Dissecting Web Latency in Ghana

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Motivation

- Increasing Internet users from 5.4% to 14.1% from 2009 to 2011

- Page loading time so slow

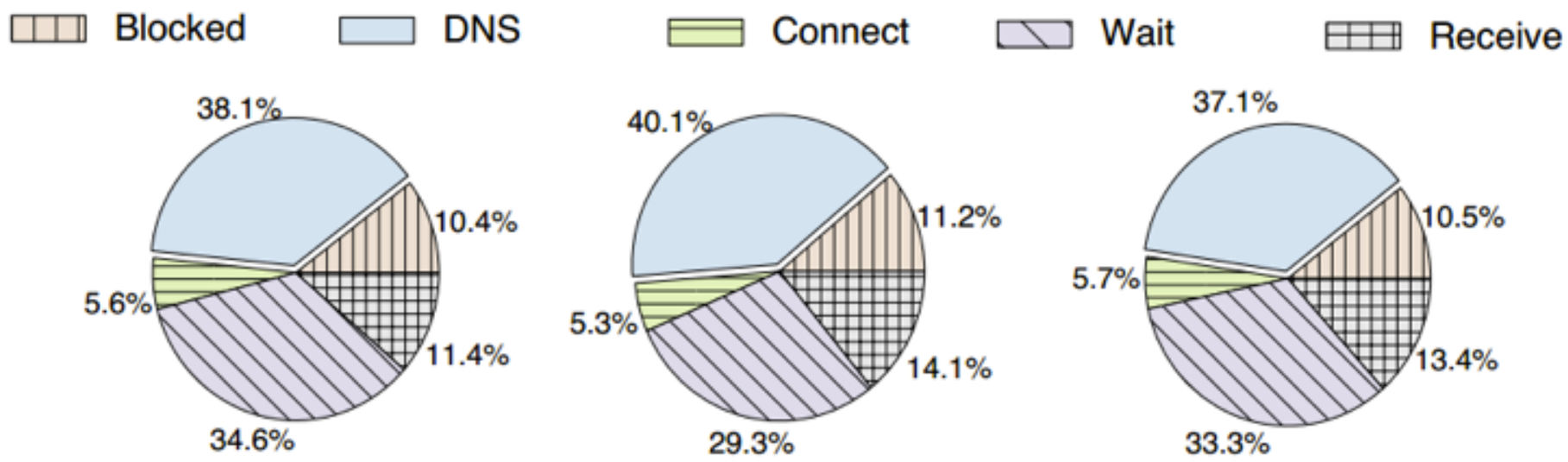
Methodology

- Firefox + Firebug + Selenium to get HAR files
- Alexa Top 1000
- Linux dig to examine DNS request for further detail
- Vantage points: NYC, Bremen (Germany), Abu Dhabi (UAE), Accra, Kumawu and Hohoe (Ghana)

Main Factors

- Blocking
- DNS Lookup
- Connecting
- Sending
- Waiting
- Receiving

Main Factors



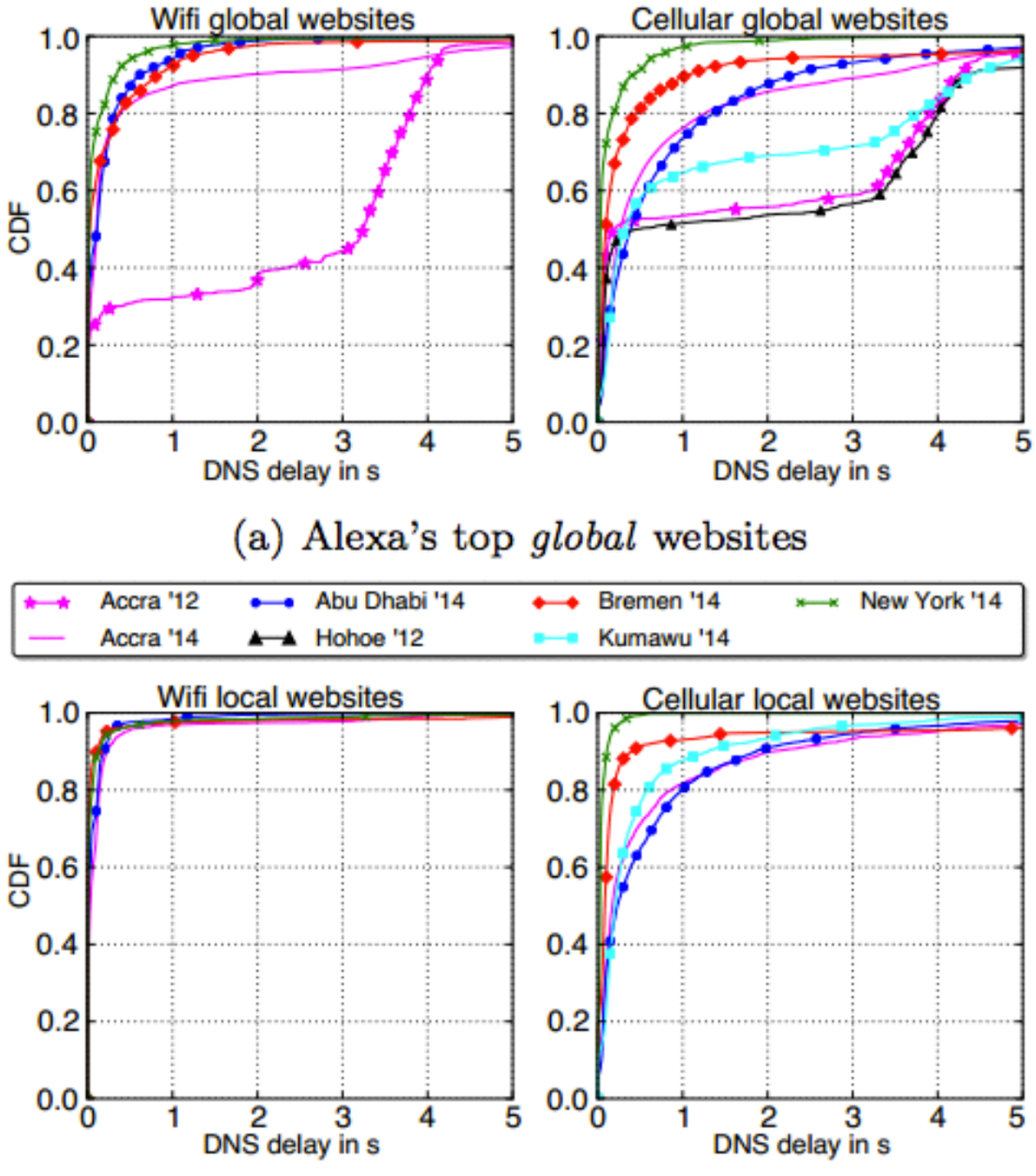
(a) Accra 3G (b) Accra Wifi (c) Hohoe 3G

Figure 2: Web page requests (Alexa's top global 2012)

Main Factors

- DNS Lookup: 37-40% latency
- HTTP redirects: 80% first request redirection
- HTTP blocking: 10% latency
- TLS/SSL: 15% objects requires, up to 9 RT

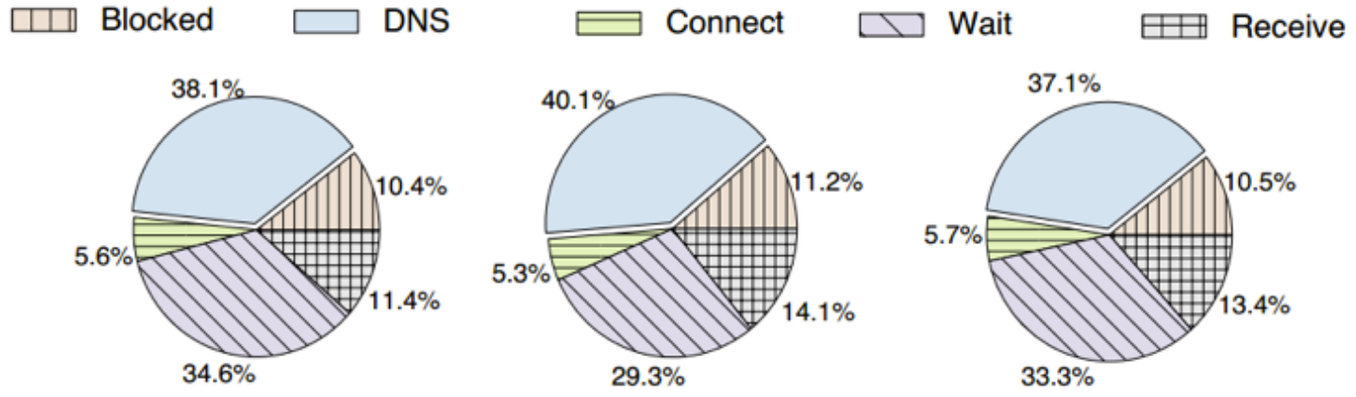
Speedup: DNS Caching



(a) Alexa's top *global* websites

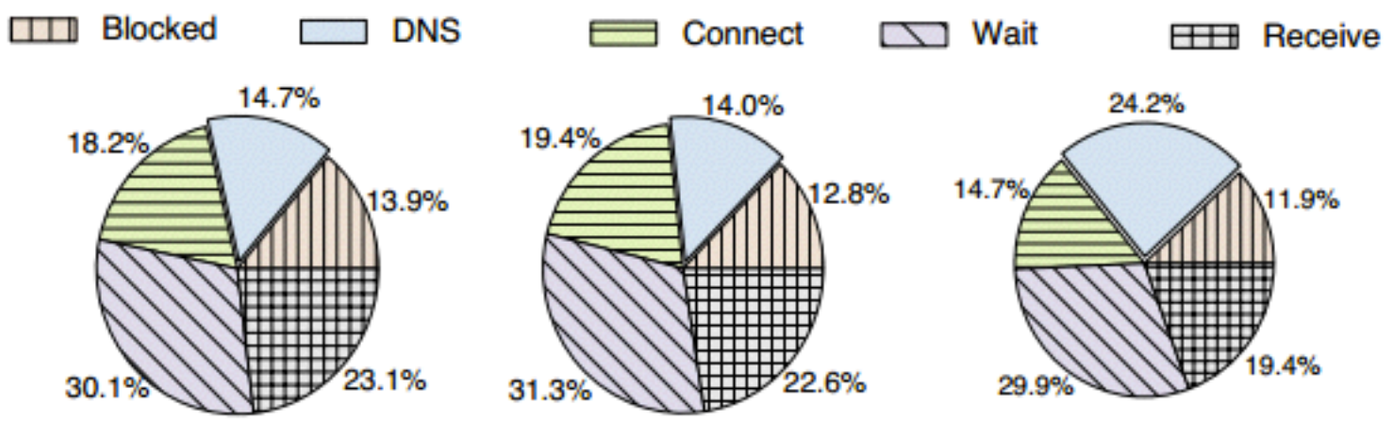
(b) Alexa's top *local* websites

DNS Caching



(a) Accra 3G (b) Accra Wifi (c) Hohoe 3G

Figure 2: Web page requests (Alexa's top global 2012)



(a) Accra 3G (b) Accra Wifi (c) Kumawu 3G

Figure 6: Web page requests (Alexa's top global 2014)

DNS Server Placement

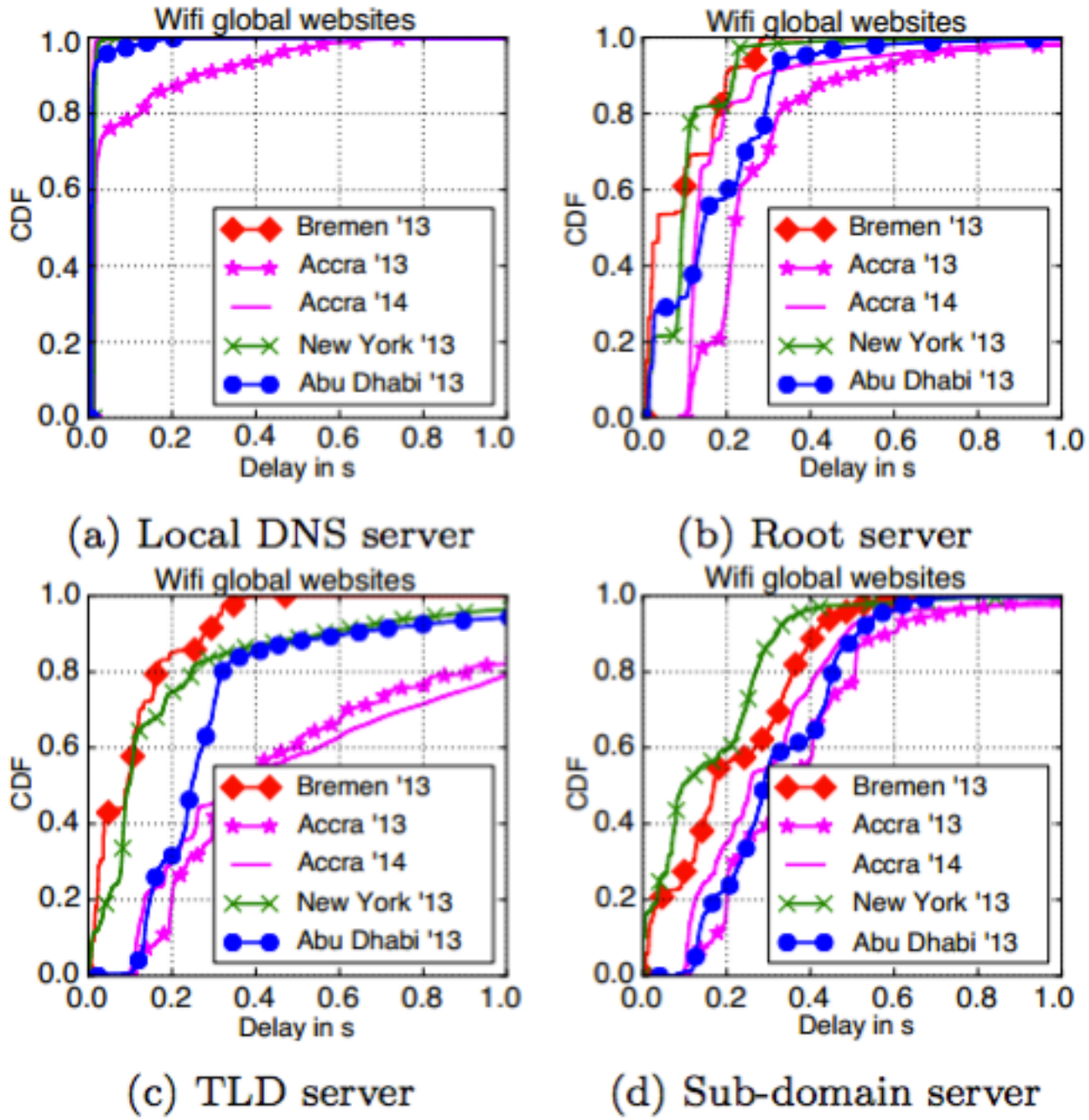


Figure 8: Per location/hierarchy delay CDFs

Caching Redirects

- Enhance the overall page load time by about 20%

Table 2: Redirects delay to total page load time (2012)

Location	Websites with Redirects	Average Ratio	Standard Deviation
Accra cellular	79%	25%	15%
Accra Wifi	78%	20%	16%
Hohoe cellular	81%	21%	17%

SPDY

- SPDY is an application layer protocol proposed to enhance the webpage loading time

- It also helps TLS/SSL

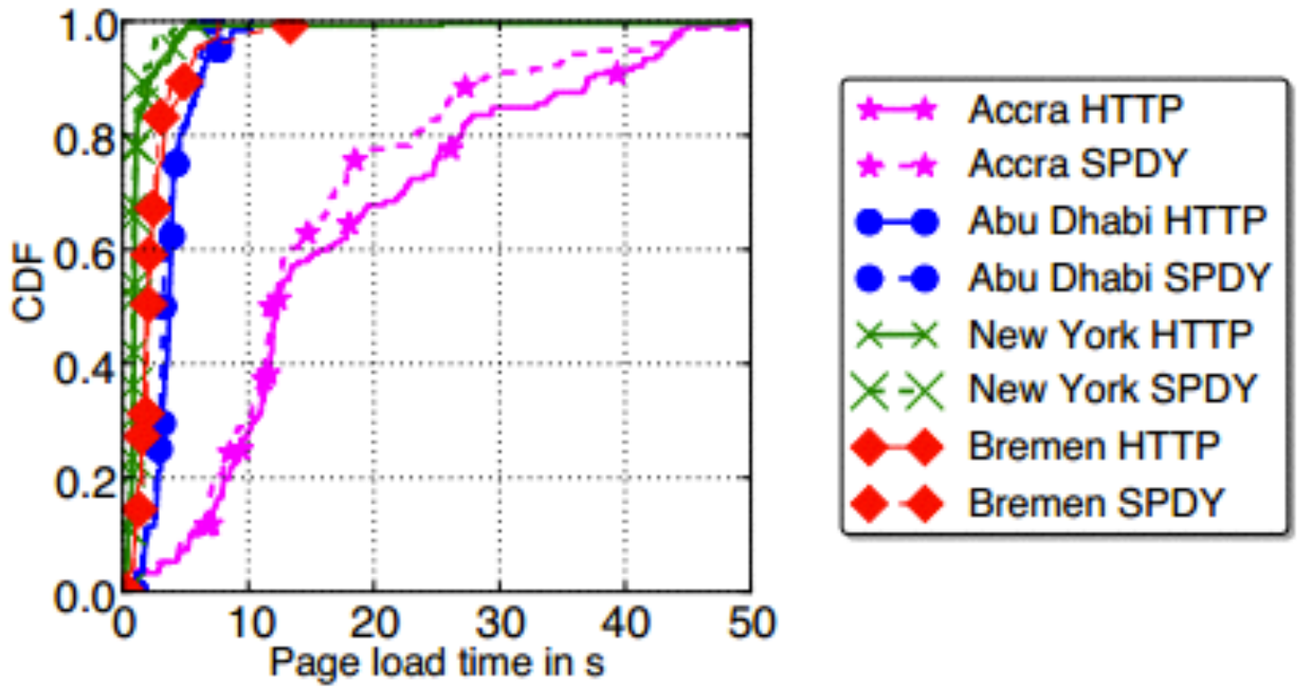


Figure 9: Per location SPDY vs HTTP in 2013