Life on the Edge: CDN and HTTPS Delivery in 2018
Performance and Security: A Business Case
HTTPS Matters

Treatment of HTTP pages with password or credit card form fields:

- Chrome 53
  - login.example.com
- Jan. 2017 (Chrome 56)
  - Not secure
  - login.example.com

Eventual treatment of all HTTP pages in Chrome:

- Not secure
- example.com

HTTPS as a ranking signal

Wednesday, August 6, 2014

Webmaster level: 5

Security is a top priority for Google. We invest a lot in making sure that our services use industry-leading security. We strongly HTTPS encryption by default. That means that people using Search, Gmail and Google Drive, for example, automatically have a secure connection. Further, HTTPS is the future of the web, and Google offers more transparency. A big step forward!

- User Security
  - Passwords
  - Personal Information
  - Payment Data

- Browser Behavior
  - Gentle at first, then more alarming

- New and powerful features are HTTPS-only
  - Geolocation
  - Notifications
  - EME
  - Device Motion/Orientation

- It is not optional.

- But, HTTPS can undermine performance if done without a good configuration and CDN.
PageRank Uses Time to First Byte (TTFB)

Mobile Search Will Use Overall Performance

New in 2018

Using page speed in mobile search ranking
Wednesday, January 17, 2018

People want to be able to find answers to their questions as fast as possible — studies show that people really care about the speed of a page. Although speed has been used as a signal that was focused on desktop searches. Today we’re announcing that page speed will be a ranking factor for mobile searches.
PageRank Affects Click-Through Rates

After Clicking, Load Times Affect Conversion

The Business Value of Performance

User Clicks Search Result
(Correlates with HTTPS and TTFB < 400ms)

User Waits for Page Load
(Correlates with TTFP < 2.4s)

User Converts
Measures of Success

- Does the site meet business value requirements?
- Is the TTFB good enough? It should be under 500ms.
- Is the TTFP good enough? It should be under 2.4s.
- Is the site staying online?

Don’t create unnecessary work for yourself.
HTTPS + Performance: Reluctant Partners
Yes (and No)
The Path to First Byte

RT × RTT
What’s Fast and What’s Slow with HTTPS

Solved Problems

- Negotiation CPU Overhead
- Active Connection CPU Overhead
- +2 Round Trips vs. HTTP (Initial)
  - Incurring this $\times 6$ with HTTP 1.1
- +1 Round Trip vs. HTTP (To Resume)
  - Incurring this $\times 6$ with HTTP 1.1
  - Will be solved with TLS 1.3 0-RTT
- +1 Round Trip vs. UDP
  - Will be solved with QUIC

Remaining Challenges

- +1 Round Trip vs. HTTP
  - May not be solvable
Round Trips: Old Versus Modern Stacks

Old Stack
TLS < 1.2, HTTP/1.1, No QUIC

- Each Connection
  - TCP: +1 Round Trips
  - TLS: +2 Round Trips
  - HTTP: +1 Round Trip

- Connections
  - Initial Connection: +1
  - Additional Connections: +5 (In Parallel)

= 8 Round Trips

Modern Stack
TLS 1.2 with False Start, HTTP/2, No QUIC

- Each Connection
  - TCP: +1 Round Trips
  - TLS: +1 Round Trips
  - HTTP: +1 Round Trip

- Connections
  - Initial Connection: +1

= 3 Round Trips

Future Stack

TLS 1.3, HTTP/2, QUIC

- Each Connection
  - QUIC: 0 Round Trips
  - TLS: +1 Round Trips
  - HTTP: +1 Round Trip

- Connections
  - Initial Connection: +1

= 2 Round Trips
Adding in CDN Models
HTTPS is best on a CDN

It’s all about the round trips.
Big, Upcoming Assumption:

200ms

Page Render Times from Drupal

Adapt the numbers for your sites accordingly.
# Effect on TTFB: Same Continent

## Old Stack and No CDN

- TCP: +45ms
- TLS: +90ms
- HTTP: +45ms
- No HTTP/2: ×2 (or worse)

**TTFB = 360ms**

- Missed Page Cache: +245ms

**TTFB = 705ms**

## Modern Stack with CDN

- TCP: +2ms
- TLS: +2ms
- HTTP: +2ms

**TTFB = 6ms**

- Missed Page Cache: +245ms

**TTFB = 251ms**
Effect on TTFB: Europe to North America

Old Stack and No CDN

- TCP: +85ms
- TLS: +170ms
- HTTP: +85ms
- No HTTP/2: × 2 (or worse)

TTFB = 680ms
- Missed Page Cache: +285ms

TTFB = 965ms

Modern Stack with CDN

- TCP: +2ms
- TLS: +2ms
- HTTP: +2ms

TTFB = 6ms
- Missed Page Cache: +285ms

TTFB = 291ms
Effect on TTFB: APAC to North America

Old Stack and No CDN
- TCP: +175ms
- TLS: +350ms
- HTTP: +175ms
- No HTTP/2: $\times 2$ (or worse)

TTFB = 1400ms
- Missed Page Cache: +375ms

TTFB = 1775ms

Modern Stack with CDN
- TCP: +2ms
- TLS: +2ms
- HTTP: +2ms

TTFB = 6ms
- Missed Page Cache: +375ms

TTFB = 381ms
The Cost of Old Stacks and No CDNs

Goal: < 500ms

TTFB Latency

- Old-CDN: Page Hit
- Old-CDN: Page Miss
- New+CDN: Page Hit
- New+CDN: Page Miss

Same Continent | Europe to North America | APAC to North America
---|---|---
Old-CDN: Page Hit | Old-CDN: Page Hit | Old-CDN: Page Miss
Old-CDN: Page Miss | New+CDN: Page Hit | New+CDN: Page Miss
New+CDN: Page Hit | New+CDN: Page Hit | New+CDN: Page Miss

Goal: < 500ms
The Path to First Paint

TTFB
+ Size / BW
+ CPU Time
The Necessity of a CDN for Assets and Pages

![Graph showing the comparison of No CDN, Asset-Only CDN, and Full CDN in terms of time]

- **No CDN**:
  - Data Transfer: 6000 ms
  - Assets: Around 4000 ms
  - CMS Processing: Around 2000 ms
  - Initial Connection: 0 ms

- **Asset-Only CDN**:
  - Data Transfer: 6000 ms
  - Assets: Around 4000 ms
  - CMS Processing: Around 2000 ms
  - Initial Connection: 0 ms

- **Full CDN**:
  - Data Transfer: 6000 ms
  - Assets: Around 4000 ms
  - CMS Processing: Around 2000 ms
  - Initial Connection: 0 ms

Pantheon.io
Traditional
No CDN, No Proxy Page Cache

Page Loading Progress

- Page TCP Connection
- Page TLS Negotiation
- HTML Response
- HTML Downloaded
- Additional TCP Connections
- Additional TLS Negotiations
- Critical Resource Downloads
- Additional Resource Downloads

Time to First Byte
Time to First Paint
Page Loaded

LOAD TIME (MILLISECONDS)
Standard CDN

Origin Proxy Page Cache, Resource CDN, No HTTP/2
Full CDN

Page CDN + Resource CDN + HTTP/2

Page Loading Progress

- Page TCP Connection
- Page TLS Negotiation
- HTML Response
  - Time to First Byte
- HTML Downloaded
- Additional TCP Connections
- Additional TLS Negotiations
- Critical Resource Downloads
  - Time to First Paint
- Additional Resource Downloads
  - Page Loaded
What We’re Seeing at Pantheon
Effects of a Full CDN on Page Load Times

Median Time to First Paint

- Legacy
- Global CDN

West Coast
EU
Asia
Updated Advice on Best Practices
The Past (Stop Doing This Now)

- Separate CDN domains
- Separate hosts for assets
- No HTTPS
  - Disables HTTP/2 in most browsers
The Present (Please Care About This)

- Focus Performance Testing on Mobile
- Compress Images Effectively
  - WebP is an amazing format
  - Use appropriate resolutions
- Using Disparate Page Caching Times
  - Long time in CDN w/ explicit invalidation
  - Shorter cache times for browsers
- Better TCP Congestion Control: BBR
  - Implemented at the kernel level
  - http://blog.cerowrt.org/post/bbrs_basic_beauty/
- HTTP/2
  - https://caniuse.com/#feat=http2
The Future (Keep an Eye on These)

- **Drupal Configuration**
  - Less reliance on aggregated CSS/JS
  - Less reliance on generated image variants

- **Last-Mile Improvements**
  - QUIC
  - HTTP/2 push with cache manifests
  - Brotli compression
Questions?

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