http://

PART 1: GOING DEEP ON HTTP
PART 2: HIGH LEVEL HTTP APIS

Jesse Wilson

Hi, I'm Jesse

- Infrastructure nerd
- Former Android core libraries lead
  - Maintained Android's HttpURLConnection and Apache HTTP client
- Today I'm at Square
  - Working on OkHttp & MockWebServer

Plan

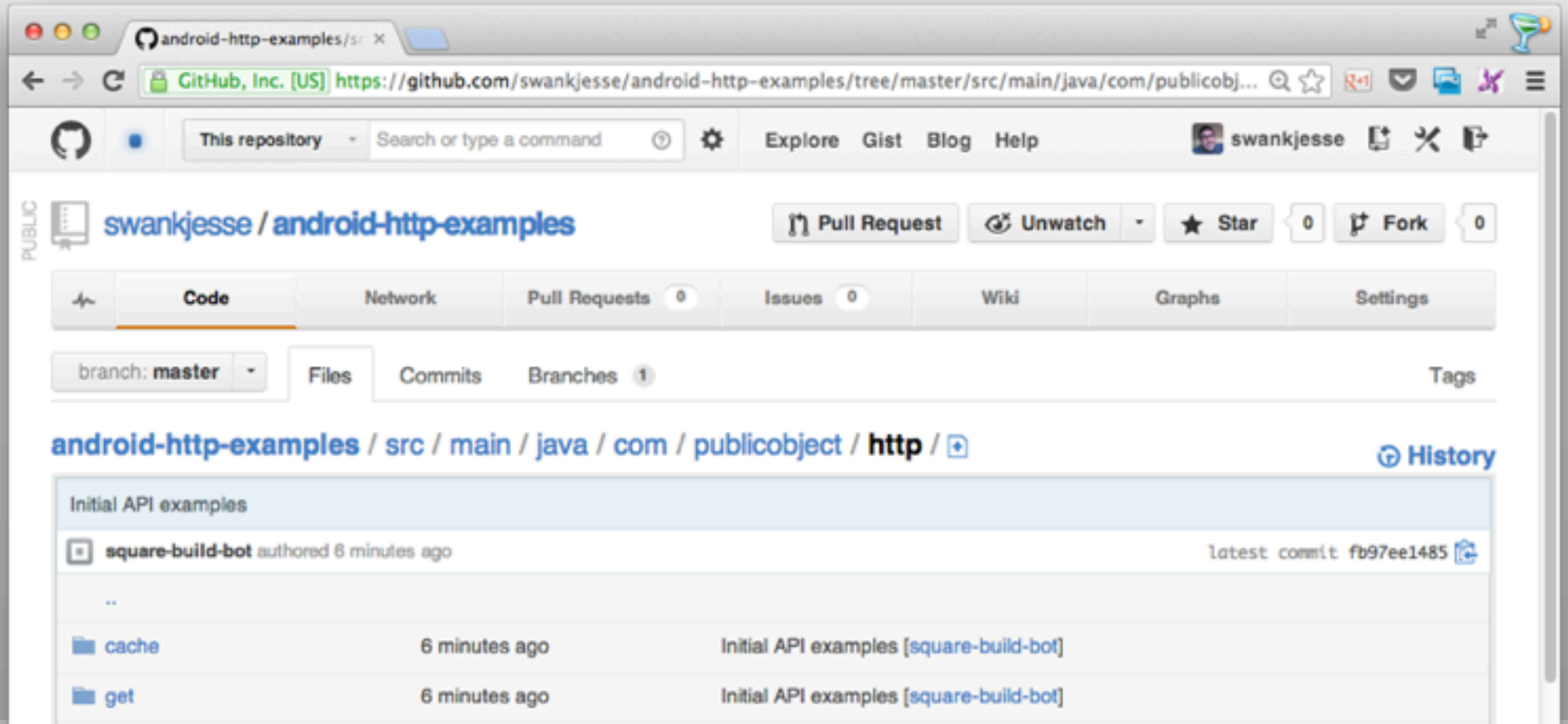
- HTTP in 2013
- HTTP clients for Android
  - Apache HTTP client
  - HttpURLConnection
  - OkHttp
- Essential dev tools
  - Charles Web Debugging Proxy
  - MockWebServer

Plan

- Retrofit
- Picasso
- Volley

Follow along

http://tinyurl.com/androidhttp



HTTP in 2013

Demo

Port 80

```
$ telnet swank.ca 80
Trying 69.163.193.18...
Connected to swank.ca.
Escape character is '^]'.
GET / HTTP/1.1
Host: swank.ca

HTTP/1.1 200 OK
Date: Tue, 08 Jan 2013 00:16:56 GMT
Server: Apache
Last-Modified: Wed, 14 Sep 2011 19:12:02 GMT
ETag: "27b-4aceb88f6a480"
Accept-Ranges: bytes
Content-Length: 199
Vary: Accept-Encoding
Content-Type: text/html; charset=utf-8

<html>
  <head><title>swank.ca</title></head>
  <body align="center" bgcolor="#003399">
    <img src="logo.png">
  </body>
</html>
```

Proxies

- HTTP proxies exist, annoy
- You speak HTTP to the proxy. It speaks HTTP to the world.

- HTTP and HTTPS

Caching

- Fundamental
- HTTP distinguishes between resources (GET) and actions (POST).

Caching example

Caching: for servers

- Use the Cache-Control & ETag headers.

```
HTTP/1.1 200 OK
Cache-Control: max-age=3600
Etag: v3
...
```

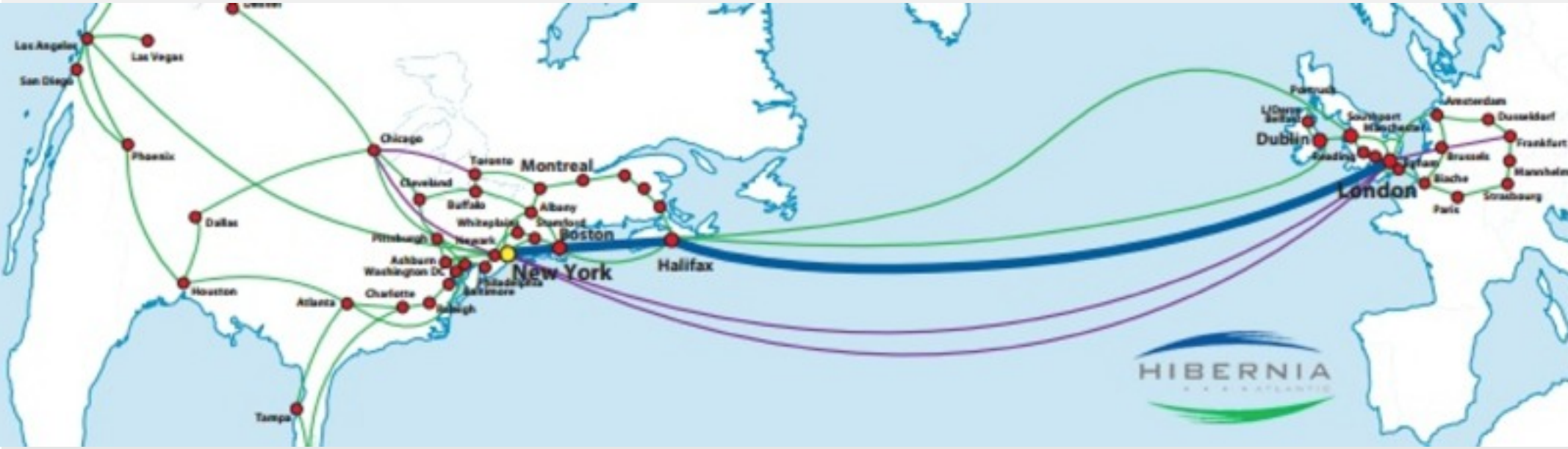
- Using modification dates is clumsy! The user agent is dumb and uses heuristics.

Caching: for servers

- Serving static resources like images?
  Use a permanent URL and let it cache forever!
- When the resource is updated, just change the URL!

Content Delivery Networks (CDNs)

- Occasionally, you're bottlenecked by the speed of light



Thumbor

http://im.squareup.com/stand.png

http://thumbor.squareup.com/unsafe/160x160/http://im.squareup.com/stand.png

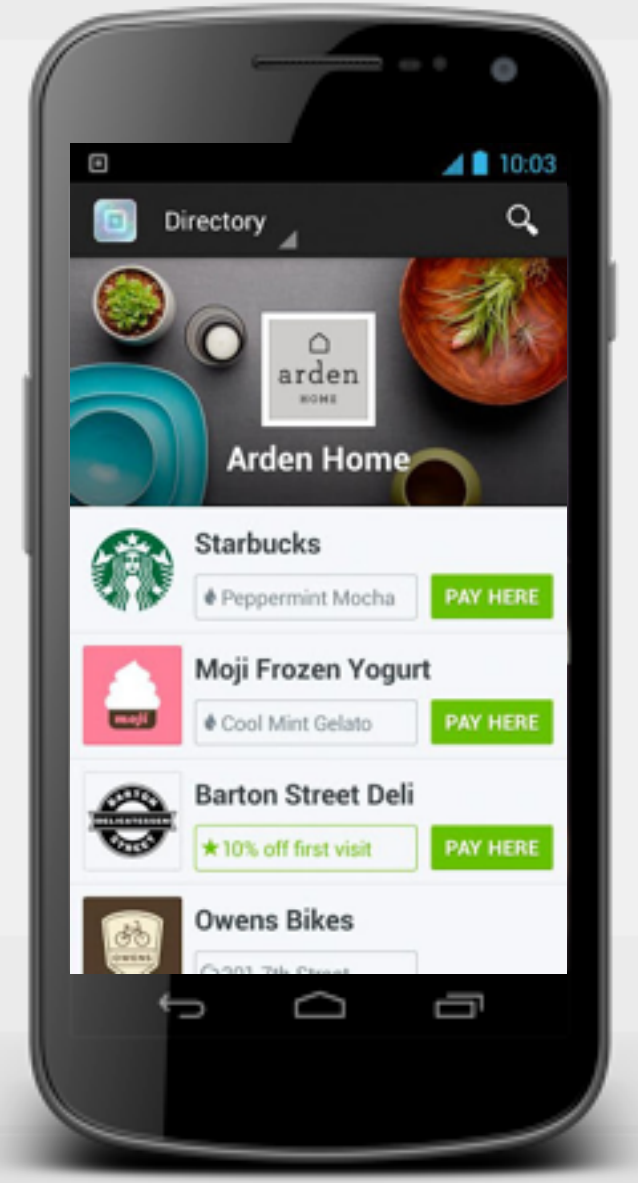
Gzip

JSON: **53** KiB

Proto: **31** KiB

gzipped JSON: **9.1** KiB

gzipped Proto: **8.5** KiB



Gzip: Clients

- Use the Accept-Encoding request header:

```
GET /directory.json HTTP/1.1
Accept-Encoding: gzip
...
```

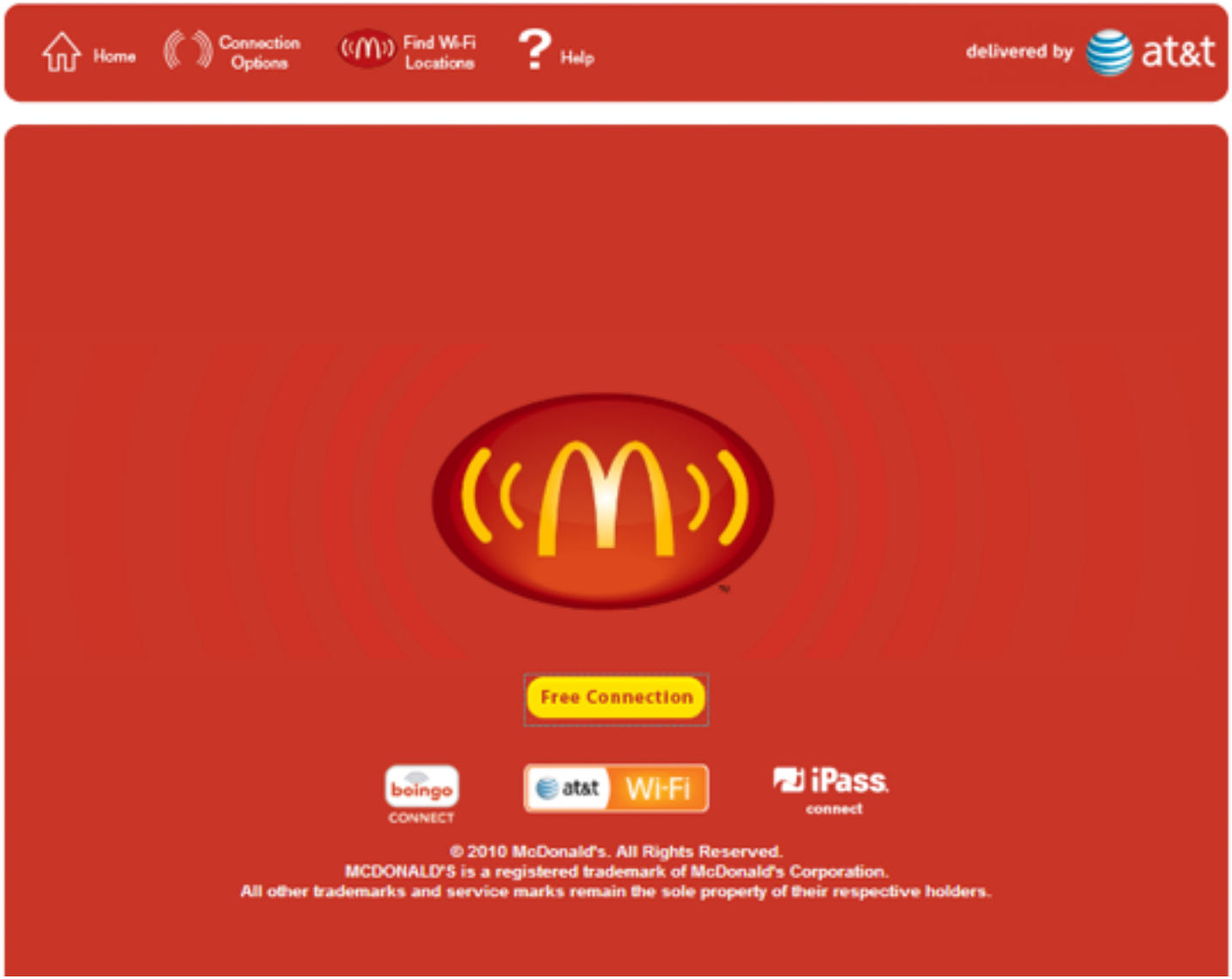
Gzip: Servers

- Using gzip on already-compressed content like images is wasteful. Don't double compress content types like image/png or image/jpeg

DNS

- Redundant datacenters?
- Supporting IPv6 and IPv4?
- Each host may have multiple IP addresses!

WiFi Hotspots



WiFi Hotspots

- Coffee shop?
- Airport?
- Your HTTP requests may be redirected.

HTTPS

- Transport Layer Security (TLS), the successor to Secure Sockets Layer (SSL).
- Reduces eavesdropping while you use the Wifi at Panera Bread or the airport

Certificate Authorities

- Lots of problems
- Governments want to spy

Certificate Authorities

- Browser vendors have two bad options:
  - Include a CA
  - Don't include a CA

Certificate Authorities

- Hardcode your cert in your app:

```
SSLSocketFactory goodSslSocketFactory(Context context) {
  KeyStore trusted = KeyStore.getInstance("BKS");
  InputStream in = context.getResources().openRawResource(R.raw.truststore);
  trusted.load(in, TRUST_STORE_PASSWORD);
  SSLContext sslContext = SSLContext.getInstance("TLS");
  TrustManagerFactory trustManagerFactory = TrustManagerFactory.getInstance(
      TrustManagerFactory.getDefaultAlgorithm());
  trustManagerFactory.init(trusted);
  sslContext.init(null, trustManagerFactory.getTrustManagers(), null);
  return sslContext.getSocketFactory();
}
```

Hostname Verification

- Does *.squareup.com match beta.api.squareup.com ?
- Validate that the certificate matches the host.
- Rules followed inconsistently!

www.cs.utexas.edu/~shmat/shmat_ccs12.pdf

The Most Dangerous Code in the World: Validating SSL Certificates in Non-Browser Software

Martin Georgiev
The University of Texas at Austin

Subodh Iyengar
Stanford University

Suman Jana
The University of Texas at Austin

Rishita Anubhai
Stanford University

Dan Boneh
Stanford University

Vitaly Shmatikov
The University of Texas at Austin

ABSTRACT

SSL (Secure Sockets Layer) is the de facto standard for secure Internet communications. Security of SSL connections against an active network attacker depends on correctly validating public-key certificates presented when the connection is established.

We demonstrate that SSL certificate validation is completely broken in many security-critical applications and libraries. Vulnerable software includes Amazon's EC2 Java library and all cloud clients based on it; Amazon's and PayPal's merchant SDKs responsible for transmitting payment details from e-commerce sites to payment gateways; integrated shopping carts such as osCommerce, ZenCart, Ubercart, and PrestaShop; AdMob code used by mobile websites; Chase mobile banking and several other Android apps and libraries; Java Web-services middleware—including Apache Axis, Axis 2, Codehaus XFire, and Pusher library for Android—and *all* applications employing this middleware. Any SSL connection from any of

cations. The main purpose of SSL is to provide end-to-end security against an active, man-in-the-middle attacker. Even if the network is completely compromised—DNS is poisoned, access points and routers are controlled by the adversary, etc.—SSL is intended to guarantee confidentiality, authenticity, and integrity for communications between the client and the server.

Authenticating the server is a critical part of SSL connection establishment.[1] This authentication takes place during the SSL handshake, when the server presents its public-key certificate. In order for the SSL connection to be secure, the client must carefully verify that the certificate has been issued by a valid certificate authority, has not expired (or been revoked), the name(s) listed in the certificate match(es) the name of the domain that the client is connecting to, and perform several other checks [14, 15].

SSL implementations in Web browsers are constantly evolving through "penetrate-and-patch" testing, and many SSL-related vulnerabilities in browsers have been repaired over the years. SSL

Cookies

- Four specs:
  Netscape, RFC 2109, RFC 2965, RFC 6265

"Prior to this document, there were at least three descriptions of cookies."

"However, none of these documents describe how the Cookie and Set-Cookie headers are actually used on the Internet."

Cookies

- Awkward on Android. No out-of-the-box place to persist across app launches.

Ranges

- Restarting a failed download sucks.
- If your app does large downloads (> 5 MiB) you should look into the Range header. You'll need to do this manually.

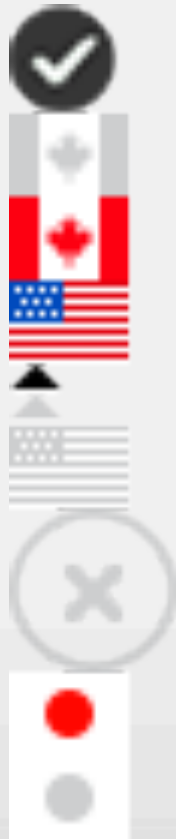
Sockets

"A single-user client SHOULD NOT maintain more than 2 connections with any server or proxy."

- IE 10 uses 8
- Chrome uses 6
- Firefox uses 6

Sockets

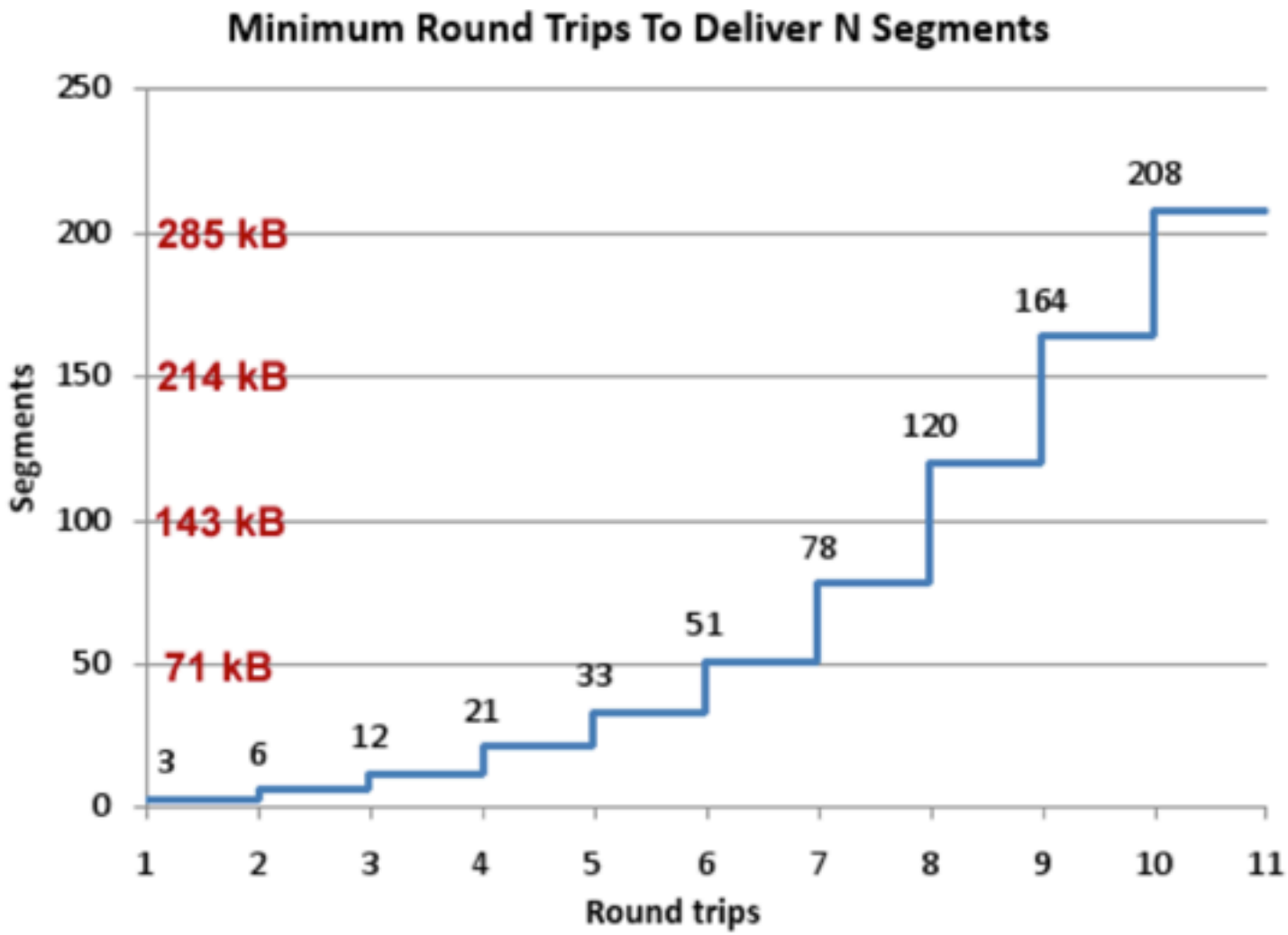
- Hacks!
  - Image spriting
  - Flattening CSS
  - Google serves content from multiple hostnames!
- These hacks hurt caching!



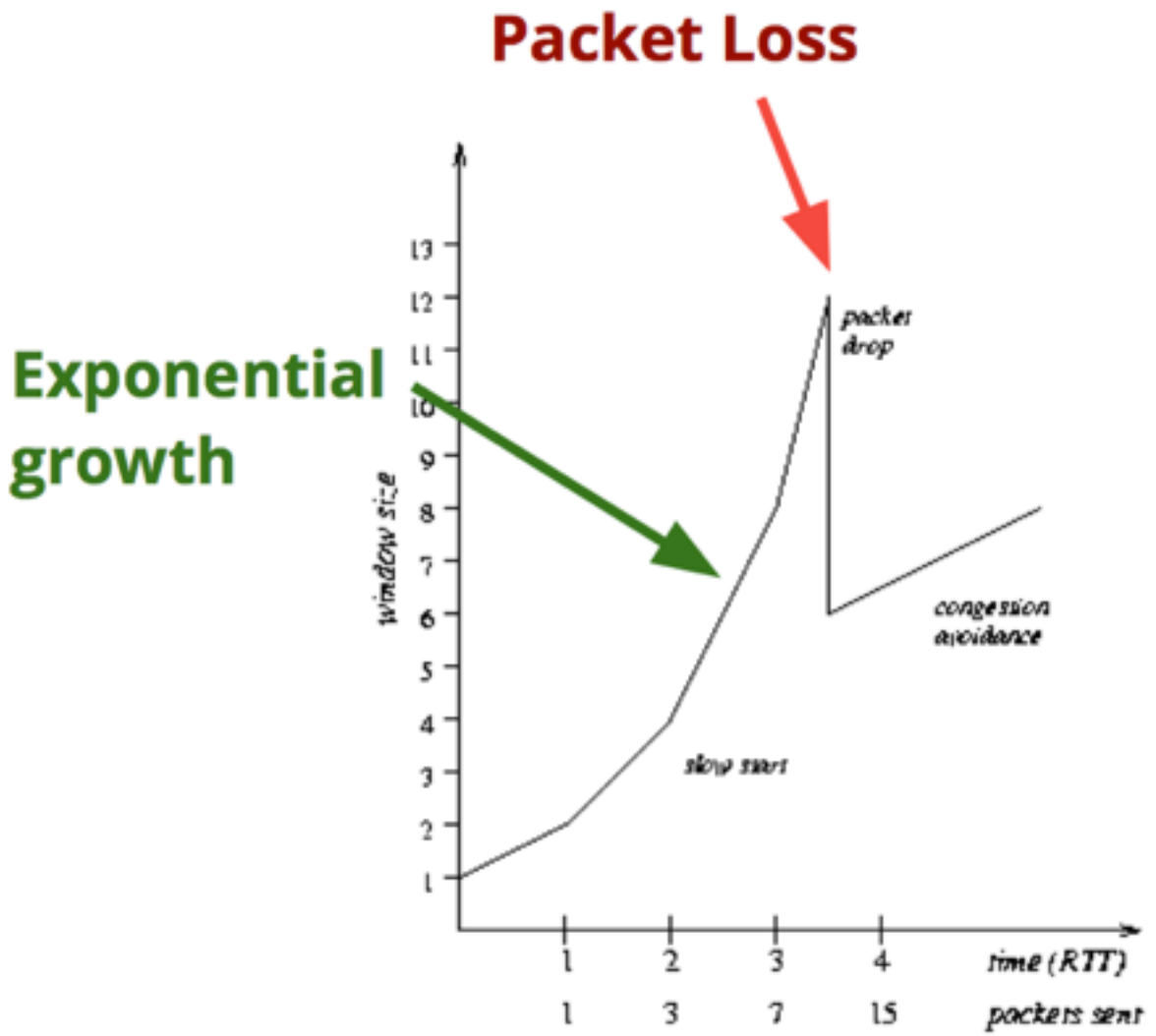
locale.png

icon.png

Sockets


Minimum Round Trips To Deliver N Segments
Segments
250
200
150
100
50
0
285 kB
214 kB
143 kB
71 kB
3
6
12
21
33
51
78
120
164
208
1
2
3
4
5
6
7
8
9
10
11
Round trips

Sockets


Packet Loss
Exponential growth
window size
13
12
11
10
9
8
7
6
5
4
3
2
1
packet drop
congestion avoidance
slow start
1
2
3
4
time (RTT)
1
3
7
15
packets sent

Sockets

- Connection pooling

SPDY

- Keep the good parts!
- But fix the sockets problem
- Compress more stuff

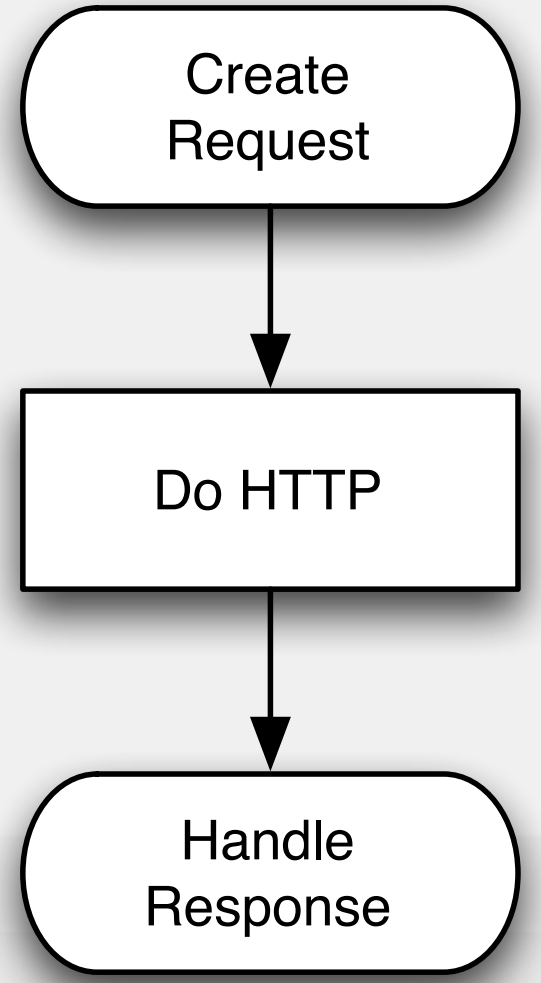
- Reasonable go-to-market strategy:
  Chrome browser + google.com website + NPN

SPDY

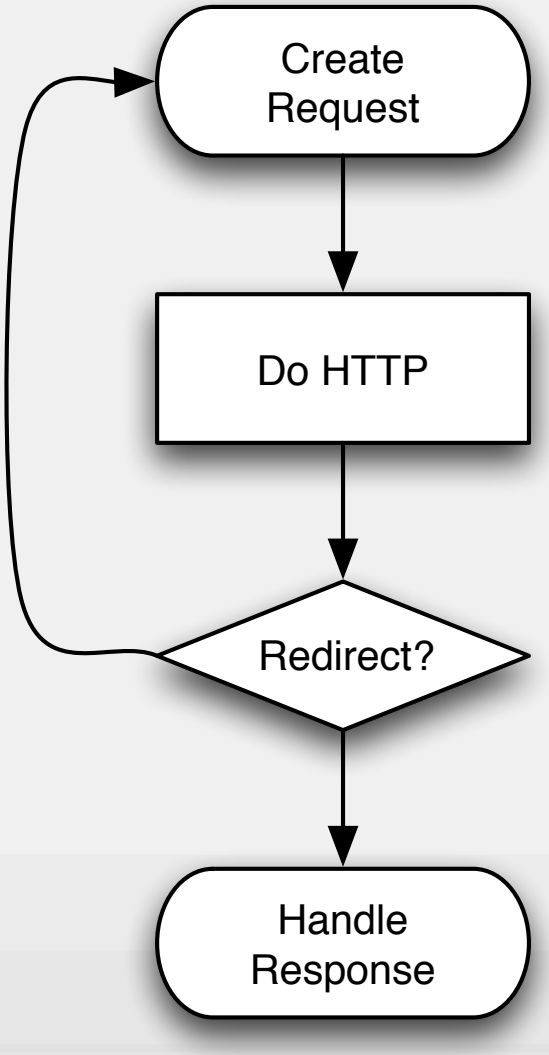
- Needs HTTPS
- Needs Android 4.1+

Android's HTTP Clients

HTTP

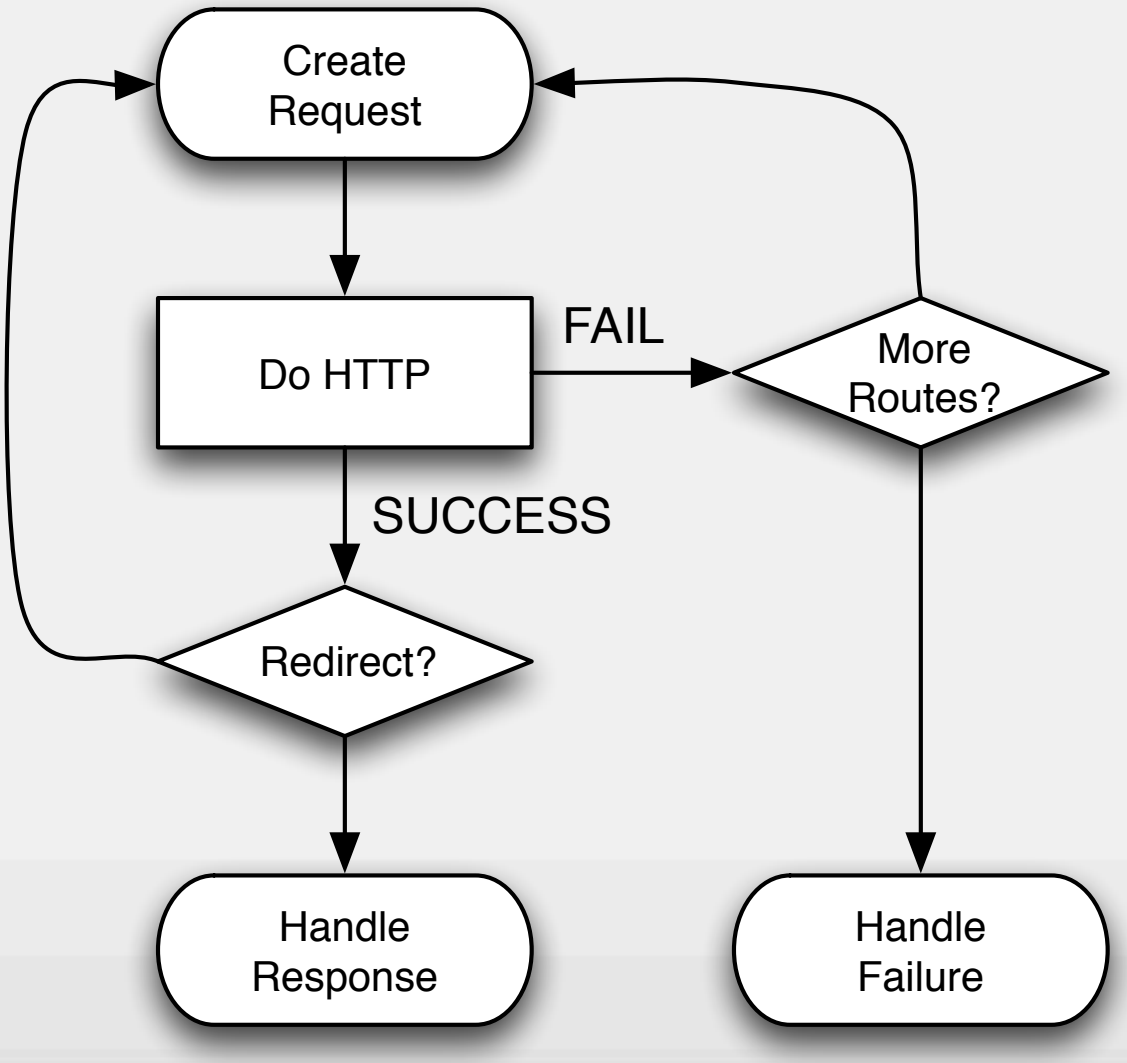


HTTP with redirects

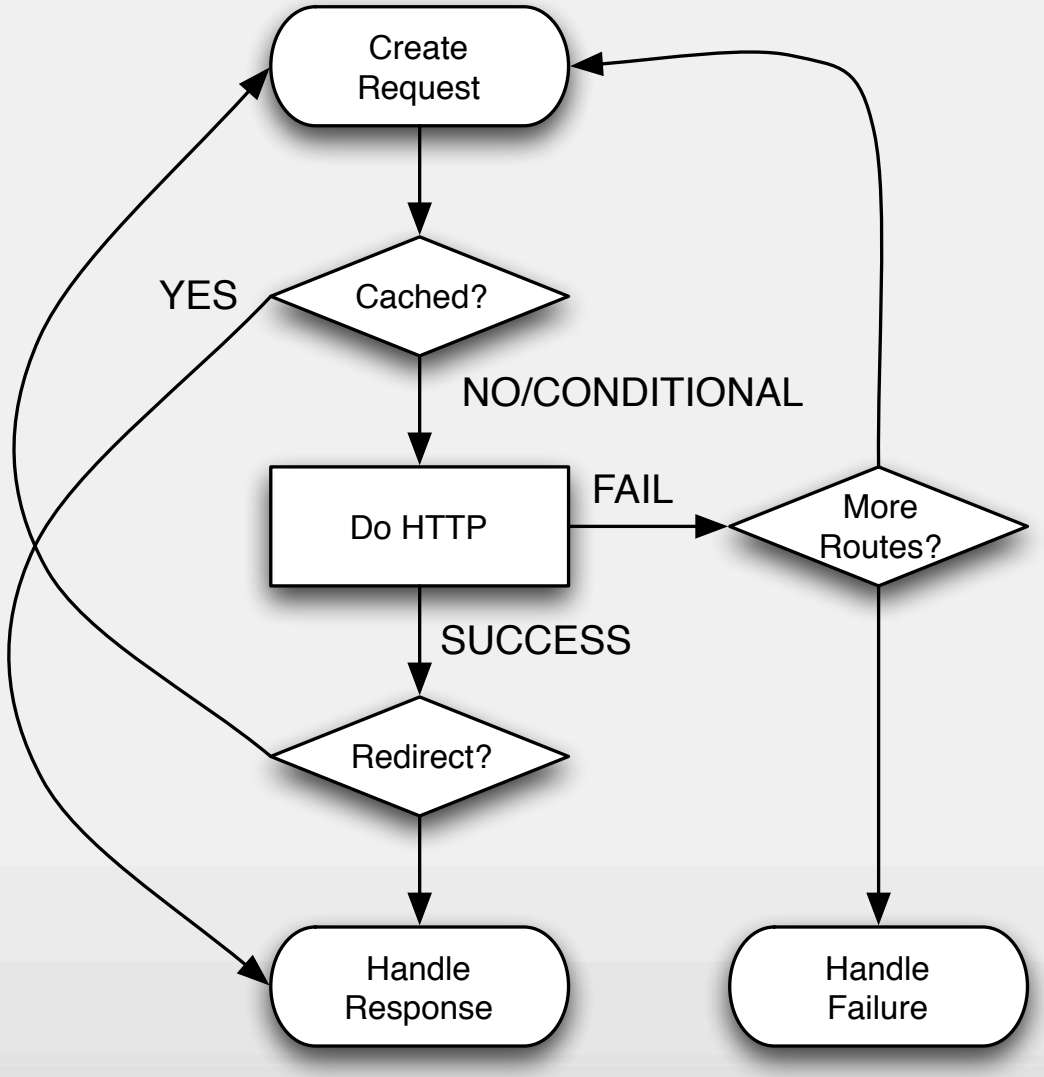


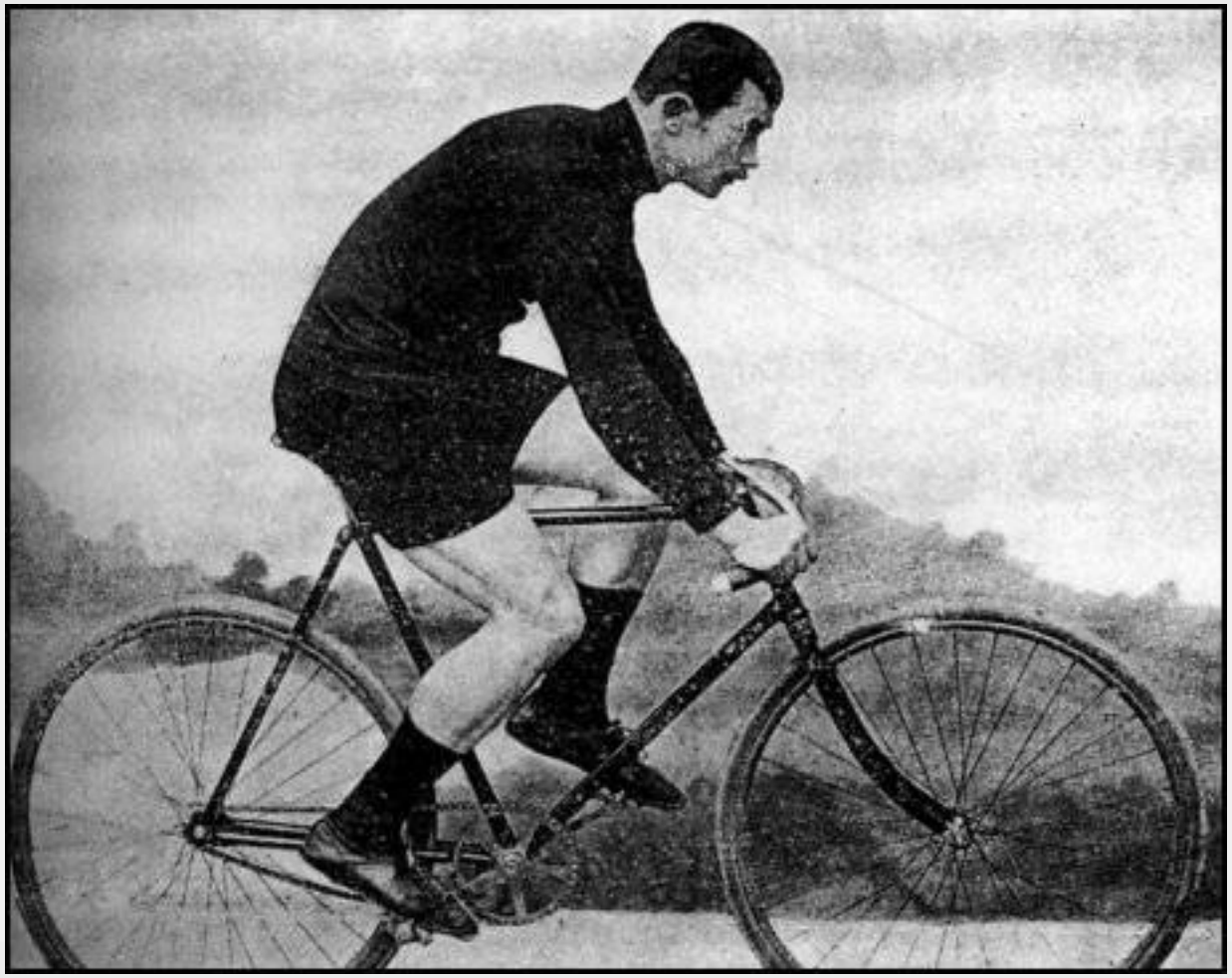

```
HTTP/1.1 302 Moved
Location: /account
```

HTTP with redirects and routing



HTTP with redirects, routing and caching





http://www.flickr.com/photos/paukrus/

HttpURLConnection

- Limited API, grown organically since the 1996
- ~ 9,000 lines of code

HttpURLConnection

- Problems
  - Connection pool configuration is gross system properties
  - Connection pool is buggy in Froyo and should be disabled

Demo

http://www.flickr.com/photos/dhwright

Apache HTTP Client

- Mature & capable
- Lots of knobs & configuration
- ~ 50,000 lines of code

Apache HTTP Client

- Problems:
  - Where does the work happen? How do I get the behavior I want?
  - Enterprisey: HttpAbstractParamBean

Demo

http://www.flickr.com/photos/turbulentflow

OkHttp

- Forked from Android 4.0's HttpURLConnection
- New features:
  - SPDY
  - Fault recovery
- ~ 12,000 lines of code

OkHttp

- Problems:
  - It's new. No deep archive of support on stackoverflow.com!
  - Still uses the old API

Demo

Essential Dev Tools

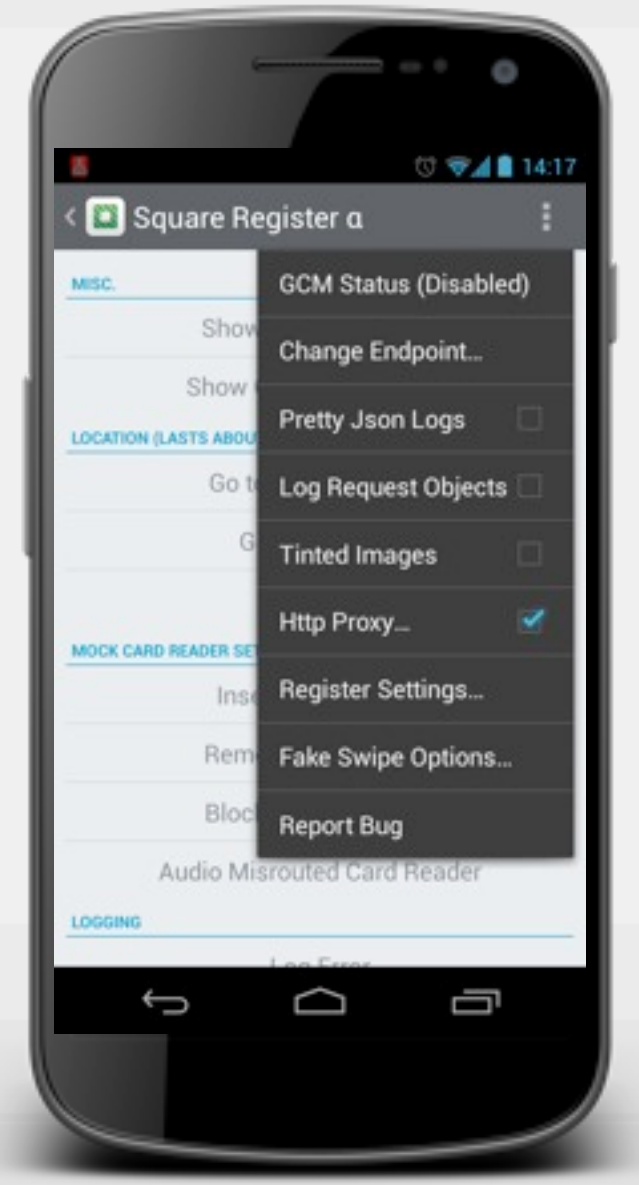
Charles

- Web Debugging Proxy
- $50

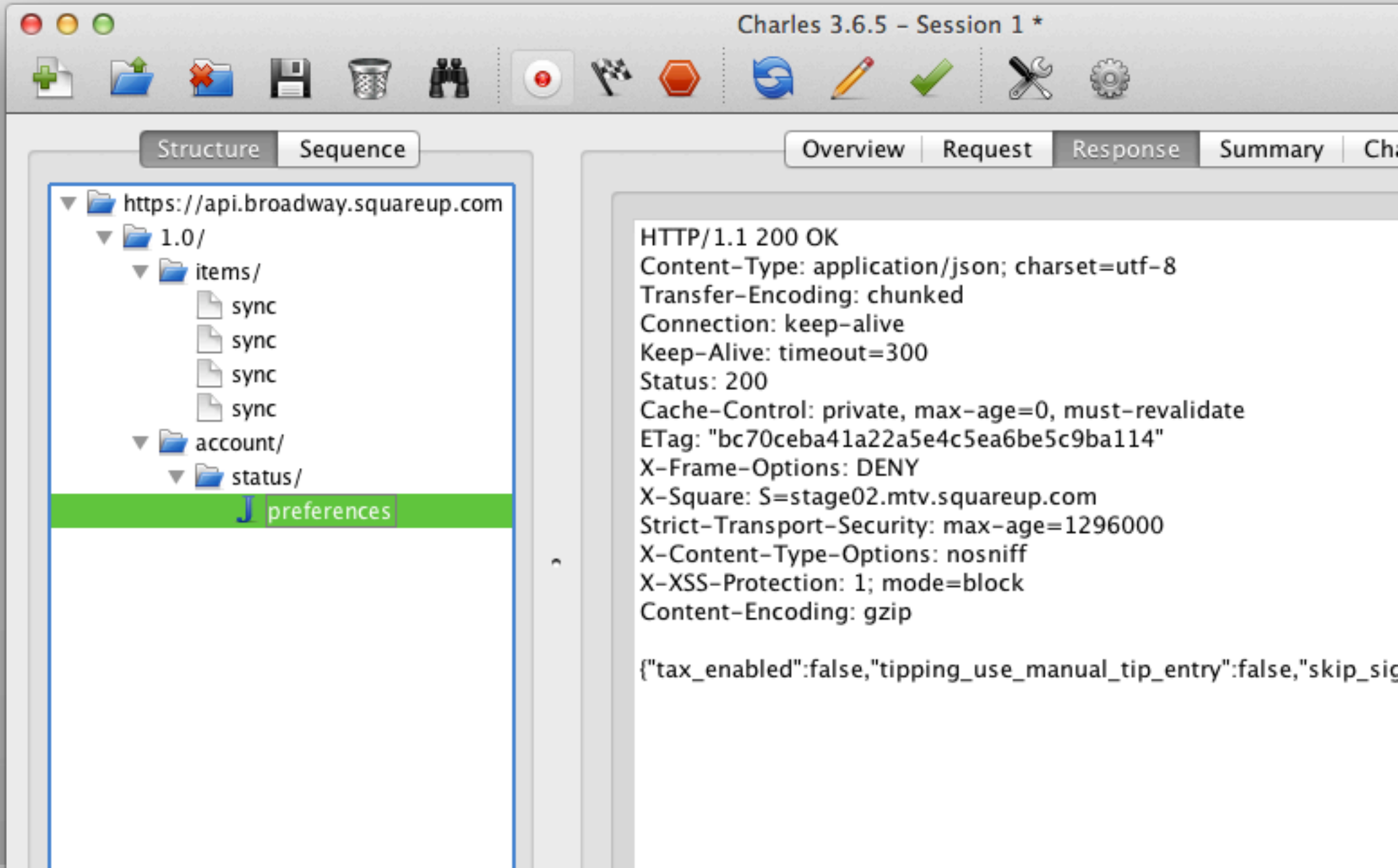
http://www.charlesproxy.com

Demo

Charles


14:17
Square Register α
MISC.
LOCATION (LASTS ABOU
MOCK CARD READER SE
LOGGING
Audio Misrouted Card Reader
GCM Status (Disabled)
Change Endpoint...
Pretty Json Logs
Log Request Objects
Tinted Images
Http Proxy...
Register Settings...
Fake Swipe Options...
Report Bug

Charles


Charles 3.6.5 - Session 1 *
Structure
Sequence
Overview
Request
Response
Summary
https://api.broadway.squareup.com
1.0/
items/
sync
sync
sync
sync
account/
status/
preferences
HTTP/1.1 200 OK
Content-Type: application/json; charset=utf-8
Transfer-Encoding: chunked
Connection: keep-alive
Keep-Alive: timeout=300
Status: 200
Cache-Control: private, max-age=0, must-revalidate
ETag: "bc70ceba41a22a5e4c5ea6be5c9ba114"
X-Frame-Options: DENY
X-Square: S=stage02.mtv.squareup.com
Strict-Transport-Security: max-age=1296000
X-Content-Type-Options: nosniff
X-XSS-Protection: 1; mode=block
Content-Encoding: gzip
{"tax_enabled":false,"tipping_use_manual_tip_entry":false,"skip_sig

MockWebServer

- Does my HTTP code work?

Mocks?

Mocks!

It's a script!

1. Describe a scenario.
2. Exercise your code.
3. Verify.

Demo

Retrofit

Retrofit

- Manually calling HTTP services requires a lot of code
- There's pain!
  - Error handling
  - Async
  - Testing

Retrofit

- Adapts an HTTP service to a Java interface

http://macklemore.com

Demo

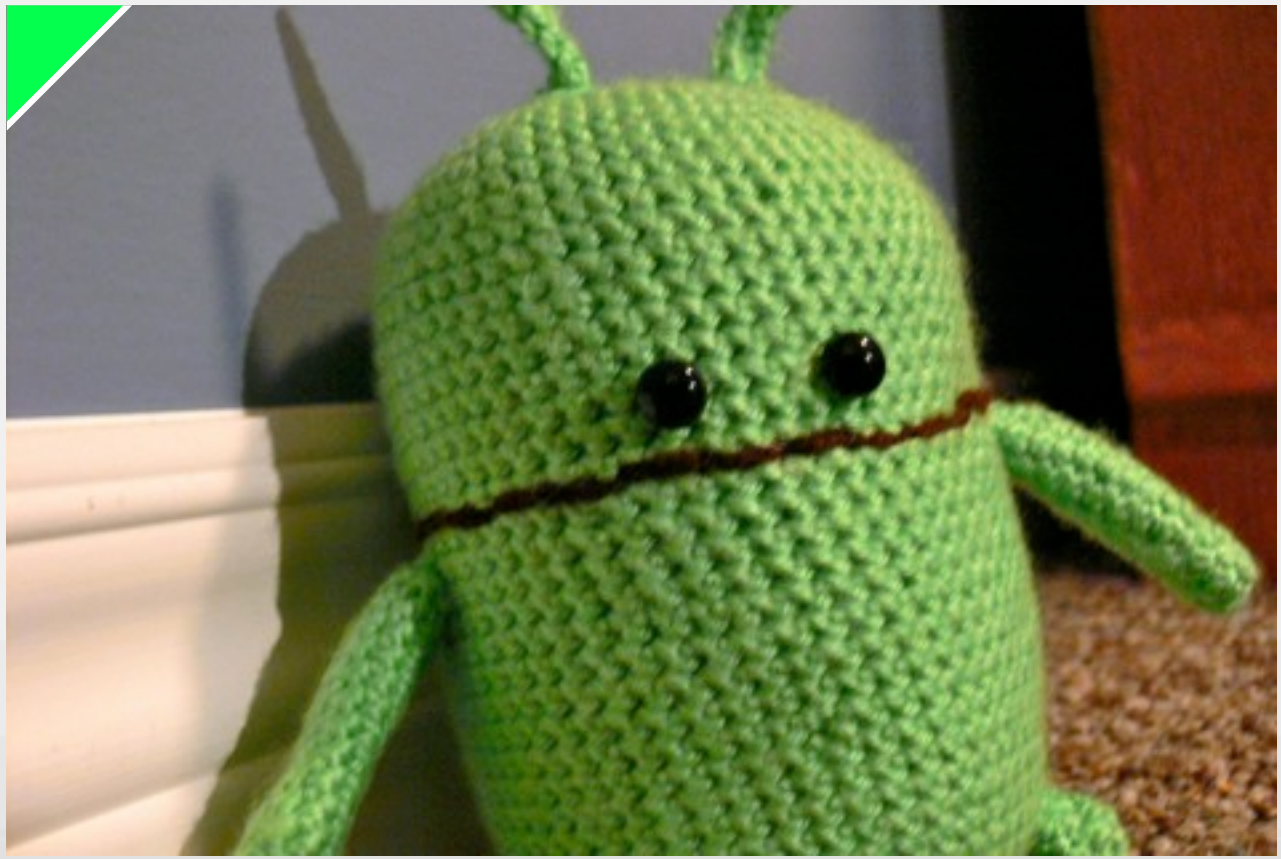
Picasso

Picasso

- Manually showing images on Android requires a lot of code
- There's pain!
  - Threading
  - View recycling
  - Memory caching
  - Disk caching
  - Transforming images

Picasso

- Makes it foolishly easy to show images in your Android app



http://www.flickr.com/photos/jumpyjodes

Demo

Volley

Volley

- An HTTP library from the guys who make the Play Store app
- Sophisticated features
  - Request canceling
  - Request scheduler
  - Pluggable

Demo

Wrapping Up

Advice: HTTP

- HTTP has knobs
- Use them

Advice: HTTP

- Don't forget about the server!

Advice: Development

- Don't fly blind!
  - Charles Web Debugging Proxy
  - MockWebServer

Advice: Android

- High level libraries exist. Use them.
  - Retrofit, Picasso, Volley

Questions?

squareup.com/careers