Don't Tread on Me: Moderating Access to OSN Data with **SpikeStrip**

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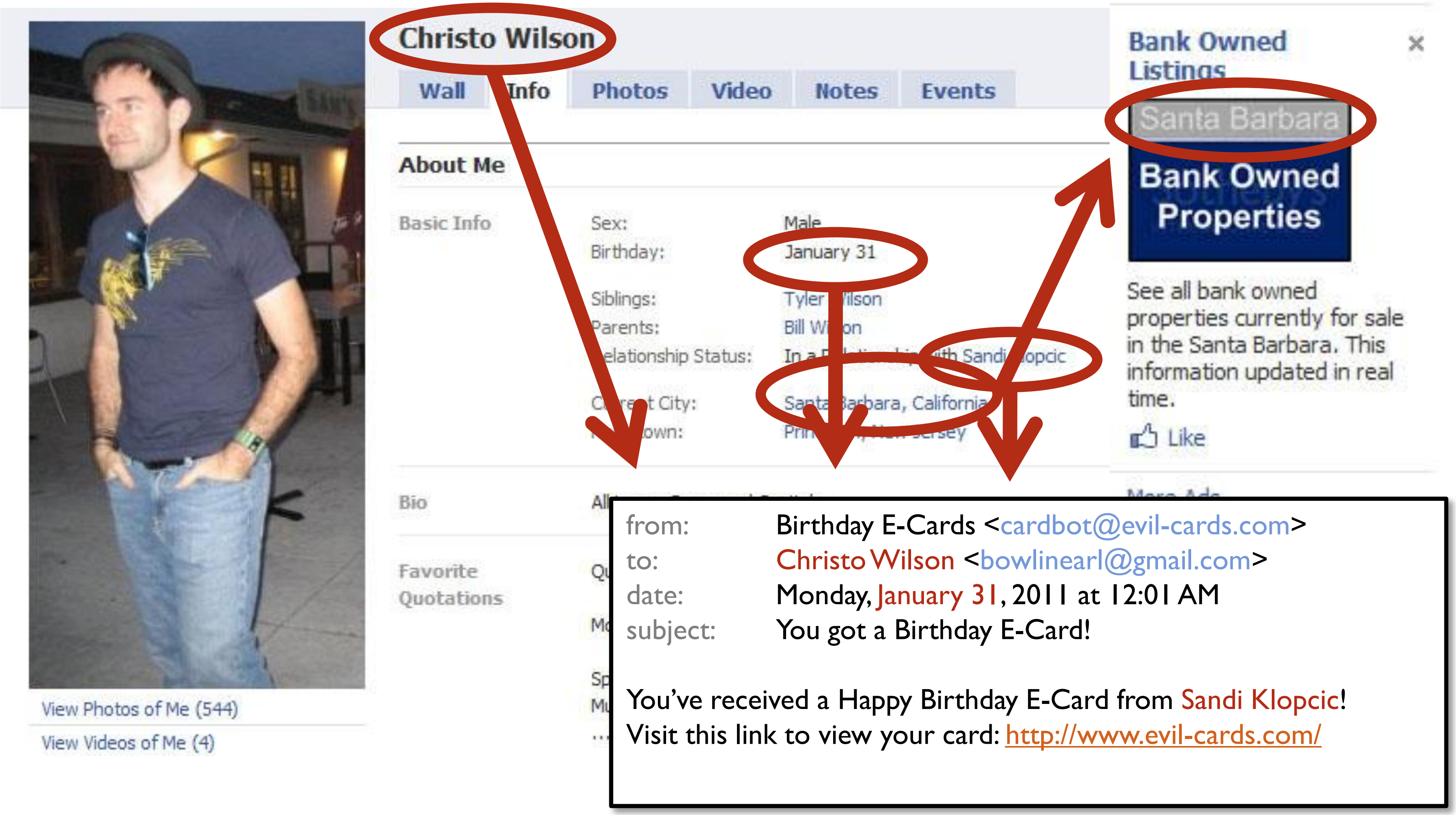
Problem: People Want Your Data



Christo Wilson

About Me

Basic Info

Sex: Male
Birthday: January 31
Siblings: Tyler Wilson
Parents: Bill Wilson
Relationship Status: In a Relationship with Sandi Klopcic
Current City: Santa Barbara, California
Hometown: Princeton, New Jersey

Bio

Favorite Quotations

View Photos of Me (544)
View Videos of Me (4)

Bank Owned Listings

See all bank owned properties currently for sale in the Santa Barbara. This information updated in real time.

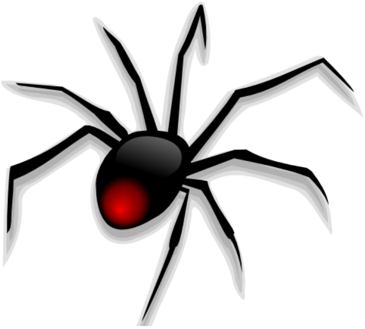
from: Birthday E-Cards <cardbot@evil-cards.com>
to: Christo Wilson <bowlinearl@gmail.com>
date: Monday, January 31, 2011 at 12:01 AM
subject: You got a Birthday E-Card!

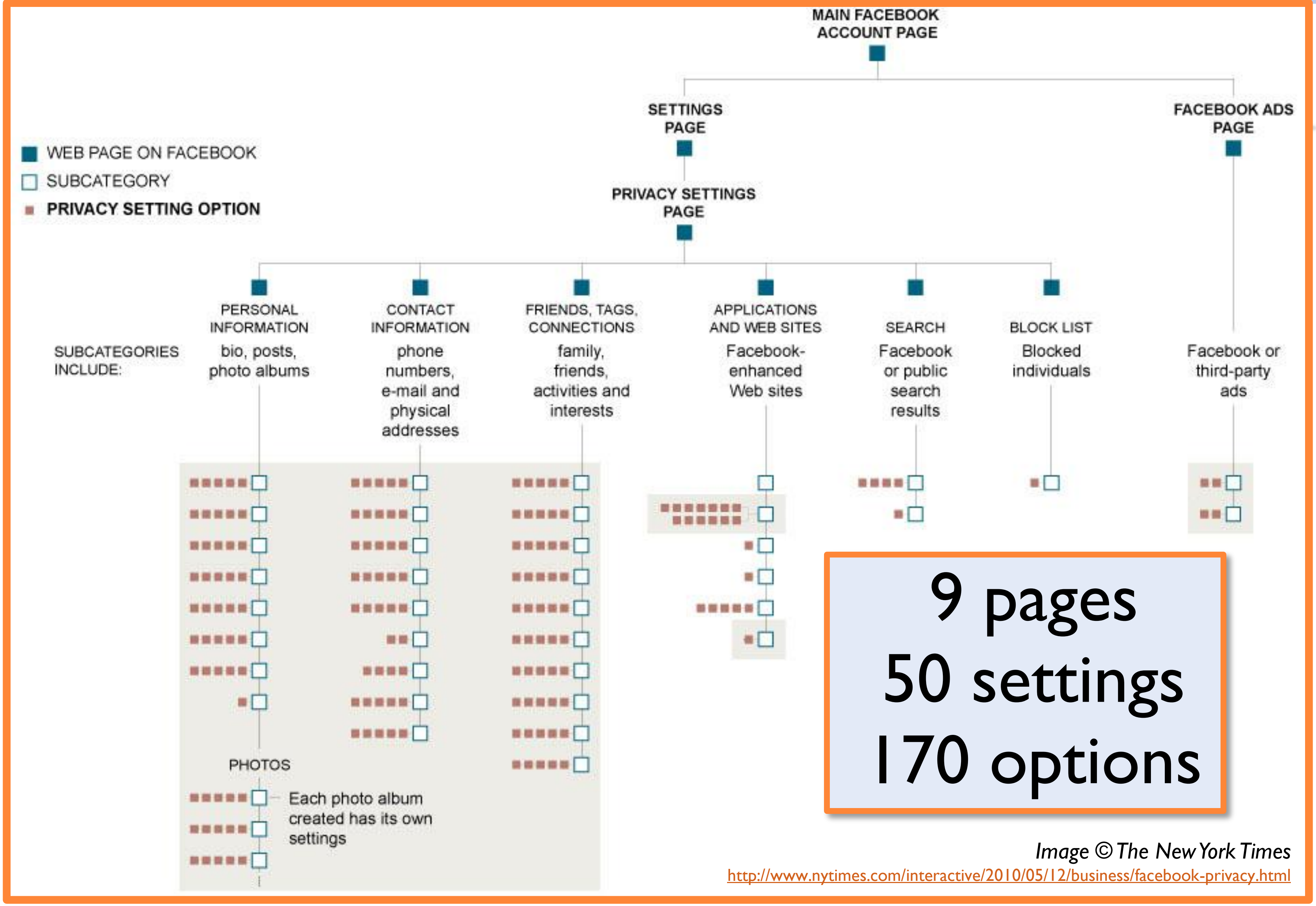
You've received a Happy Birthday E-Card from Sandi Klopcic!
Visit this link to view your card: http://www.evil-cards.com/

Big Data = Big Problems

facebook | renren 校内 xiaonei | LinkedIn

- 450 Million | 150 Million | 70 Million
- Crawlers are actively collecting OSN data
  - Pete Warden crawled 210 Million f profiles
  - RapLeaf crawls and sells OSN data to marketers
  - 80legs offers crawling as a service (150K pages per $1)
  - Yes, this includes researchers
  - Many more emerging threats!





■ WEB PAGE ON FACEBOOK
□ SUBCATEGORY
▪ PRIVACY SETTING OPTION
MAIN FACEBOOK ACCOUNT PAGE
SETTINGS PAGE
FACEBOOK ADS PAGE
PRIVACY SETTINGS PAGE
SUBCATEGORIES INCLUDE:
PERSONAL INFORMATION
bio, posts, photo albums
CONTACT INFORMATION
phone numbers, e-mail and physical addresses
FRIENDS, TAGS, CONNECTIONS
family, friends, activities and interests
APPLICATIONS AND WEB SITES
Facebook-enhanced Web sites
SEARCH
Facebook or public search results
BLOCK LIST
Blocked individuals
Facebook or third-party ads
PHOTOS
Each photo album created has its own settings

9 pages

50 settings

170 options

Image © The New York Times

http://www.nytimes.com/interactive/2010/05/12/business/facebook-privacy.html

Introducing SpikeStrip

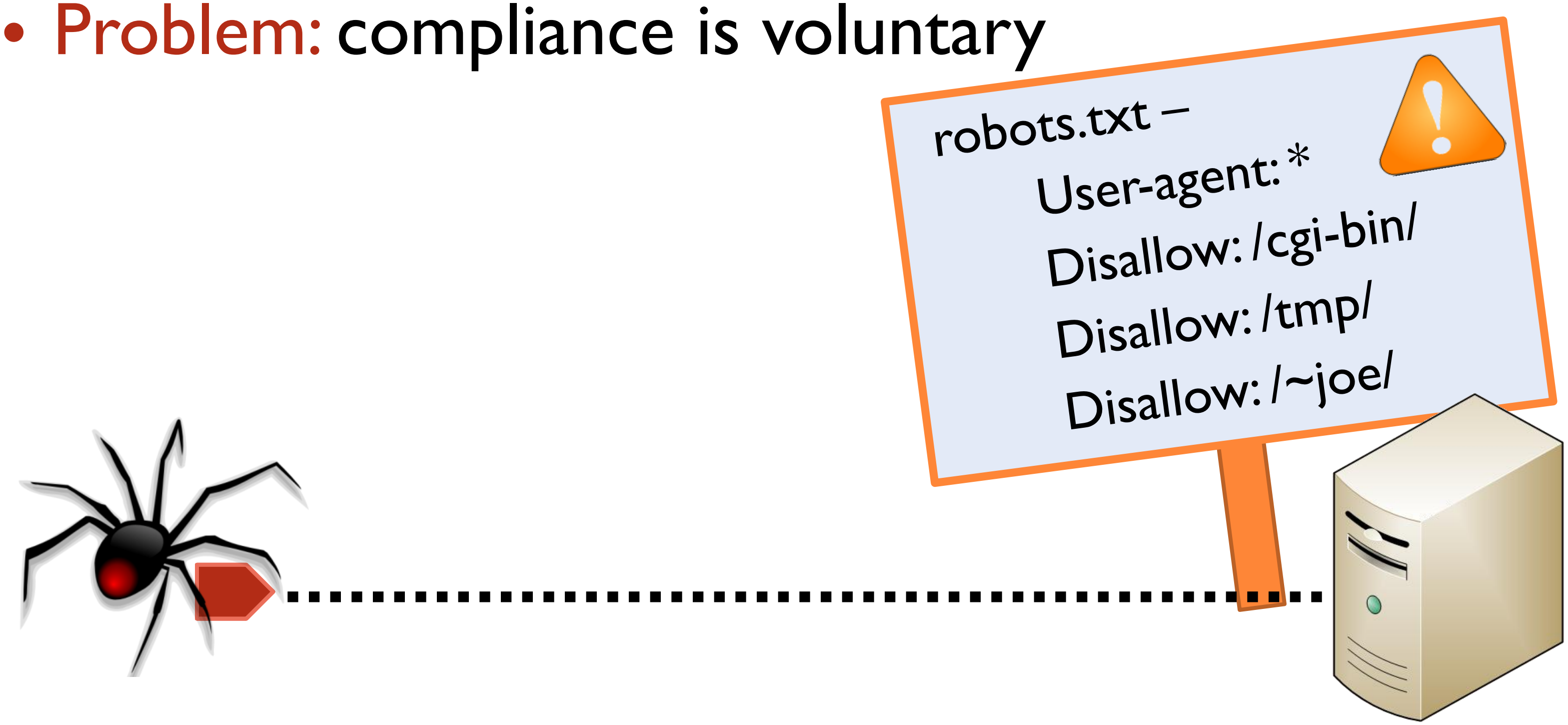
- Project goal: defend against malicious crawlers
  - Seamless to end-users and beneficial crawlers
  - Minimal impact on web server
  - Compatible with existing technology
- SpikeStrip uses novel "link-encryption" primitive
  - Used to track and rate-limit users
- Implement and evaluate SpikeStrip
  - Can impose arbitrary slowdowns on rogue crawlers
  - Only imposes 7% performance overhead on web server

Outline

- Overview
- **Existing Defenses (and why they don't work)**
- Designing SpikeStrip
- Evaluation

Robots.txt

- File placed on web server that tells crawlers how to behave
- Problem: compliance is voluntary

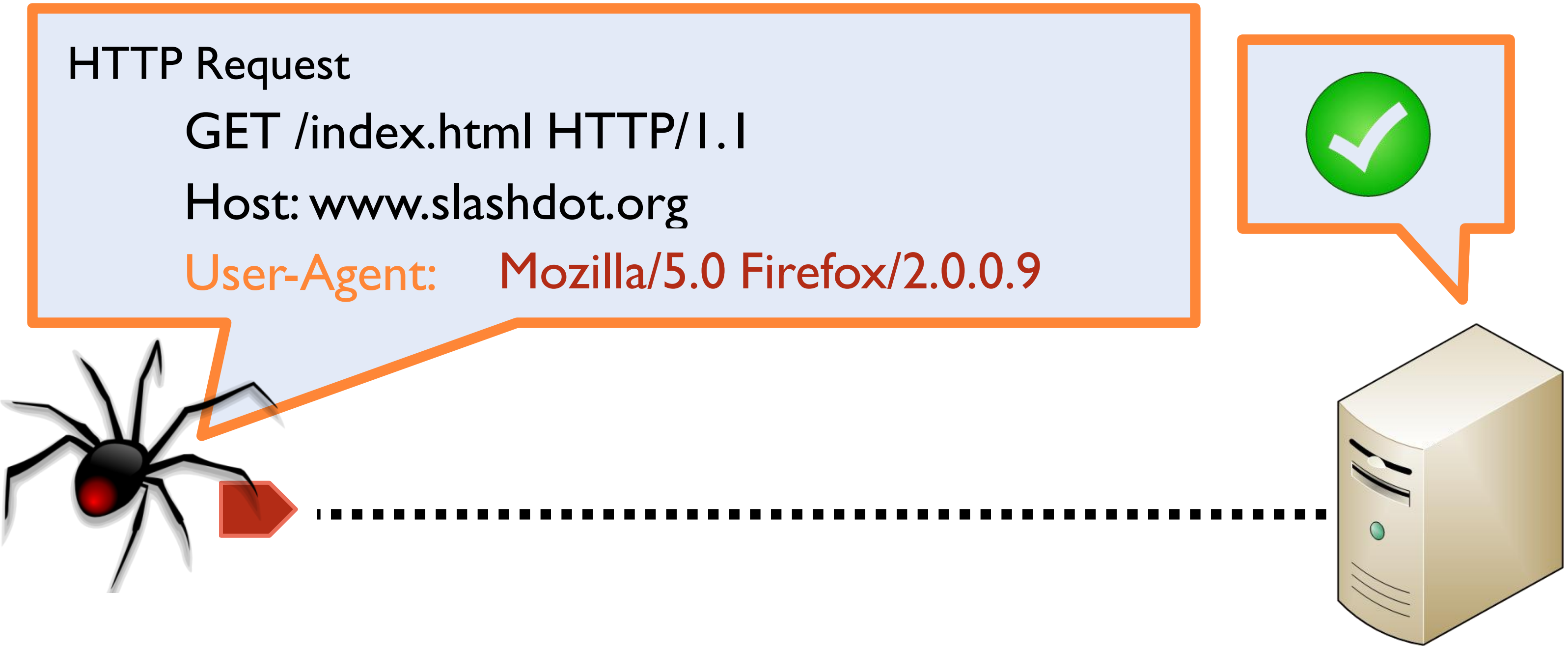


robots.txt –

```
User-agent: *
Disallow: /cgi-bin/
Disallow: /tmp/
Disallow: /~joel/
```

HTTP Request Headers

- Filter requests based on HTTP Request Header information
- Problem: headers can be modified by clients

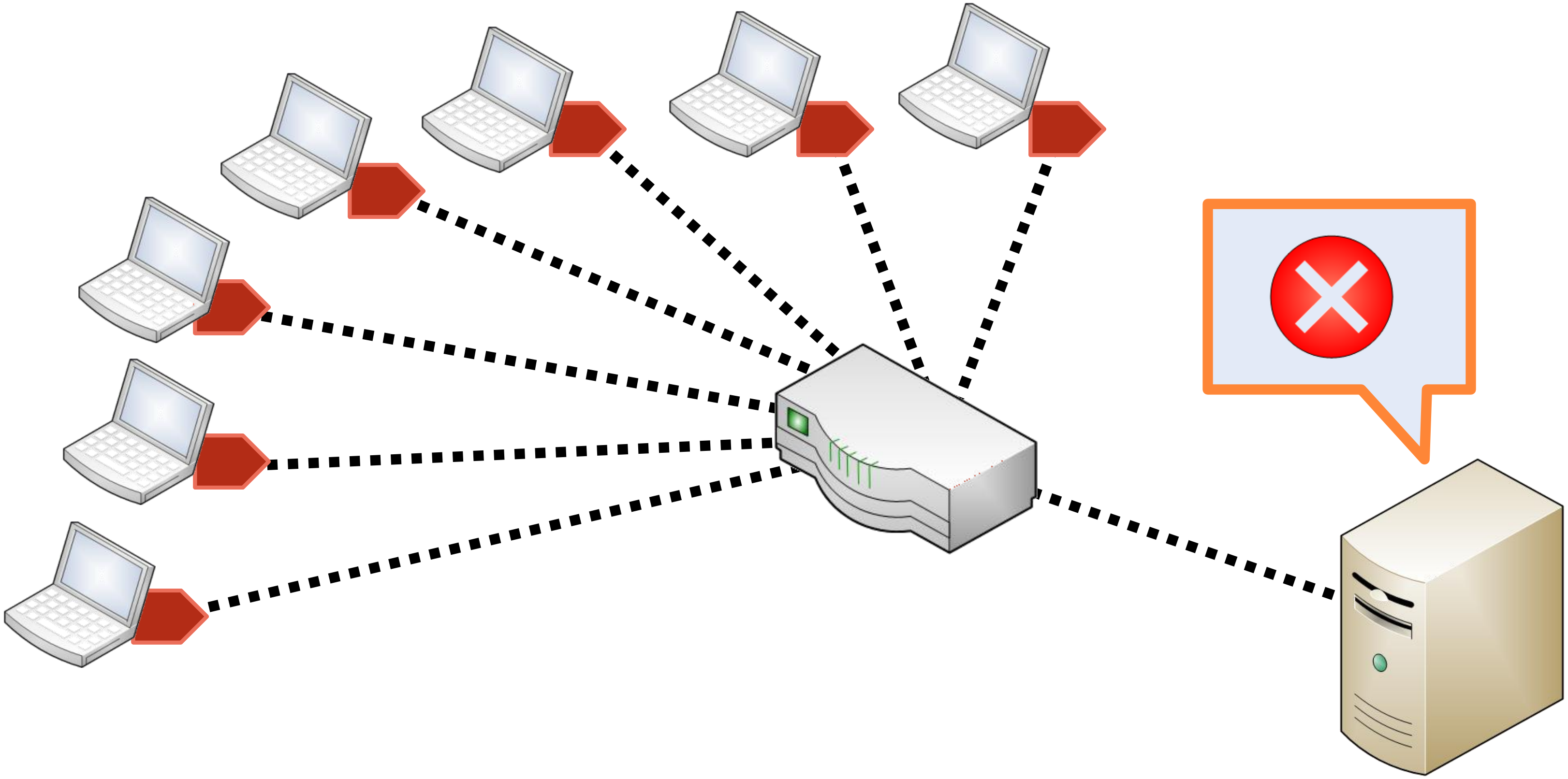


HTTP Request

```
GET /index.html HTTP/1.1
Host: www.slashdot.org
User-Agent:     Mozilla/5.0 Firefox/2.0.0.9
```

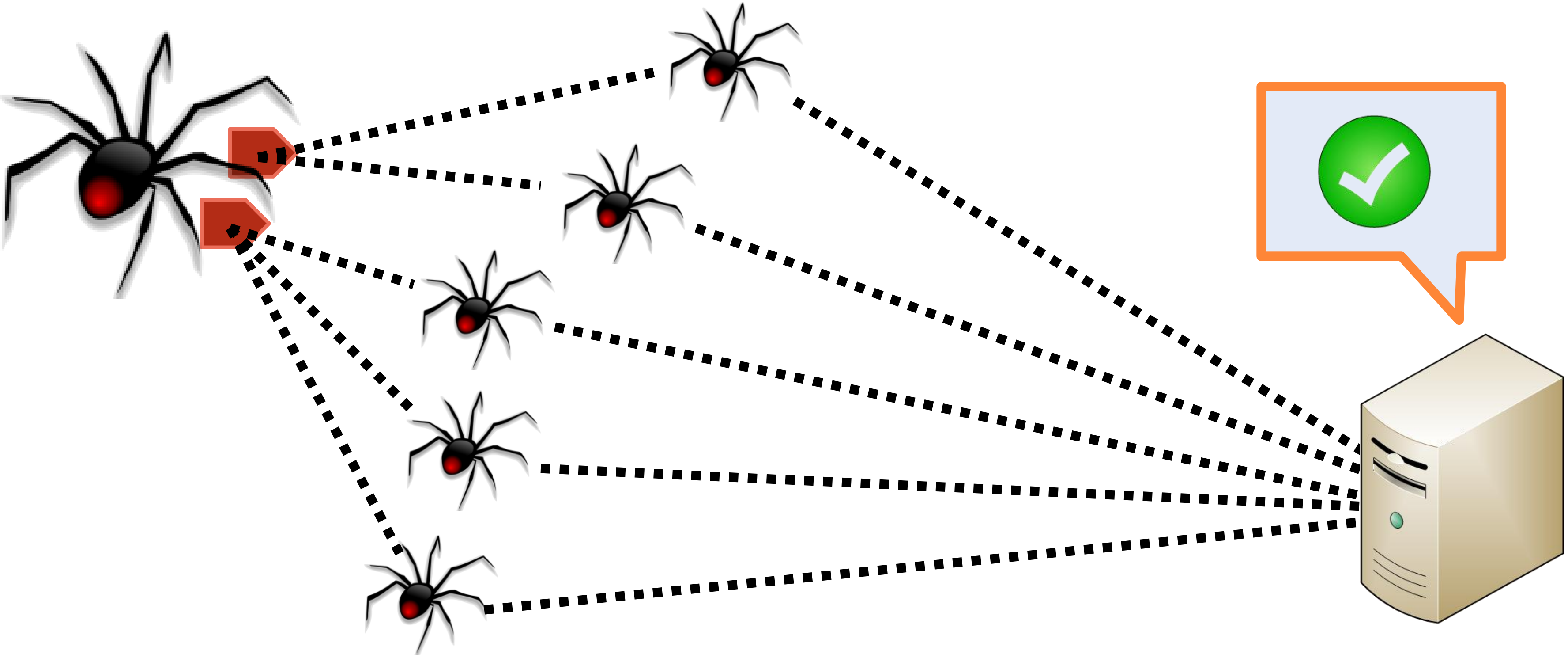
IP Address Tracking

- Rate limit request on a per-IP basis
- Problem 1: NATs and Proxies



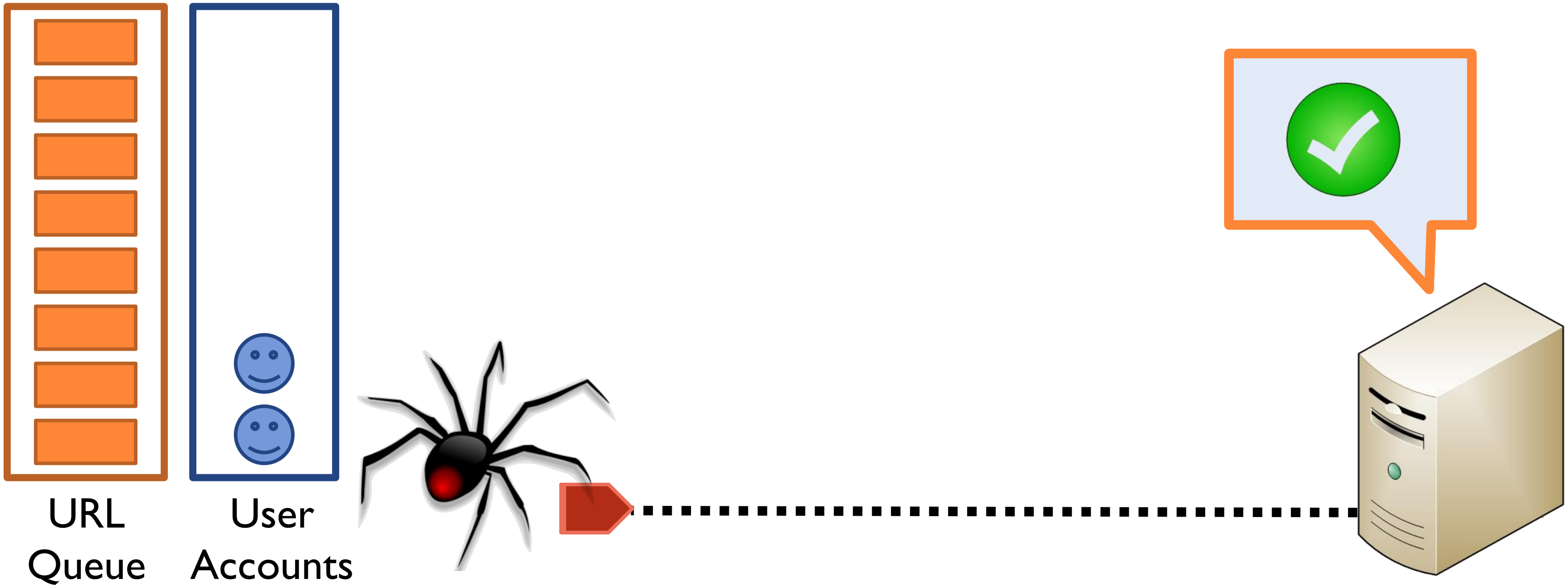
IP Address Tracking

- Rate limit request on a per-IP basis
- Problem 2: Botnets



Authenticated User Accounts

- OSNs require users to sign-up and log-in
- Ban user accounts that generate too much traffic
- Problem: URLs are **session independent**



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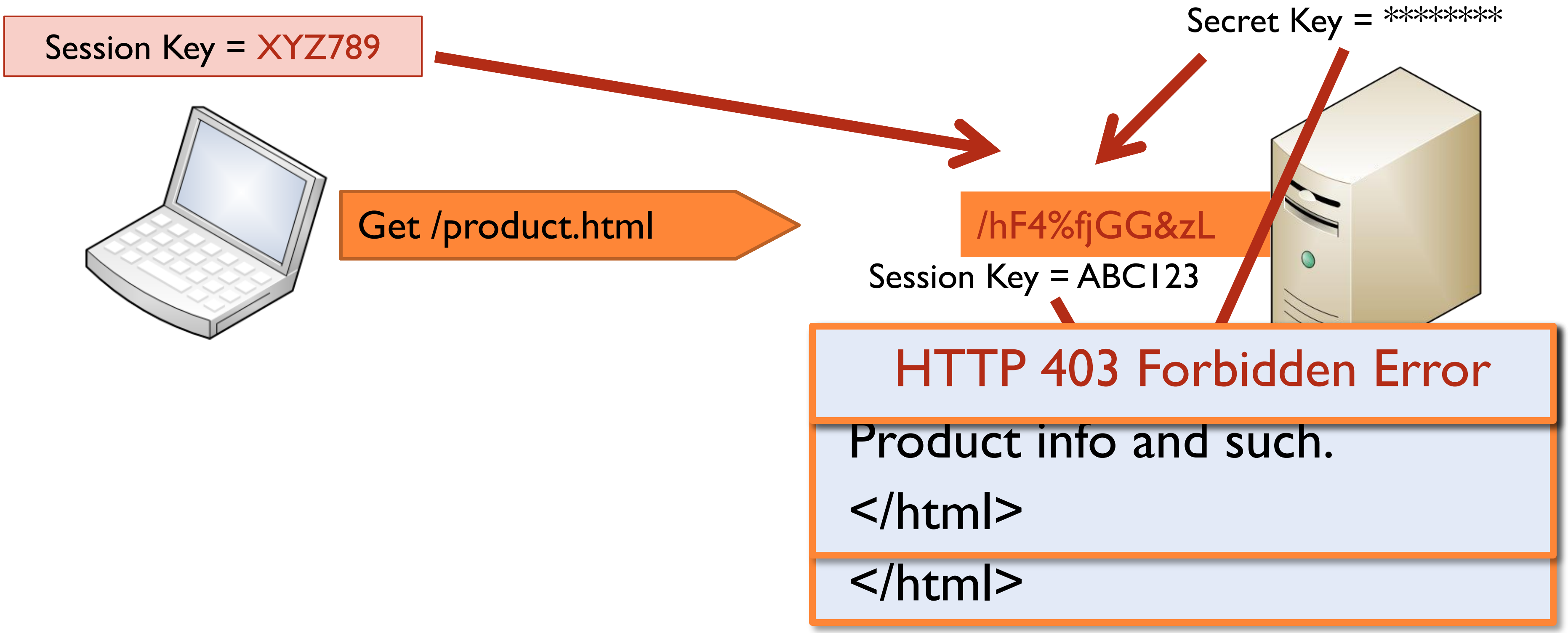
Link-Encryption

- State of the art in crawler defense isn't enough
  - URLs are still **session independent**
  - Crawlers can switch accounts, share state between accounts
  - Need a way to link URLs to clients
- Solution: server-side link-encryption
  - Encrypt links using user's session key and server-side secret key
  - Uniquely binds all served URLs to the user
- Link-encryption enables reliable per-session tracking
  - Rate-limit sessions to throttle crawlers

Link-Encryption Example



Session Key = XYZ789

Secret Key = ********

Get /product.html

/hF4%fjGG&zL

Session Key = ABC123

HTTP 403 Forbidden Error

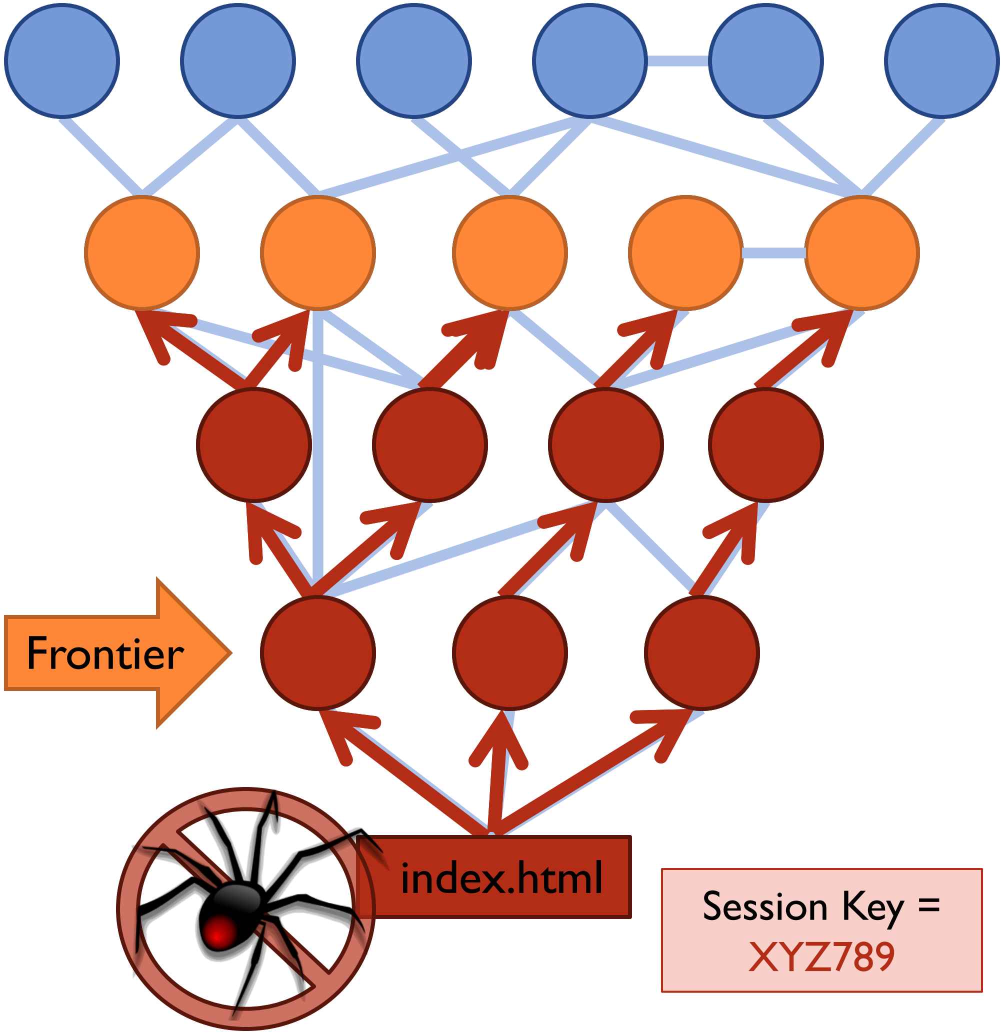
Product info and such.

</html>

</html>

Implications of Link Encryption

- Consider a BFS on an OSN website…
- Queued URLs are bound to session
- Prevents session-switching



Rate Tracking and Limiting

- Reliable tracking enables rate limiting
  - Very tight limits – no need to pad for NATs
  - Enforcement – drop requests, ban accounts, etc
- Challenge: Scaling to high volume OSN sites
- Solution: Counting Bloom Filters
  - Often used in high-throughput network security contexts
  - SpikeStrip uses d-left CBF – fastest and most space efficient CBF variant

SpikeStrip Overview

Summary

- Link-encryption creates per-session "views" of the OSN
  - URLs are unique within each view
  - Binds URLs and clients
  - Enables reliable client tracking
- Prevents bad behavior
  - Crawlers can't switch sessions
  - Distributed crawlers can't share URLs
  - Enables strong rate-limiting

New!

- Doesn't hinder normal users and useful crawlers
  - Whitelist safe URLs using regex
  - Whitelist IPs/domains of good crawlers

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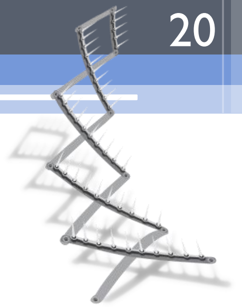
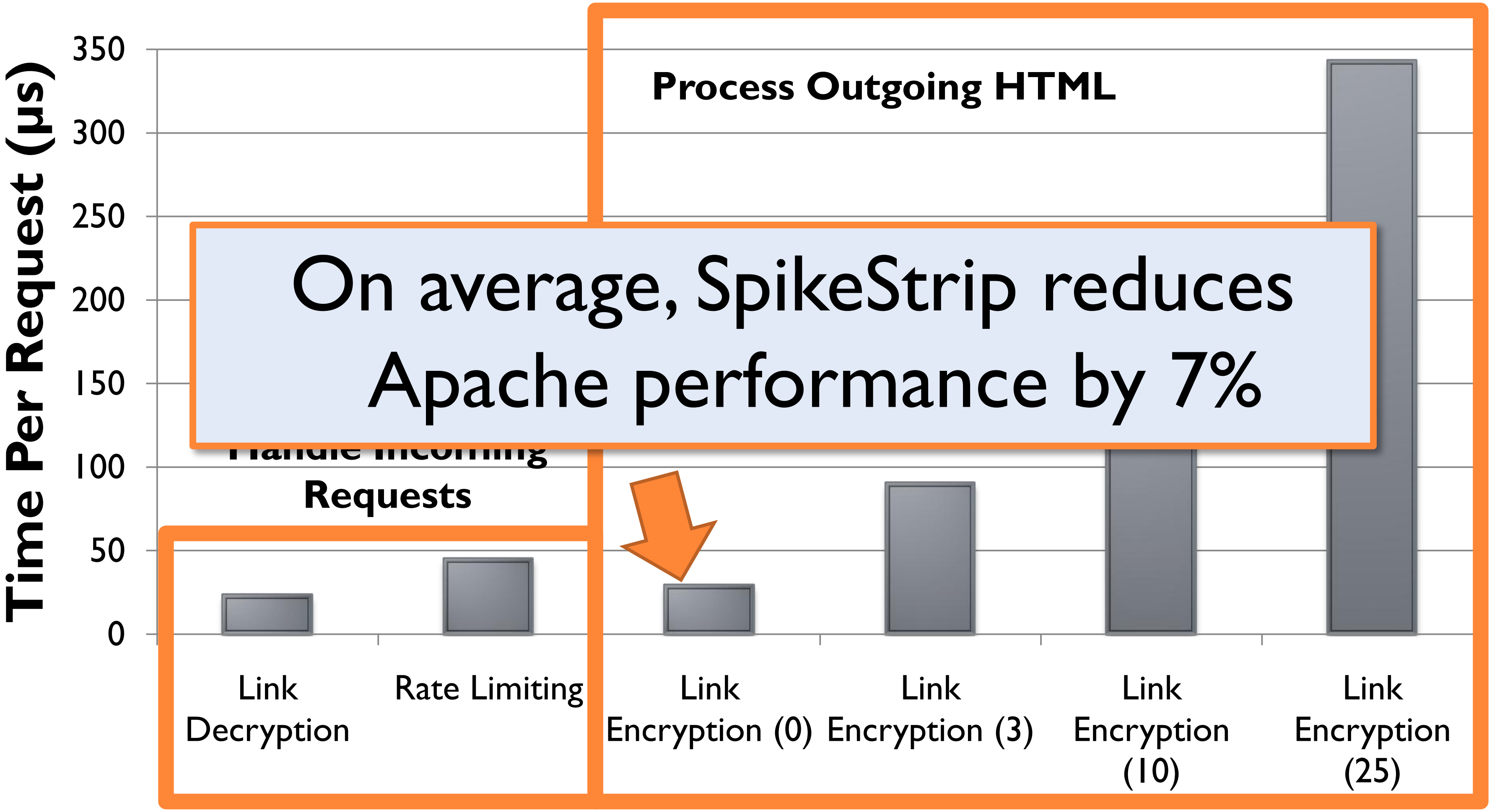
- **Evaluation**

SpikeStrip Evaluation

- Questions:
  - How much server overhead does SpikeStrip cause?
    - Implemented SpikeStrip as an Apache 2 module
    - 256-bit AES encryption, d-left CBF
  - How effective is SpikeStrip at throttling crawlers?
    - Created mock OSN called **Fakebook**
      - Based on data from f London
      - 3.5 Million pages
      - Typical LAMP setup (Linux, Apache, MySQL, Python)
      - 10 load-balanced web servers, 1 DB



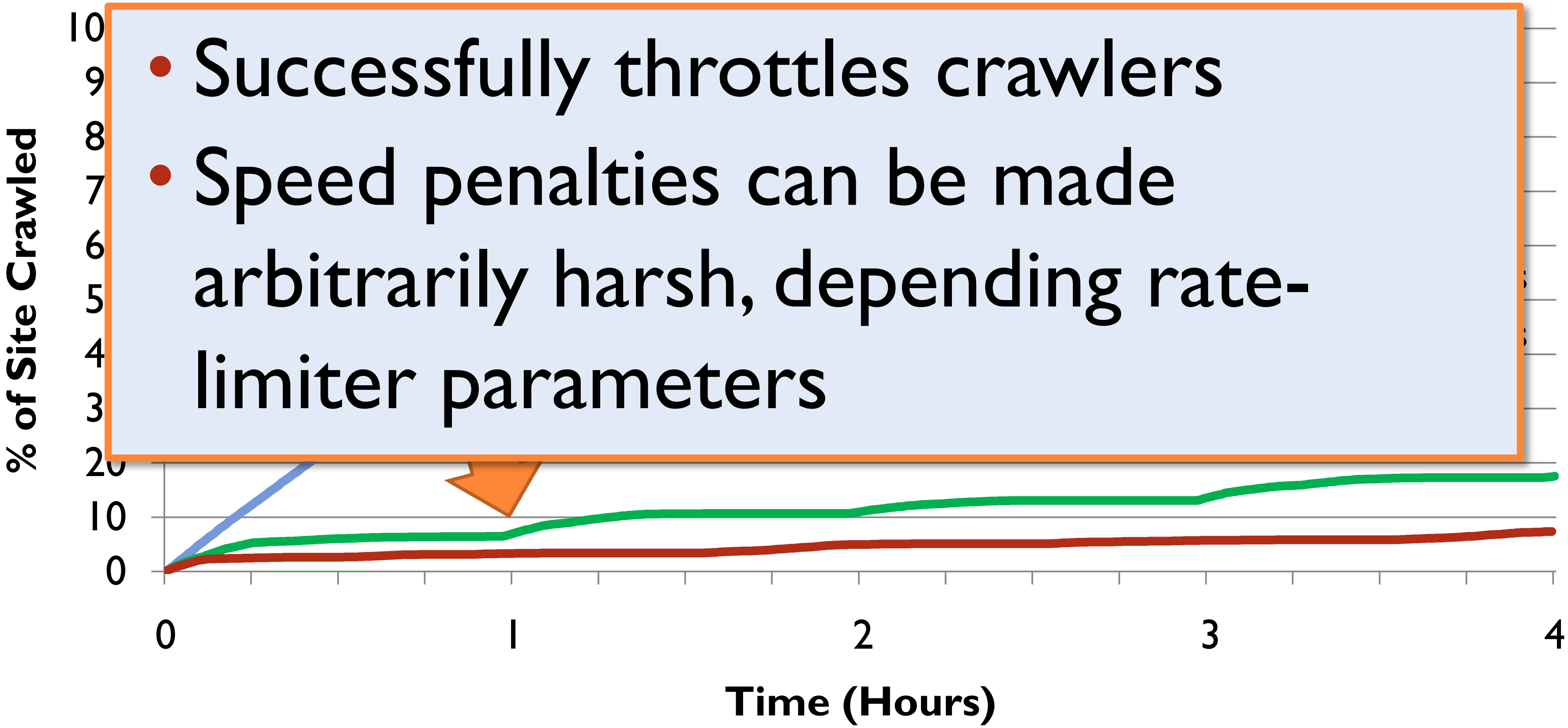
SpikeStrip Micro-Benchmarks



On average, SpikeStrip reduces Apache performance by 7%

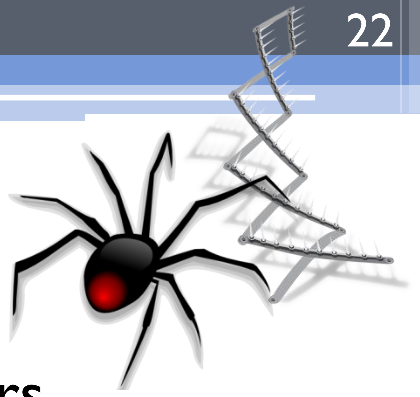
SpikeStrip vs. Crawlers

- Rate limit = 1000 requests per hour
- 0.25 Requests Per Second (RPS)



- Successfully throttles crawlers
- Speed penalties can be made arbitrarily harsh, depending rate-limiter parameters

Conclusion

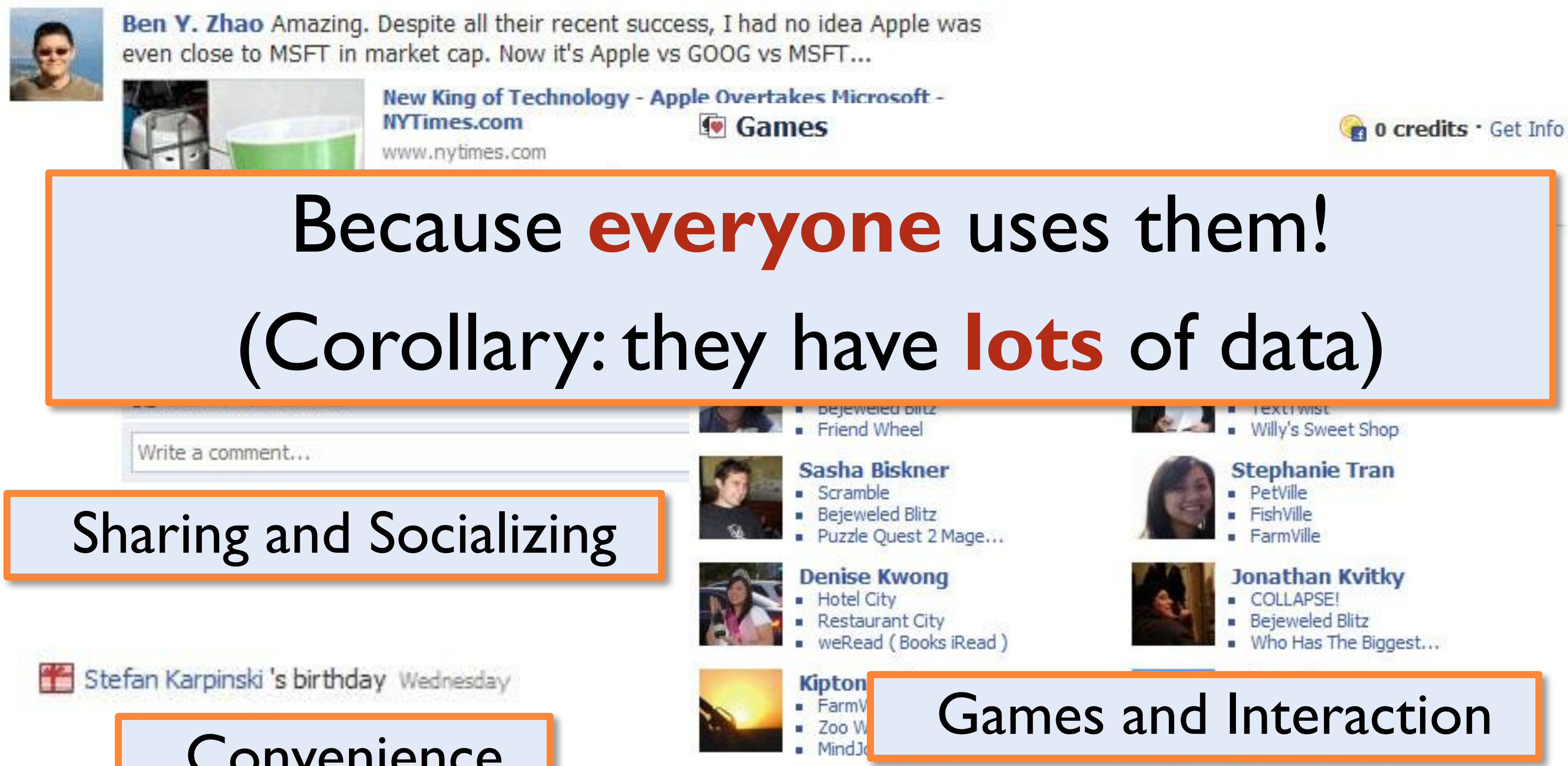


- OSN users are defenseless against malicious crawlers
- It’s up to OSNs to secure users’ data
- SpikeStrip uses novel link-encryption technique
  - Overcomes traditional user tracking challenges
    - Disambiguates users behind NATs/proxies
    - Renders botnets ineffectual
  - Minimal inconvenience for end-users
- SpikeStrip works in practice
  - Imposes minimal overhead on server
  - Successfully throttles crawlers
  - Works with existing Apache setups

SpikeStrip for Apache 2.x is Open Source!

Source code and benchmark tests available at
http://www.cs.ucsb.edu/~bowlin/projects.html

Why are OSNs so popular?



Ben Y. Zhao Amazing. Despite all their recent success, I had no idea Apple was even close to MSFT in market cap. Now it's Apple vs GOOG vs MSFT...

New King of Technology - Apple Overtakes Microsoft - NYTimes.com
www.nytimes.com

Write a comment...

Stefan Karpinski 's birthday Wednesday

Games

0 credits · Get Info

- Bejeweled Blitz
- Friend Wheel

- TextTwist
- Willy's Sweet Shop

Sasha Biskner
- Scramble
- Bejeweled Blitz
- Puzzle Quest 2 Mage...

Stephanie Tran
- PetVille
- FishVille
- FarmVille

Denise Kwong
- Hotel City
- Restaurant City
- weRead (Books iRead)

Jonathan Kvitky
- COLLAPSE!
- Bejeweled Blitz
- Who Has The Biggest...

Kipton
- FarmV
- Zoo W
- MindJ

Because **everyone** uses them!

(Corollary: they have **lots** of data)

Sharing and Socializing

Convenience

Games and Interaction

Existing Defenses Against Crawlers

- Passive Defenses
  - Robots.txt
  - HTTP Request Header Filtering
- Active Defenses
  - Relies on identifying, tracking, and rate limiting clients
  - Usually done by IP address
- Authentication Based Defenses
  - Control access by authenticating users
  - Use CAPTCHAs to control account creation
  - Ban users who break the rules

Link Opacity

- Link-encryption makes links opaque

bit.ly/bXRgmp → www.engadget.com/2010/06/07/

facebook.com/secure/AnvTR641z → facebook.com/christowilson

- Not useful for security – metadata allows disambiguation

```
<a href=http://facebook.com/secure/AnvTR641z>
Christo Wilson's Profile
</a>
```

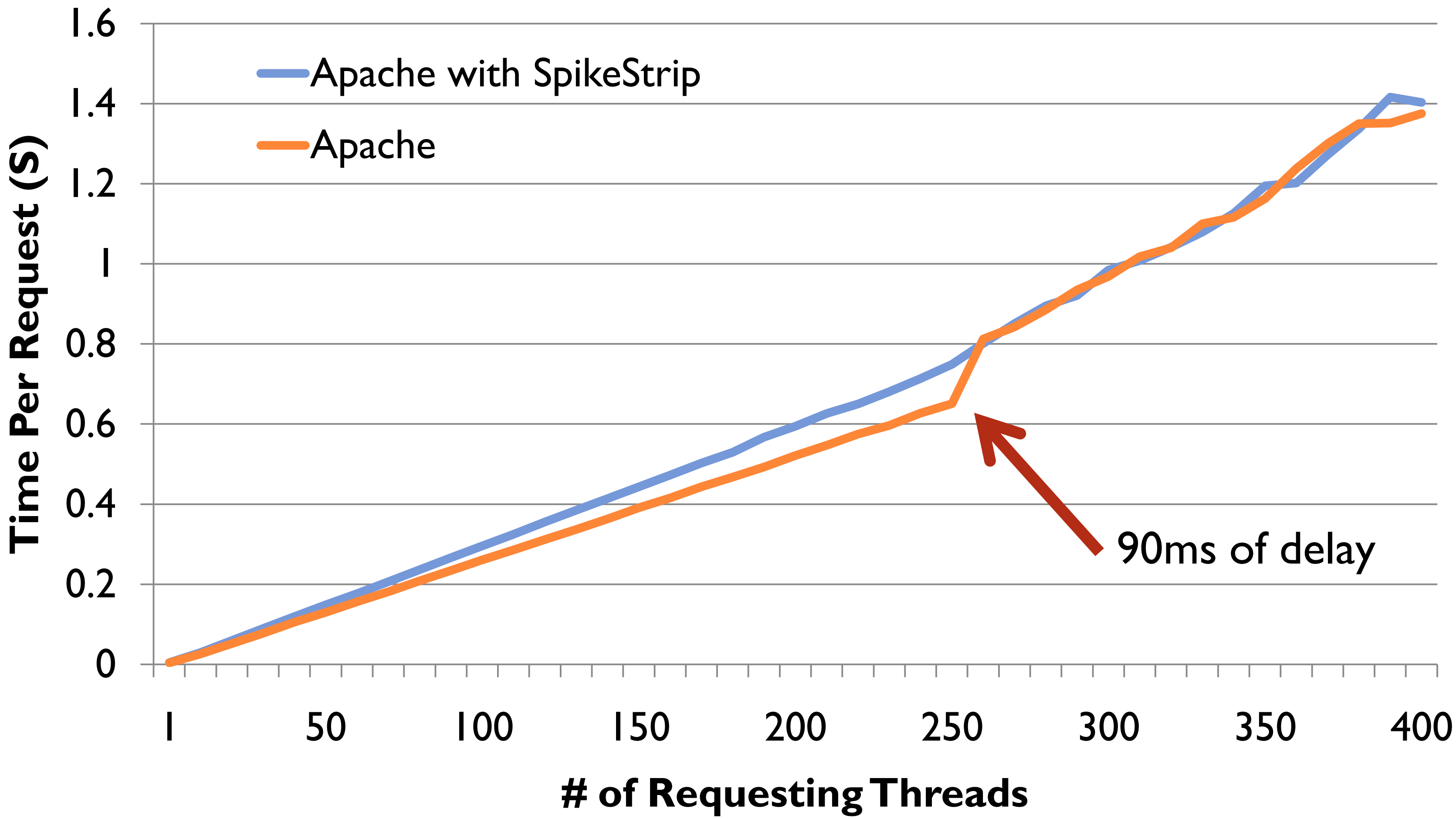
Link Sharing

- Link-encryption makes it hard to share links
- Lots of web tech already does this
  - Shopping carts
  - AJAX
- Important pages to people ≠ important pages to crawlers
  - Crawlers need friends lists and search results
  - People want pictures
- Solution: permalinks

en.wikipedia.org/wiki/Facebook vs.

en.wikipedia.org/w/index.php?title=Facebook&oldid=366580719

End-to-End Latency



90ms of delay

Does SpikeStrip Ruin OSN Research?

NO!

- SpikeStrip enables OSNs to set up controlled access channels for researchers
  - i.e. *.ucsb.edu can crawl at rate X for Y days
- This arrangement benefits both parties
  - Researchers can crawl in a secure way
    - No need deal with account bans, etc
  - OSNs can control who has access and their bandwidth allocation