PANTHEON®
Website Management Platform

# **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 06, 2014

Webmaster level: all

Security is a top priority for Google. We invest a lot in making sure that our services use industry-leading security, like strong HTTPS encryption by default. That means that people using Search, Gmail and Google Drive, for example, automatically have a secure ... safer more broadly. A big

- 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.

3

PageRank Uses Time to First Byte (TTFB)
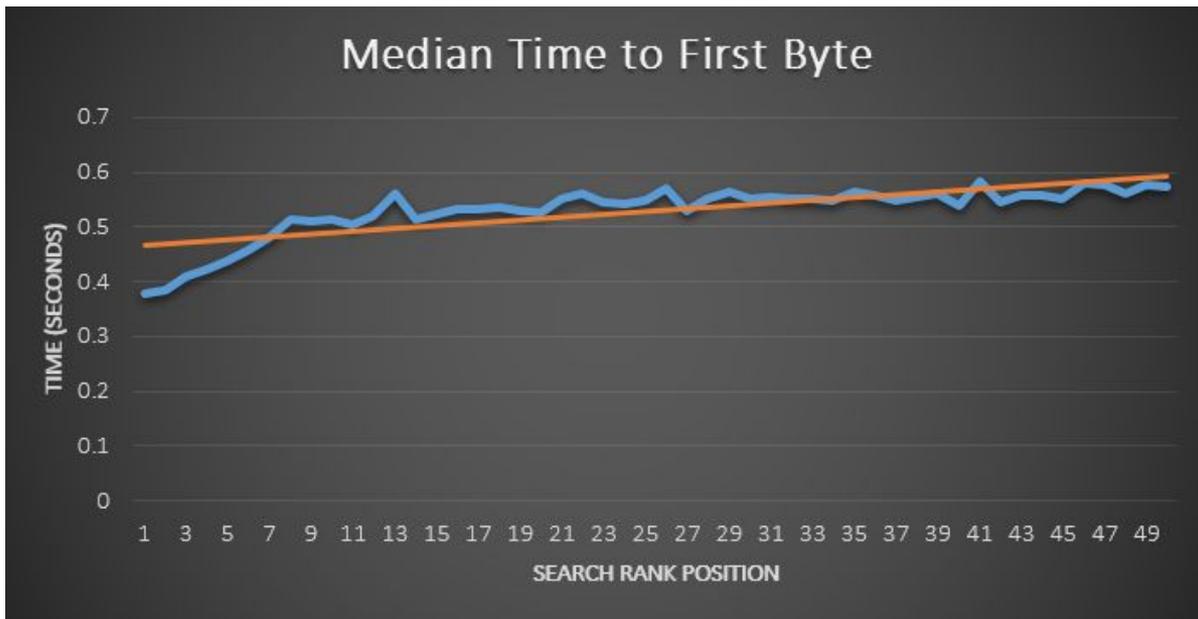
Source: "How Website Speed Actually Impacts Search Ranking," Moz, 2013

Mobile Search Will Use Overall Performance

New in 2018
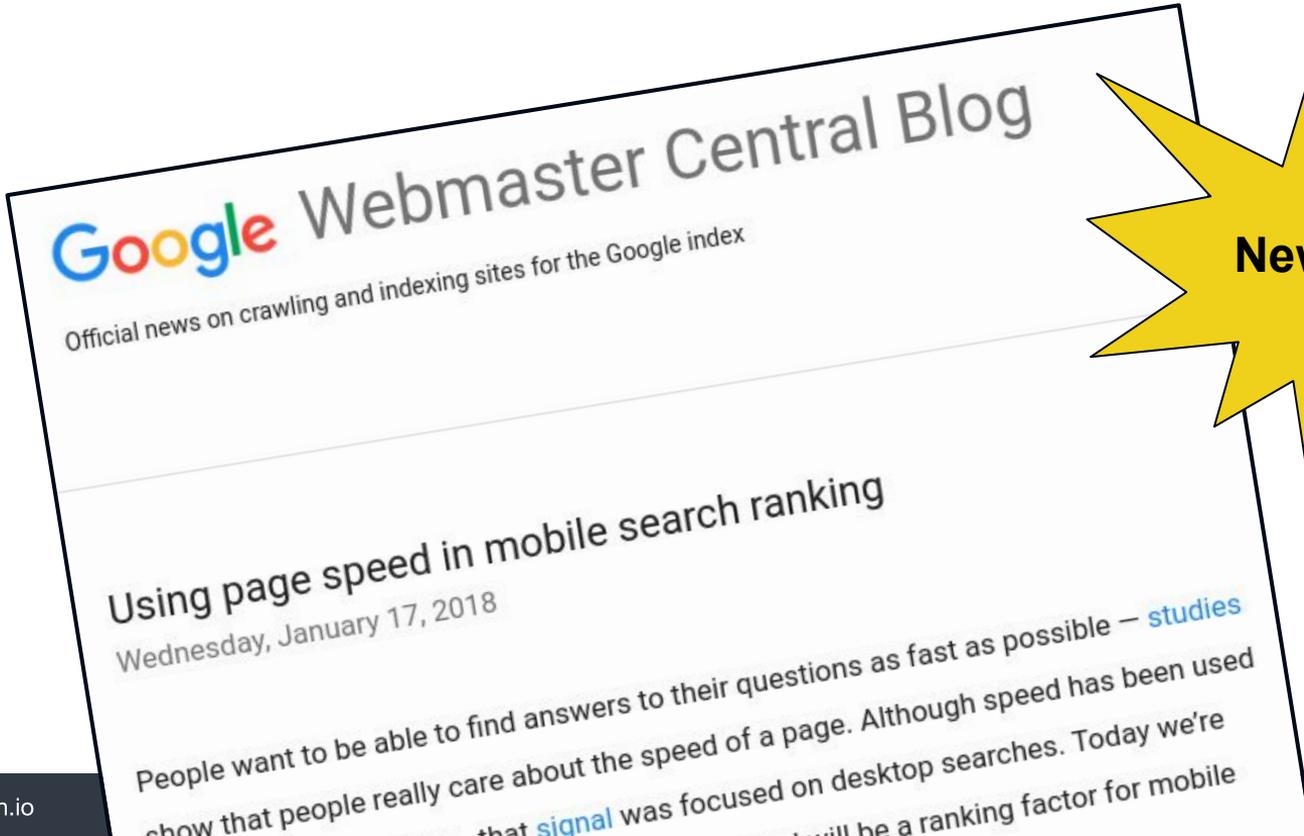
Google Webmaster Central Blog

Official news on crawling and indexing sites for the Google index

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 that signal was focused on desktop searches. Today we're will be a ranking factor for mobile

PageRank Affects Click-Through Rates

CTR vs. Organic Search Position
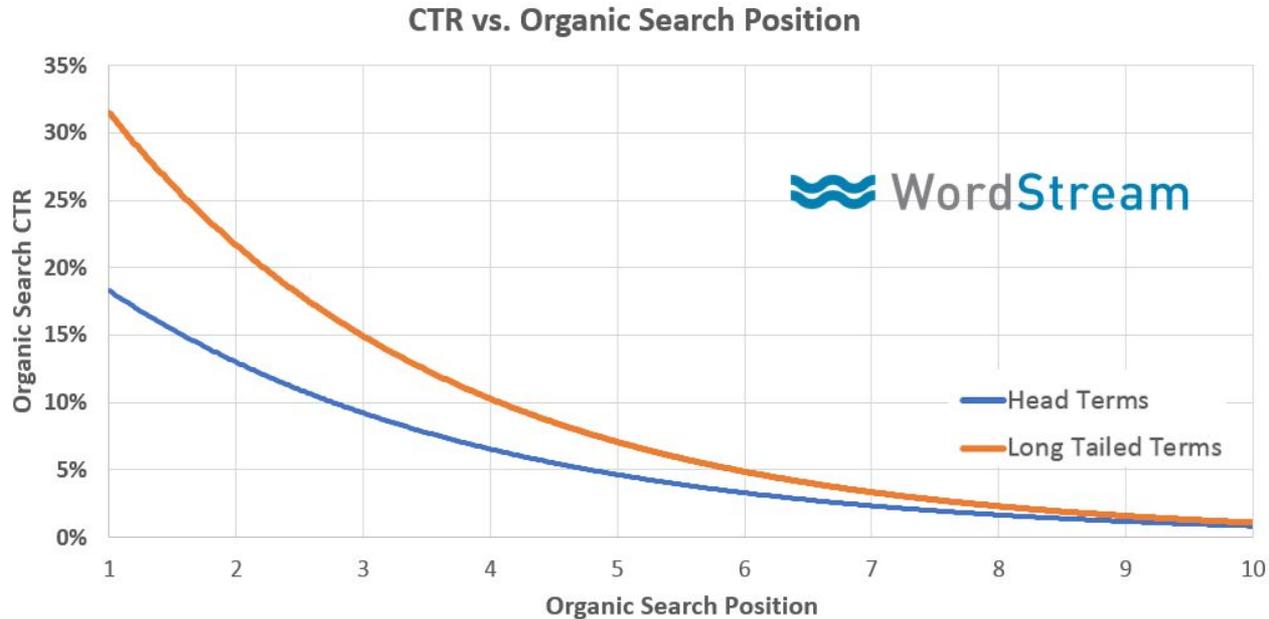
Source: "Does Organic CTR Impact SEO Rankings? [New Data]," Moz, 2016

After Clicking, Load Times Affect Conversion

Pages that loaded in **2.4s** enjoy conversion rate **1.9%**

3.3s conversion **1.5%**

4.2s dropped **below 1%**

5.7s begins to flatten out at **0.6%**

CONVERSION RATE

LOAD TIME (SECONDS)
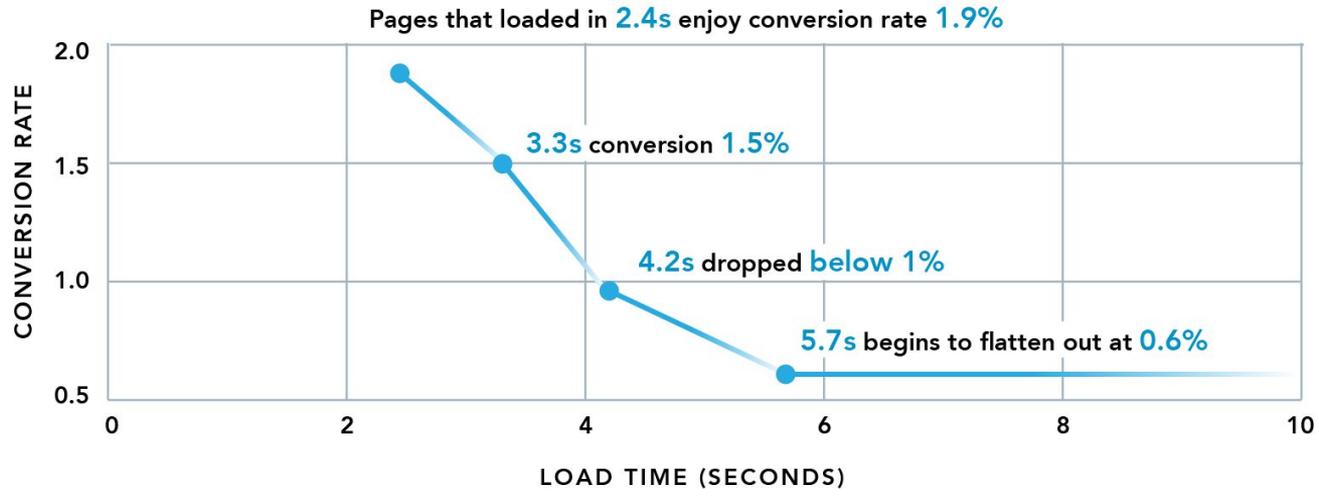
Source: "How Page Load Time Affects Conversion Rates: 12 Case Studies [Infographic]," HubSpot, 2017

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**

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Measures of Success
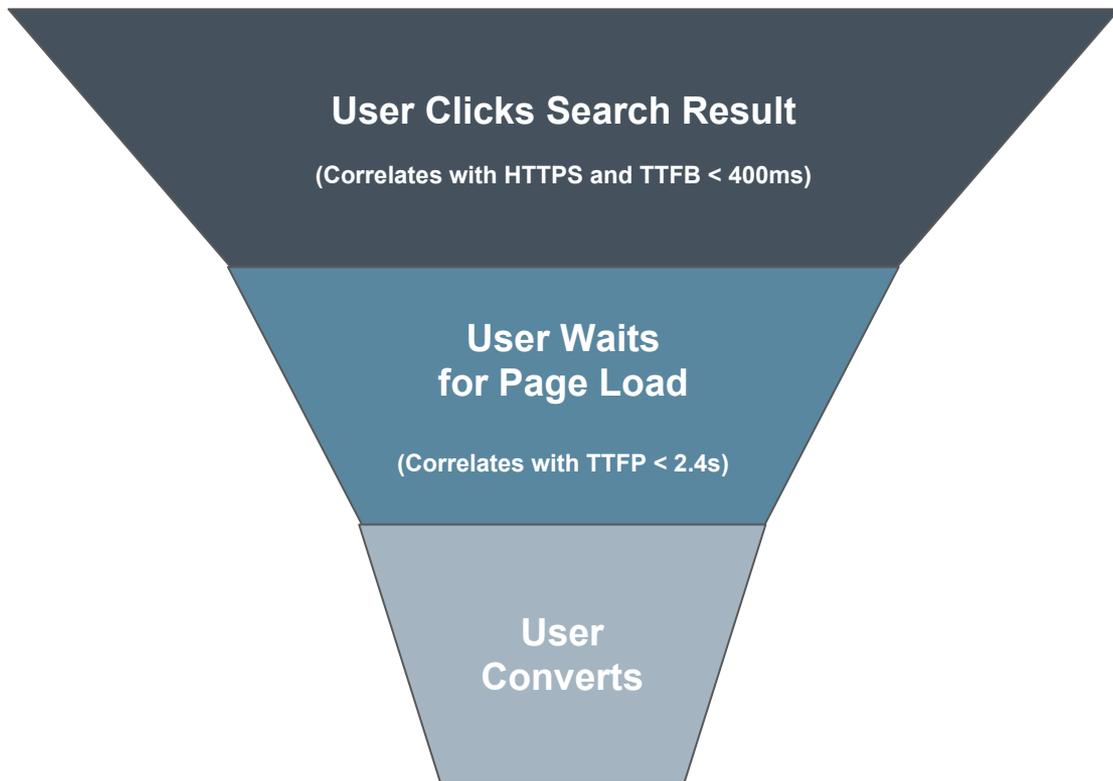
❏ Does the site meet business value requirements?

❏ 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)

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 ×6 with HTTP 1.1

- +1 Round Trip vs. HTTP (To Resume)

  ◎ Incurring this ×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

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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

Round Trips: Future Stack (2018)

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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

No CDN

Visitor — Origin

TCP Negotiation

TLS Negotiation (Double RTT if Traditional TLS)

HTTP

...and so on for resources.

100-300ms RTT

Full CDN

Visitor — POP — Origin

TCP Negotiation

TLS Negotiation

HTTP

...and so on for resources.

Cache Misses Use Persistent Connection

10ms RTT

50-250ms RTT
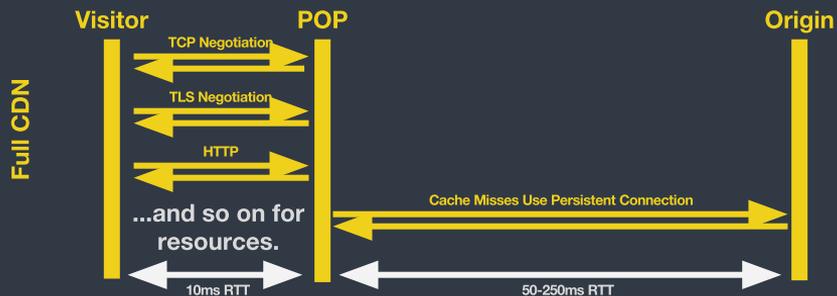
It's all about the round trips.

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: ✕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

TTFB Latency
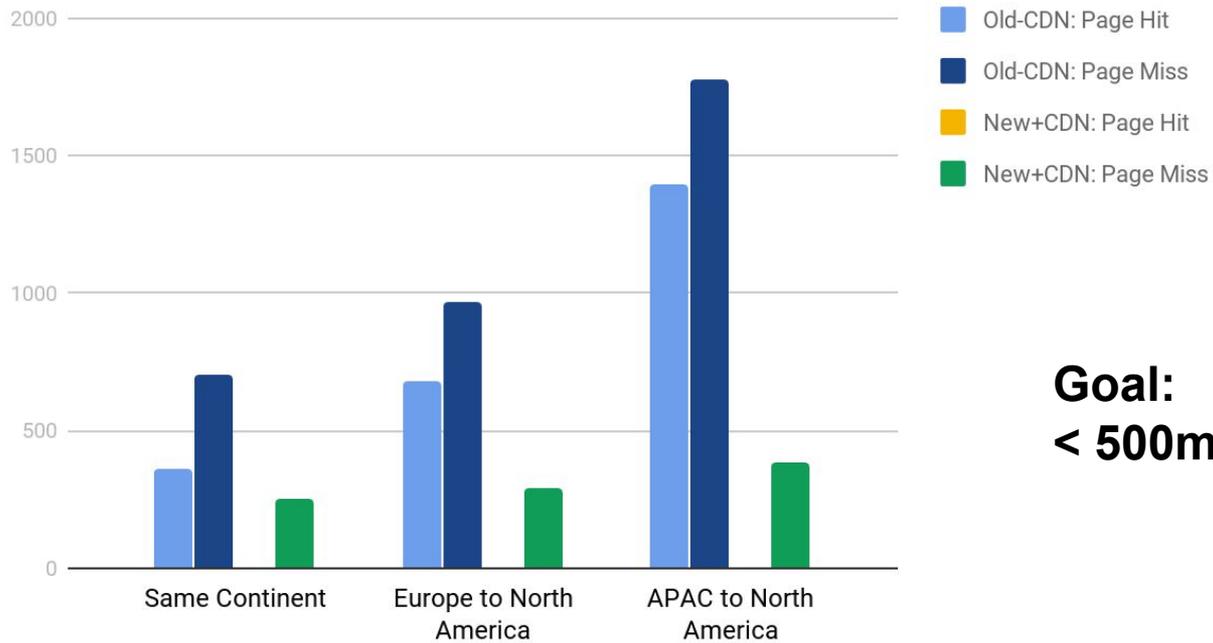
Legend:
- Old-CDN: Page Hit (light blue)
- Old-CDN: Page Miss (dark blue)
- New+CDN: Page Hit (orange)
- New+CDN: Page Miss (green)

Y-axis: 0, 500, 1000, 1500, 2000

X-axis categories: Same Continent, Europe to North America, APAC to North America

**Goal:
< 500ms**

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TTFB
+ Size / BW
+ CPU Time
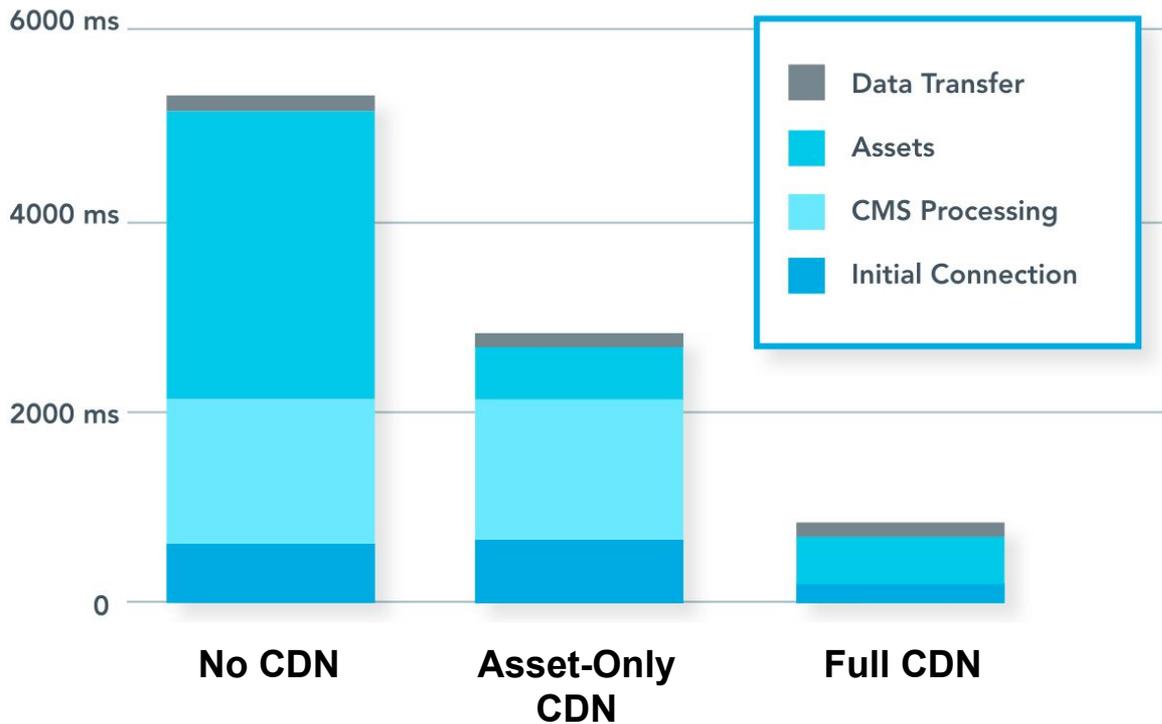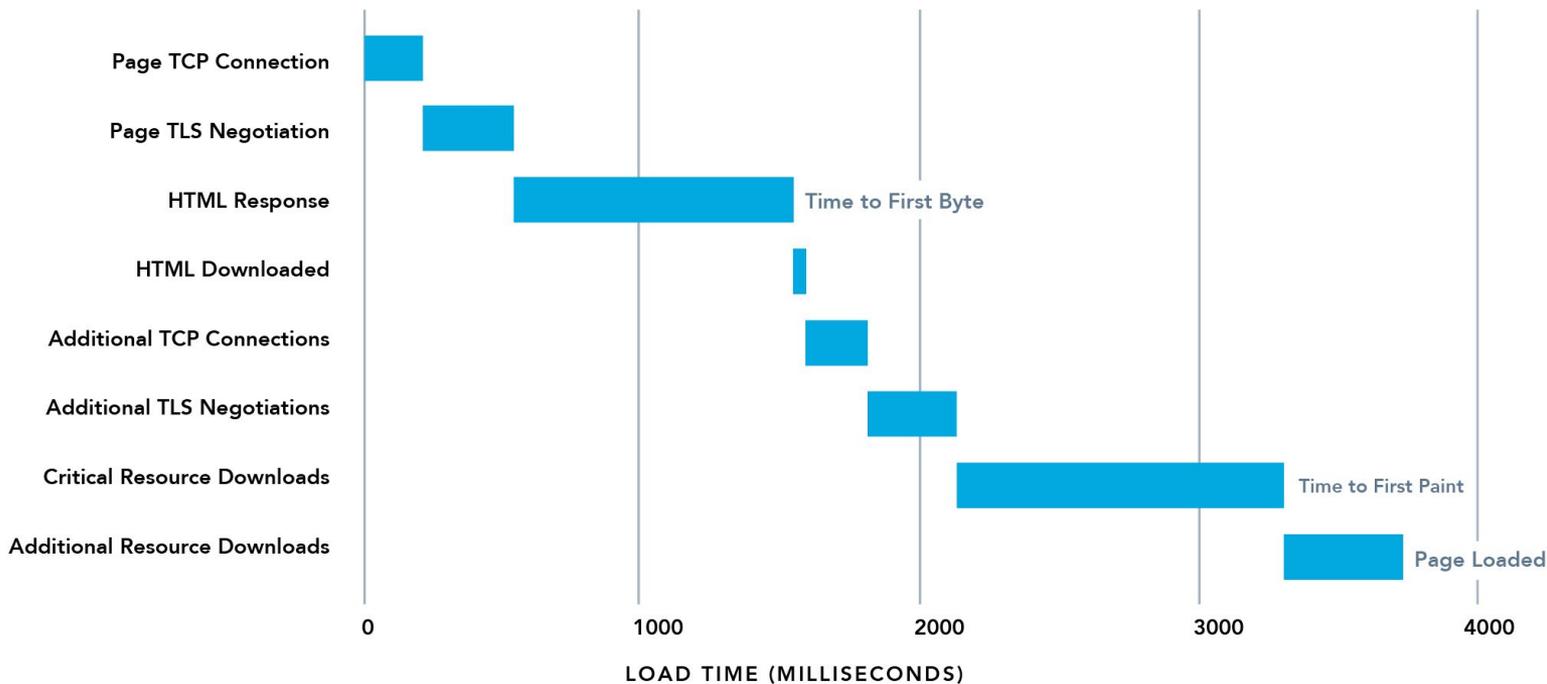
Full CDN

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

0   1000   2000   3000   4000

LOAD TIME (MILLISECONDS)
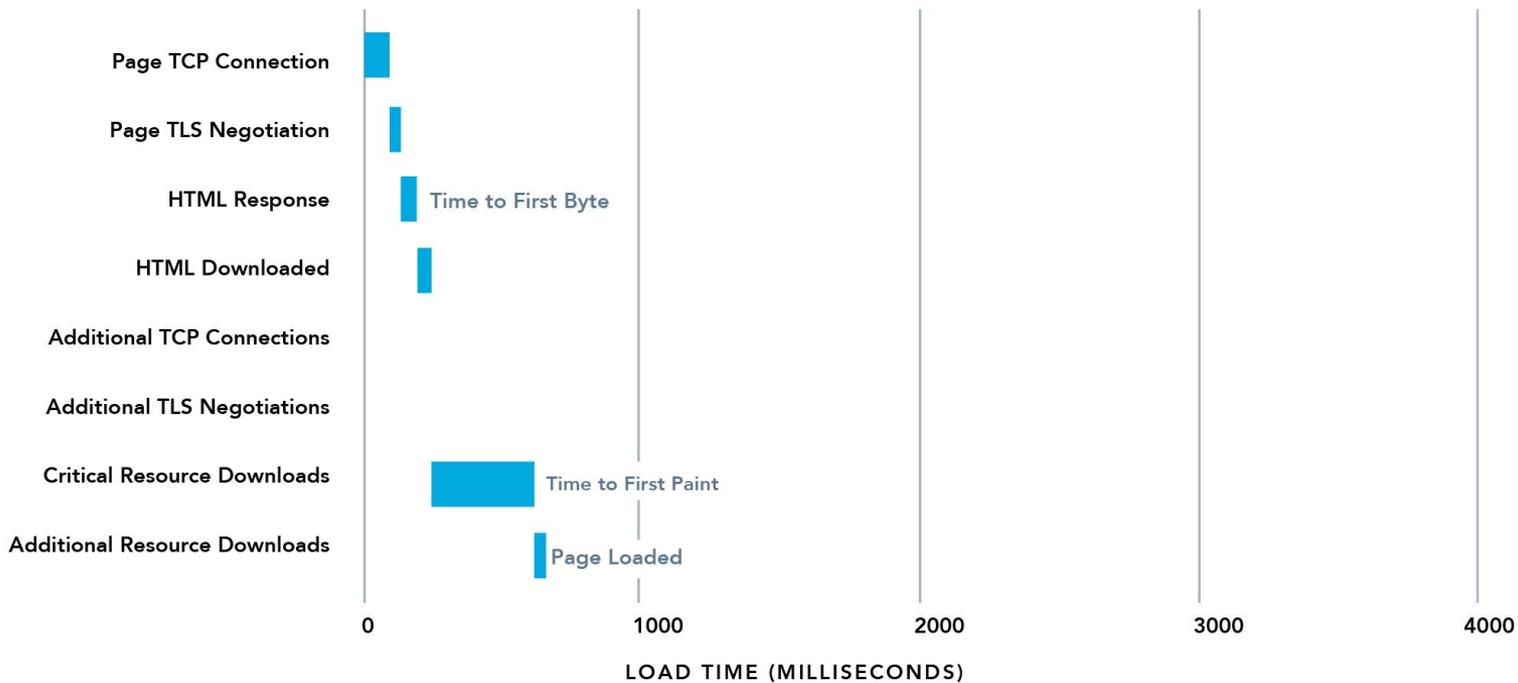
What We're Seeing at Pantheon

Effects of a Full CDN on Page Load Times

Median Time to First Paint

Legend:
- Legacy
- Global CDN

Categories: West Coast, EU, Asia
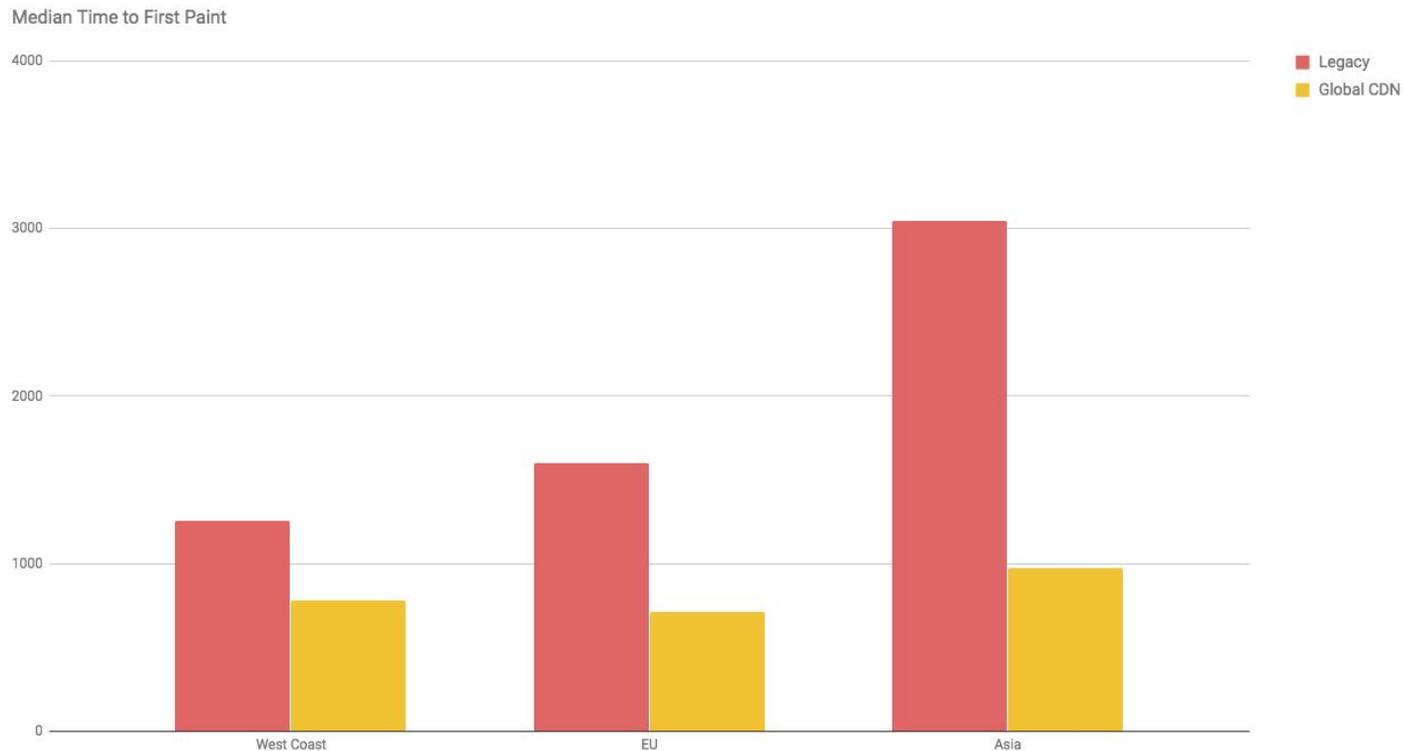
Time to First Paint by Region/CDN
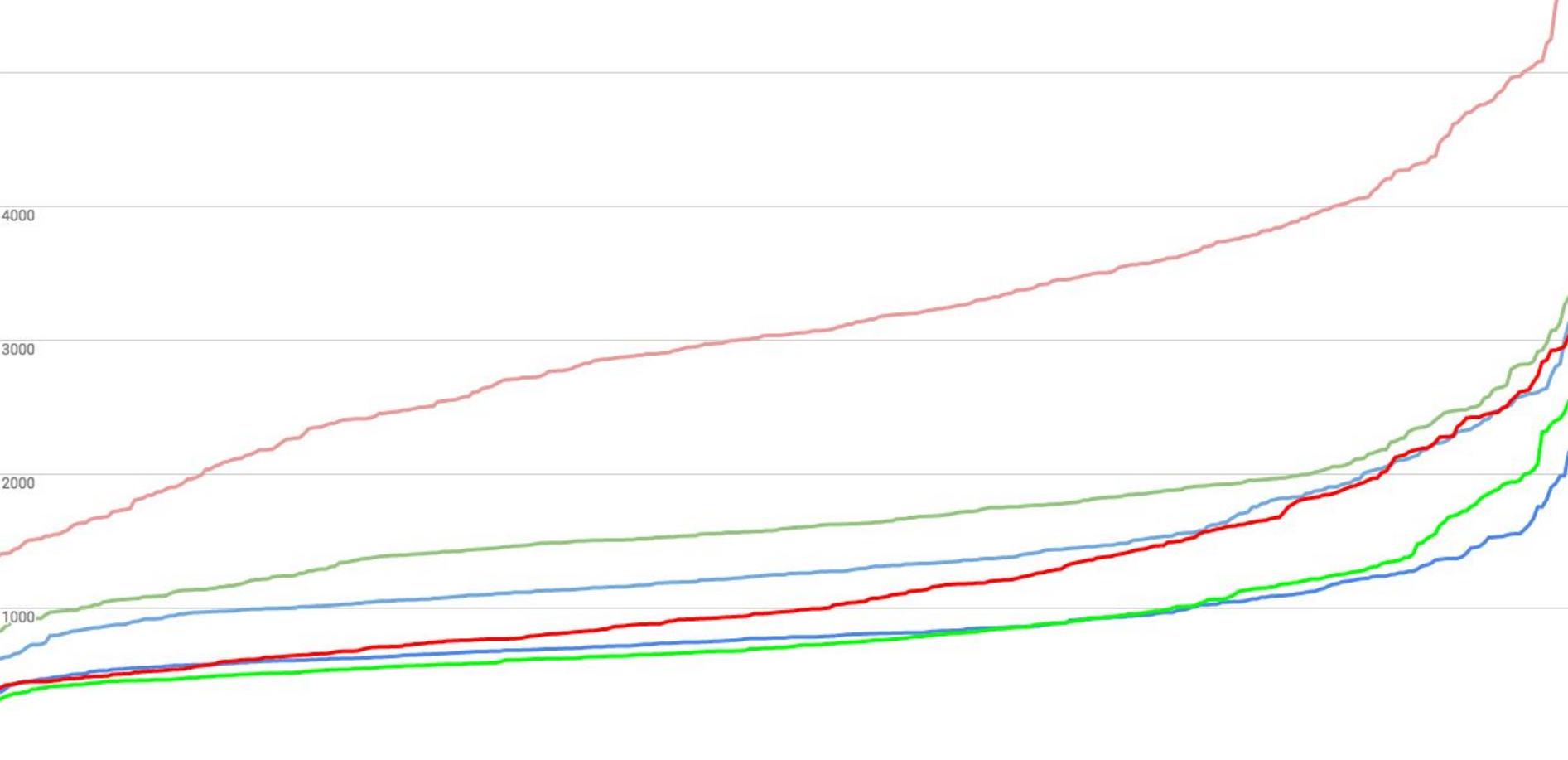
Updated Advice on Best Practices

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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