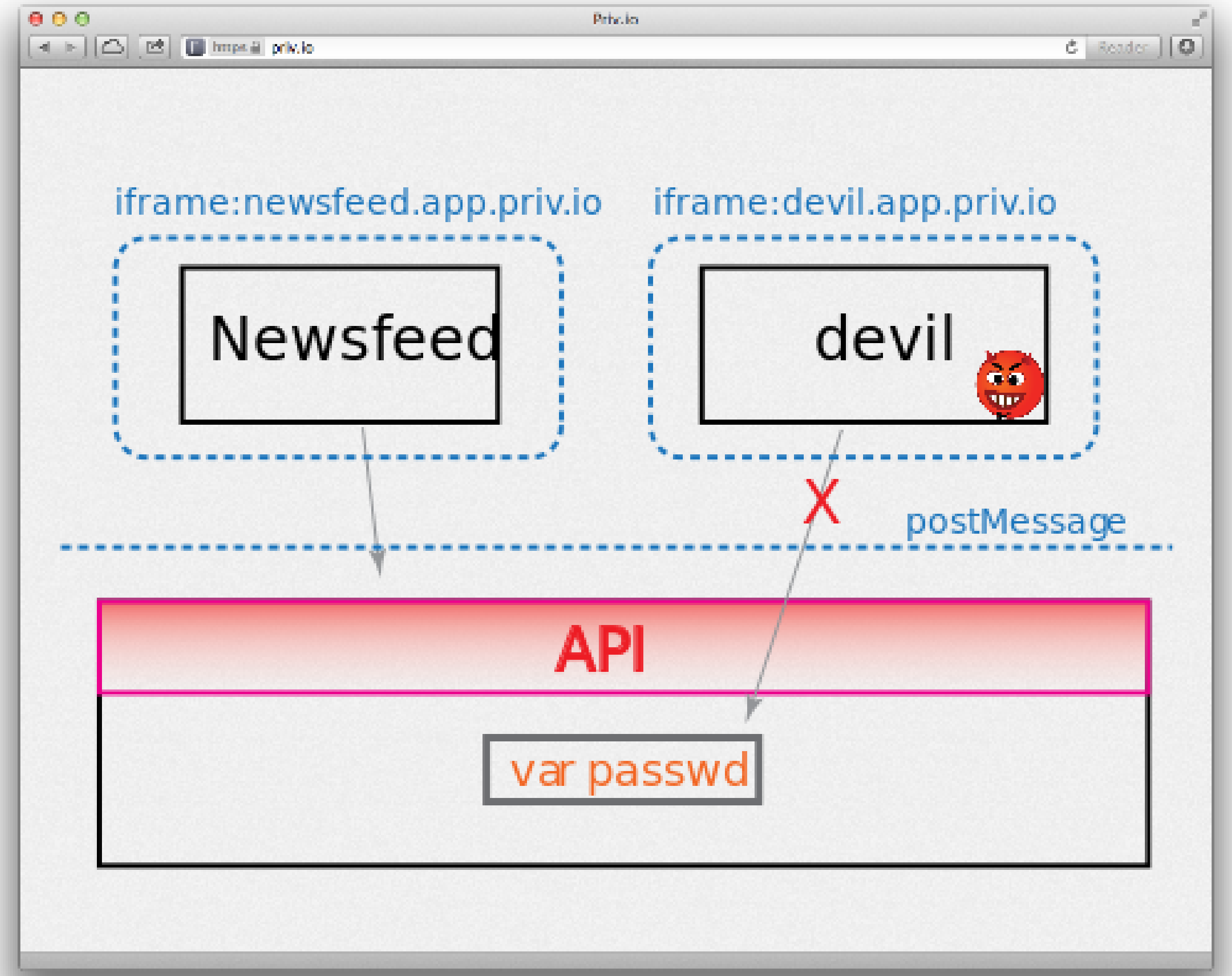

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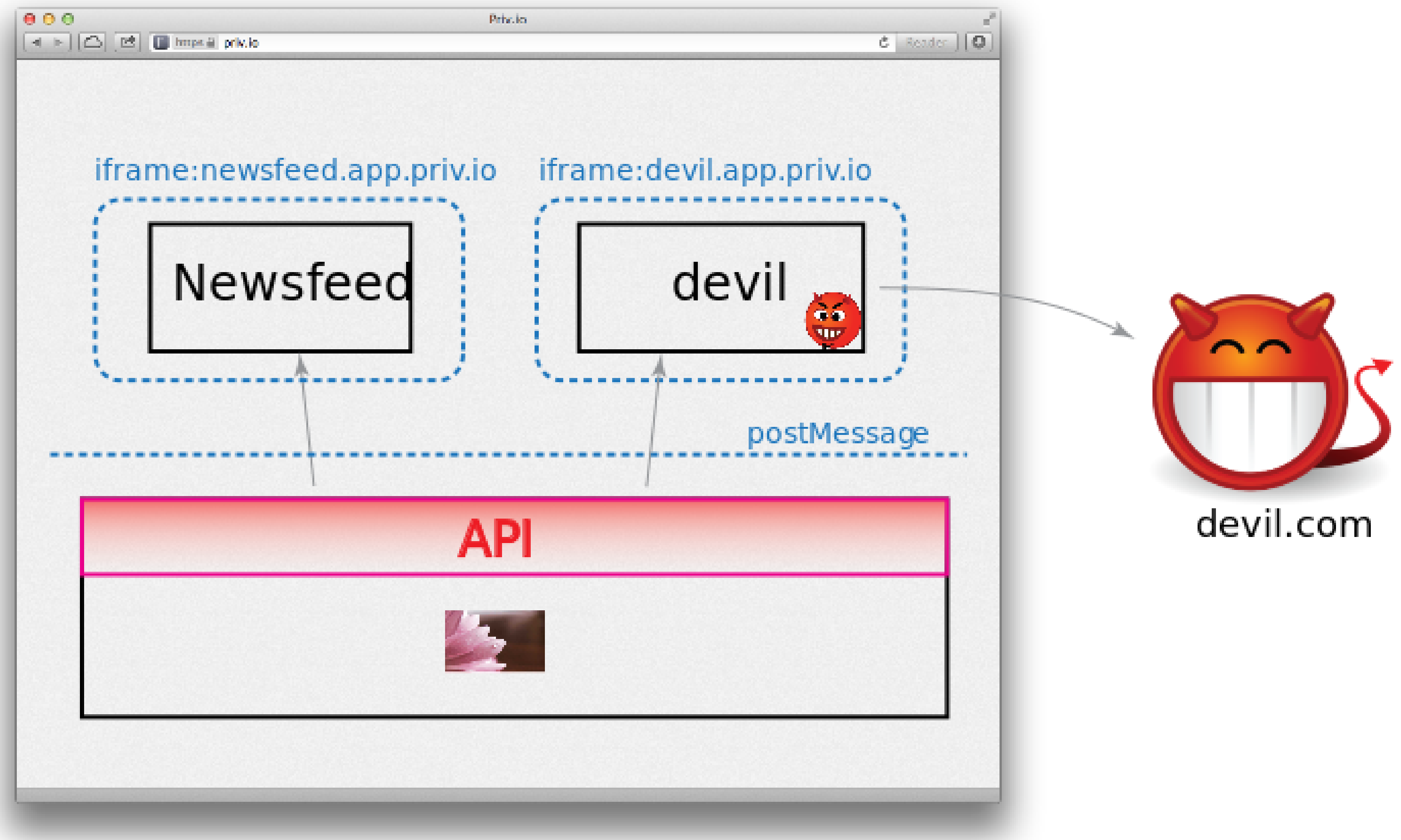

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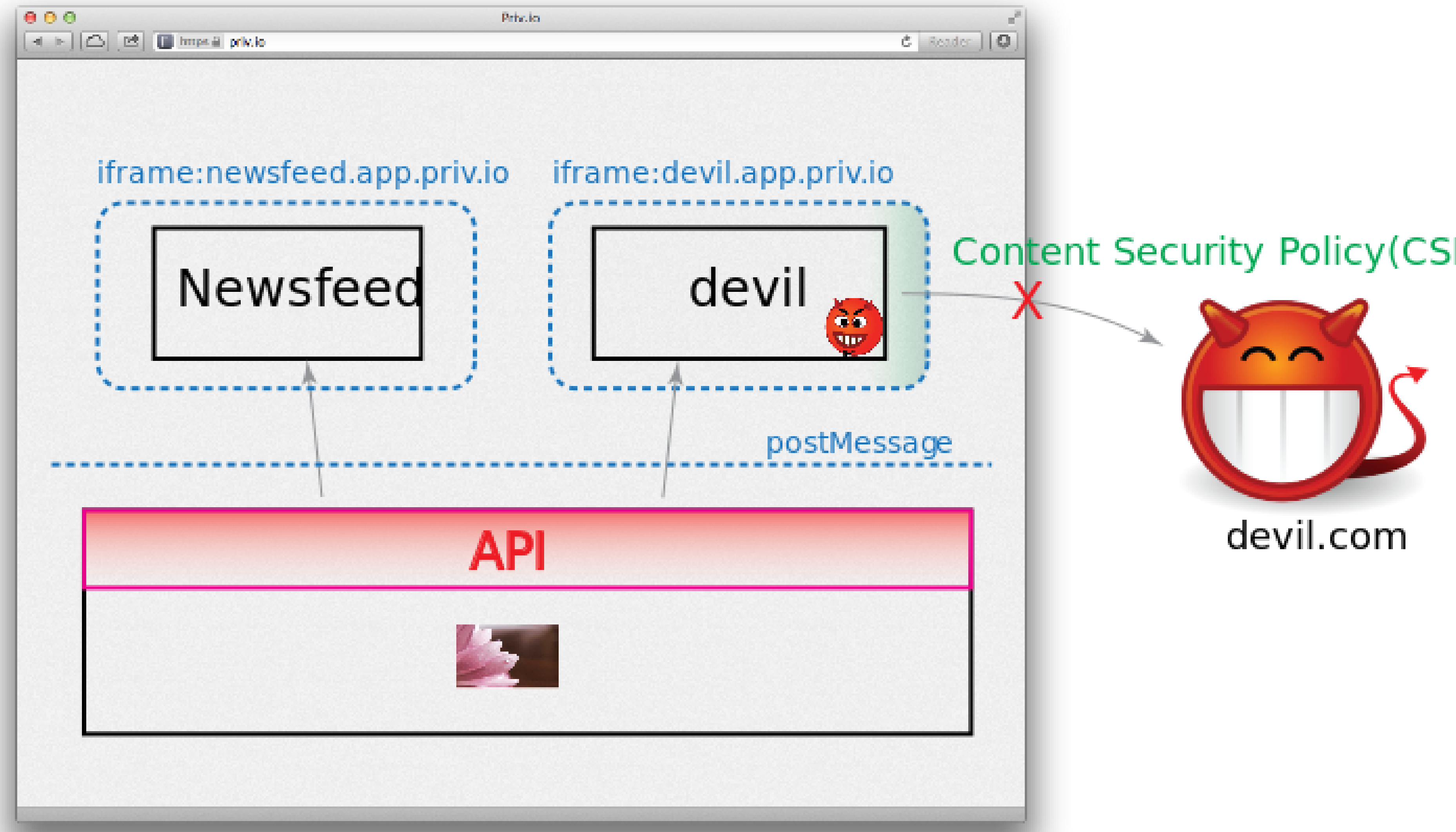

Limitations

- No global view
  - e.g., no global search
  - Some can be partially replicated with local view
    - e.g., friend suggestion
- Computation only in browser
  - Don't have background processes
  - Push notification
  - Future research

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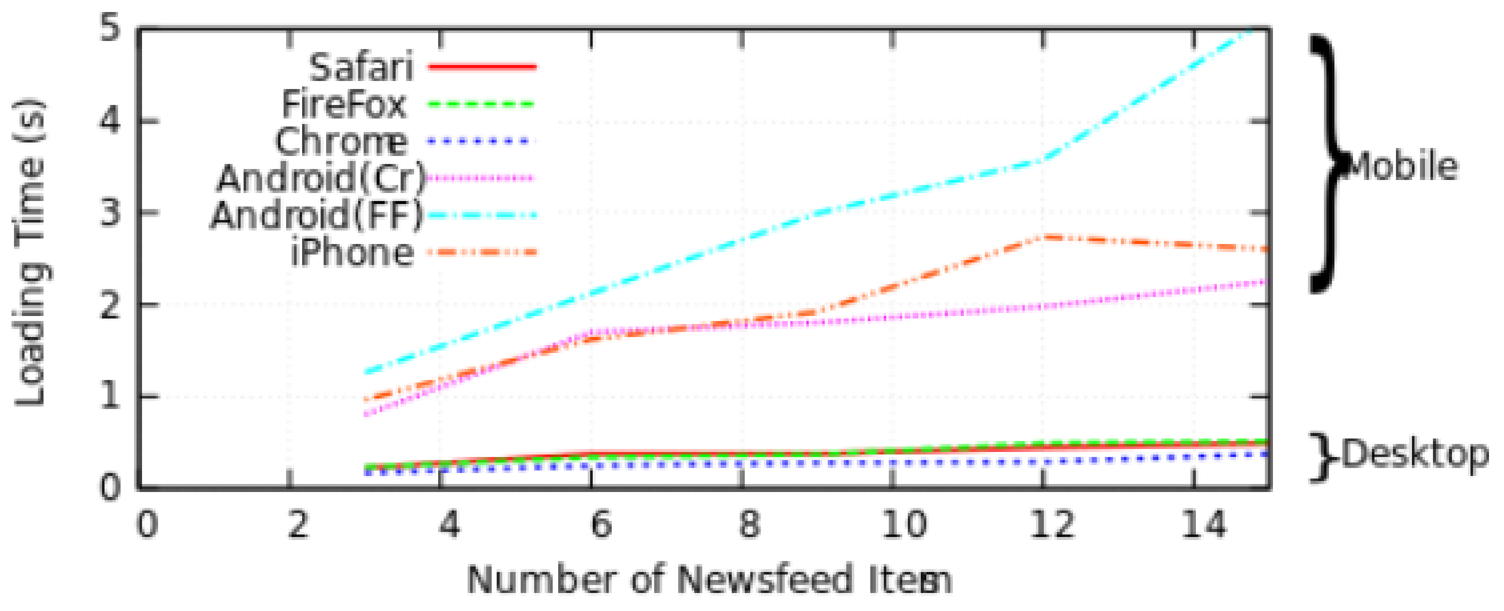
Evaluation overview

- Prototype system
  - Supports Amazon SQS and S3
  - Runs latest common web browsers (desktop and mobile)
  - 5,931 lines of JavaScript
- How much overhead from encryption?
  - Microbenchmarks on running time
  - AES: 100K object: under 43ms (desktop), 327ms (mobile)
  - **Provide decent performance**
  - ABE more expensive, but much less frequent

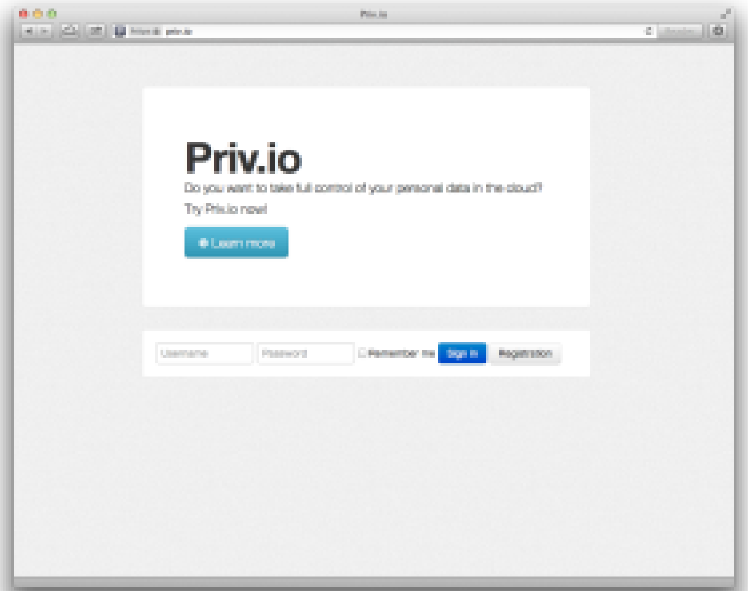
How's user-perceived performance?



- Load 15 Newsfeed items
- Feed loading time:

  below 515ms (desktop), 5.1s (mobile)
- **Comparable to today's OSN services on desktop**

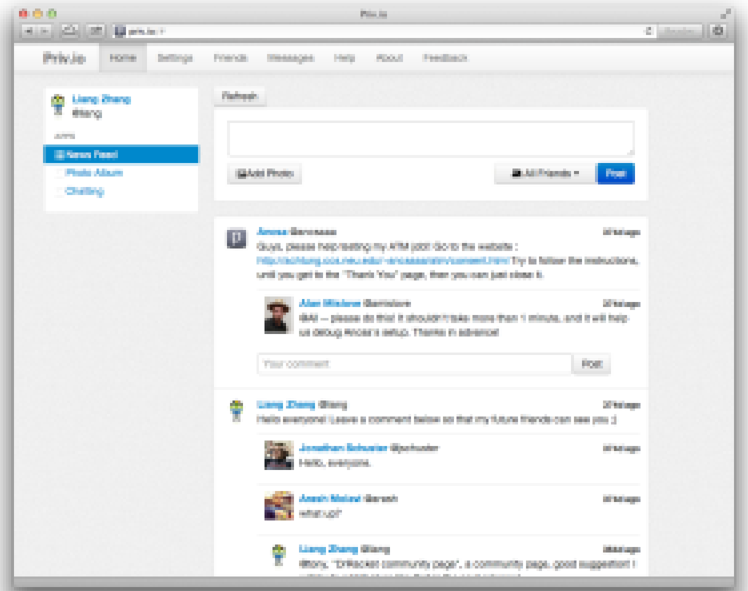
How does Priv.io work in practice?



Priv.io

Do you want to take full control of your personal data in the cloud?

Try Priv.io now!



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@tony, "DrRacket community page", a community page, good suggestion! [illegible]

- Deploy within our department for two months
    - 28 graduate students and professors
    - 88 friendships, an average 3.82 friends per user
    - Post 221 items
- **It works on today's browsers (desktop and mobile)**

Summary

- Confederated platform for building Web-based services
- Leverage:
  - Cloud providers for storage, bandwidth, and messaging
  - User’s Web browser for computation
- In Priv.io, users
  - Retain control of their own data
  - Keep data privately from the service provider
  - Enjoy a highly reliable and available service
- Result:
  - Work with today's web browsers
  - Newsfeed: Facebook alike application

Thank You!

Questions?

https://priv.io/

https://github.com/LeoLiangZhang/Priv.io