FORENSIC TOOLS FOR IN-DEPTH PERFORMANCE INVESTIGATIONS

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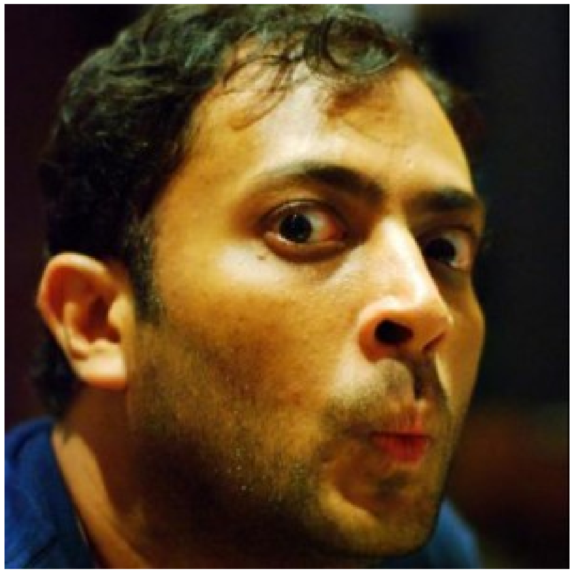
WHO ARE WE?

Nic Jansma
SOASTA



Philip Tellis
SOASTA

WHAT WE DO

SOASTA mPulse is a Real User Monitoring (RUM) tool for measuring page load performance

WHAT WE DO

- We have a JavaScript library (Boomerang) that captures performance metrics, page load characteristics, XHRs, SPA navigations, and more
- We are a **third-party** script provider
- We serve `boomerang.js` from a CDN to our customers using a script loader snippet they include in their HTML
- We can update our customer's `boomerang.js` version (if they ask)
- Our script **runs in their page** so we have to be super-duper careful

BOOMERANG

- Created by Philip Tellis @ Yahoo
- Gathers performance metrics and characteristics of the page load and beacons that data to your server (aka RUM)
- Open-source project (with contributions from SOASTA)
- https://github.com/lognormal/boomerang/

NON-BLOCKING SCRIPT LOADER PATTERN

- lognormal.com/blog/2012/12/12/the-script-loader-pattern
- Better than `<script>` nodes or `async`
- Uses an anonymous `IFRAME`

```
(function(url){
  // Section 1
  var dom,doc,where,iframe = document.createElement('iframe');
  iframe.src = "javascript:void(0)";
  iframe.title = ""; iframe.role="presentation";  // a11y
  (iframe.frameElement || iframe).style.cssText = "width: 0; height: 0; border
  where = document.getElementsByTagName('script');
  where = where[where.length - 1];
  where.parentNode.insertBefore(iframe, where);

  // Section 2
  try {
    doc = iframe.contentWindow.document;
  } catch(e) {
    dom = document.domain;
    iframe.src="javascript:var d=document.open();d.domain='"+dom+"';void(0);";
    doc = iframe.contentWindow.document;
  }
  doc.open()._l = function() {
    var js = this.createElement("script");
    if(dom) this.domain = dom;
    js.id = "js-iframe-async";
    js.src = url;
    this.body.appendChild(js);
  };
  doc.write('<body onload="document._l();">');
  doc.close();
})('http://some.site.com/script.js');
```

CUSTOMER CONCERNS

What happens when our customers think our third-party script is causing an issue on their site?

We bust out our favorite tools!

WEBPAGETEST

Fiddler

VirtualBox

WIRESHARK

Tampermonkey
by Jan Biniok

Microsoft® Windows® Performance Analyzer
Version 10.0.10240.16384 (th1.150709-1700)
© 2015 Microsoft Corporation. All rights reserved.

TCPDUMP

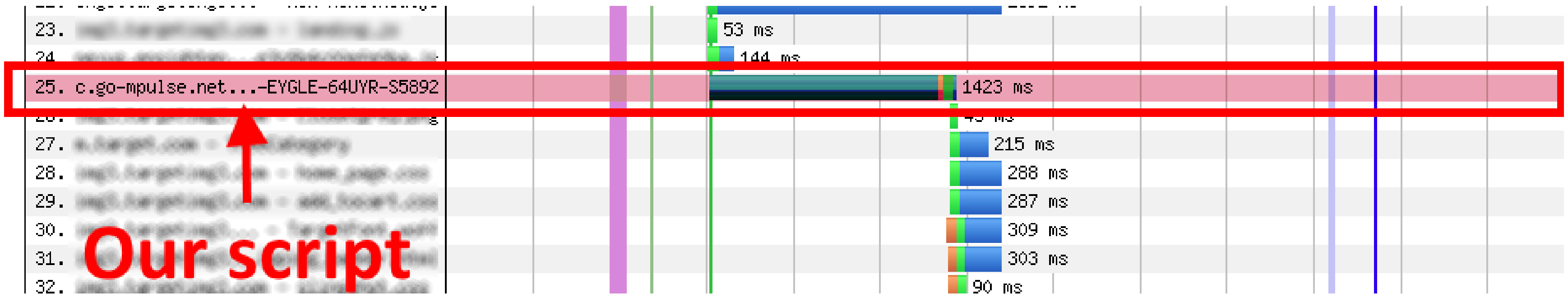
node js®

SCENARIO #1

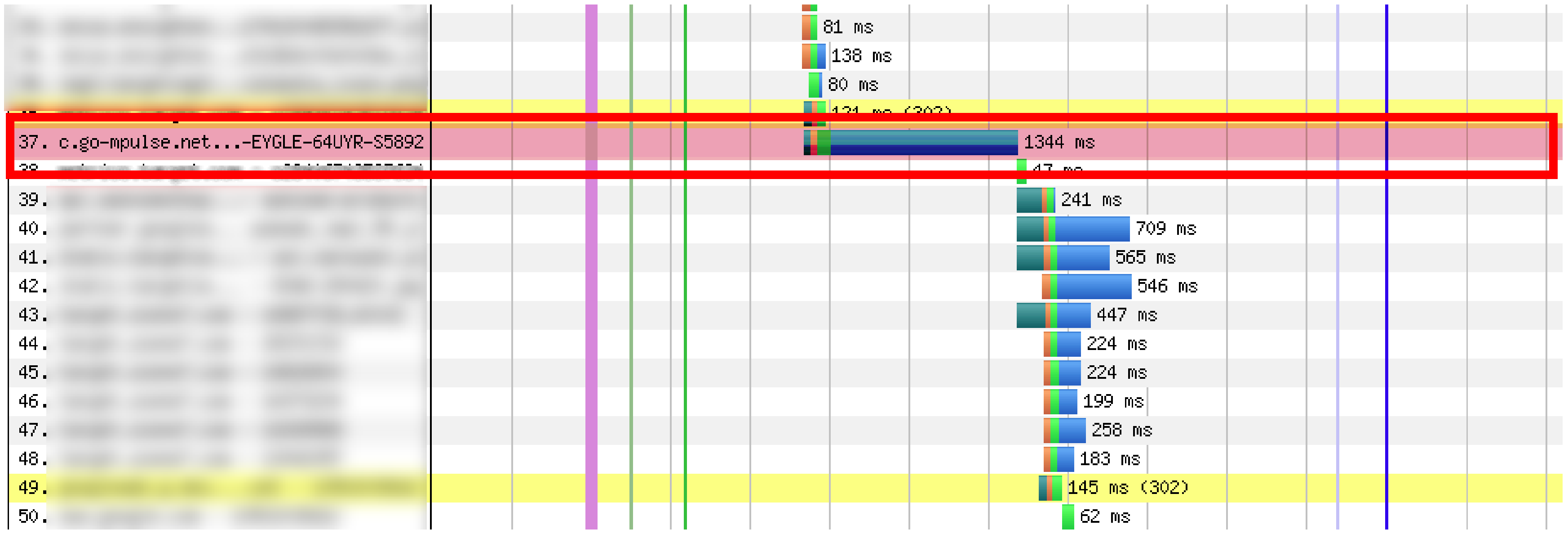
Aren't you supposed to be non-blocking?

Customer:

"Hi guys, So, I was running some WPT tests today and saw this... I thought that this was supposed to be non-blocking. If anyone sees this, they'll hang me up by my heels."



Screenshot #2 from our customer:



STEP #1

REPRODUCE THE ISSUE

TOOL #1
WEBPAGETEST

WEBPAGETEST

- For reproducing real-world page load scenarios
- For testing Single Points of Failure (SPOF)
- Can give you: waterfalls, TCP dumps, network and processing breakdowns, traces, net logs, screenshots, videos, Page Speed score, comparisons and more

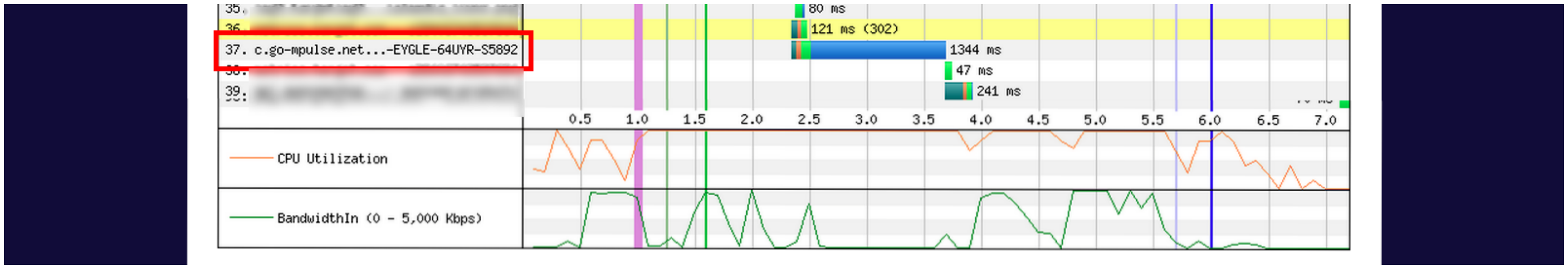
STEP #1

REPRODUCE THE ISSUE

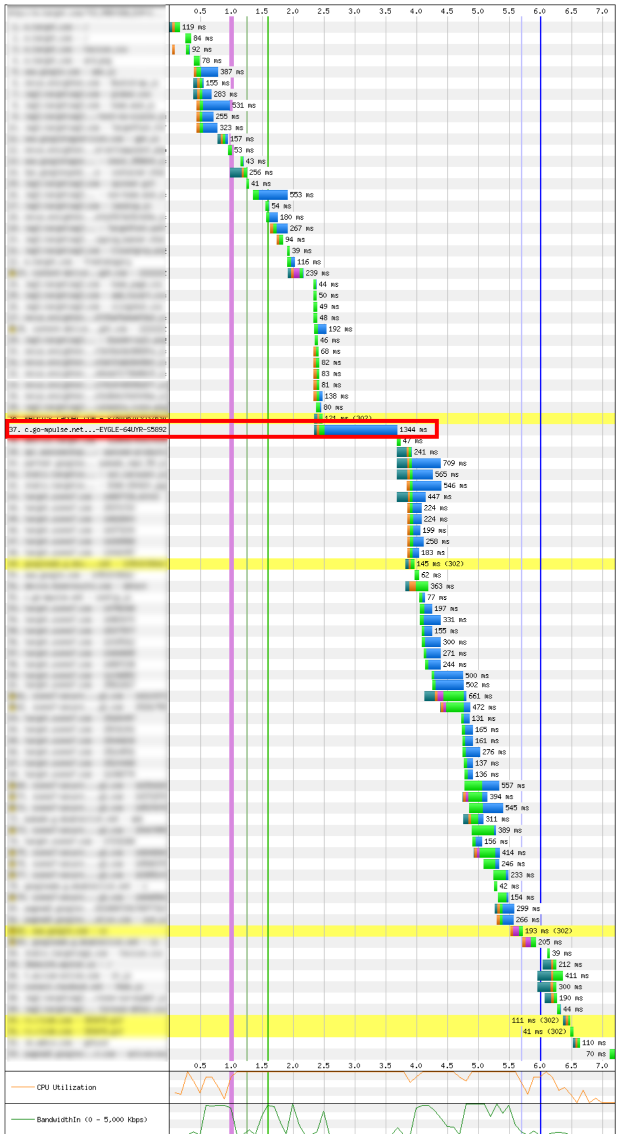
The customer shared their WebPageTest results URL, and we looked closer at the test pass

Out of the 9 runs, 2 showed what appeared to be boomerang.js blocking other downloads

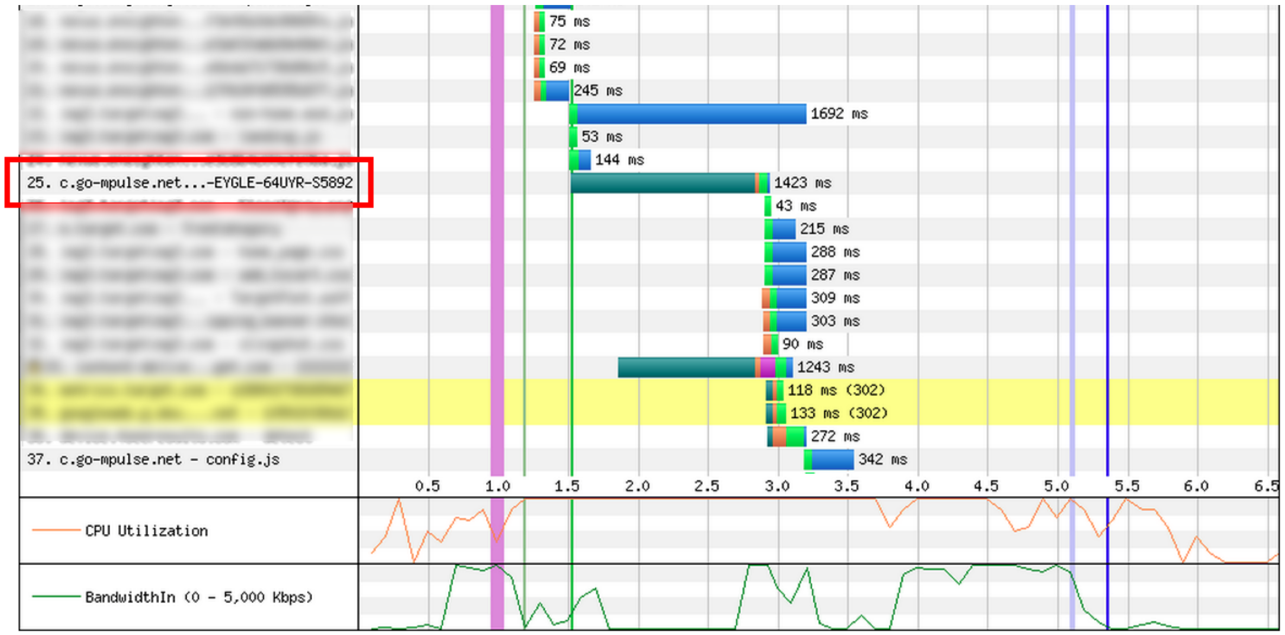
Repro #1:



Repro #1 Larger view



Repro #2:



25. c.go-mpulse.net…-EYGLE-64UYR-S5892
37. c.go-mpulse.net - config.js
75 ms
72 ms
69 ms
245 ms
1692 ms
53 ms
144 ms
1423 ms
43 ms
215 ms
288 ms
287 ms
309 ms
303 ms
90 ms
1243 ms
118 ms (302)
133 ms (302)
272 ms
342 ms
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
CPU Utilization
BandwidthIn (0 - 5,000 Kbps)

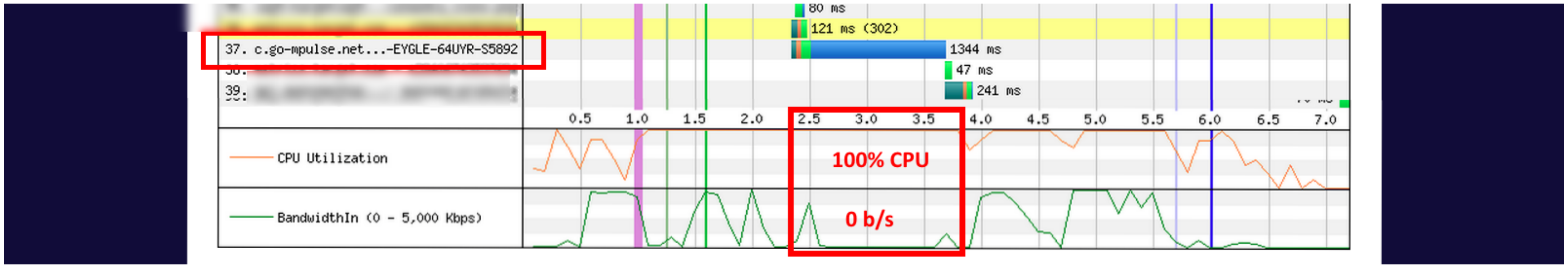
STEP #2

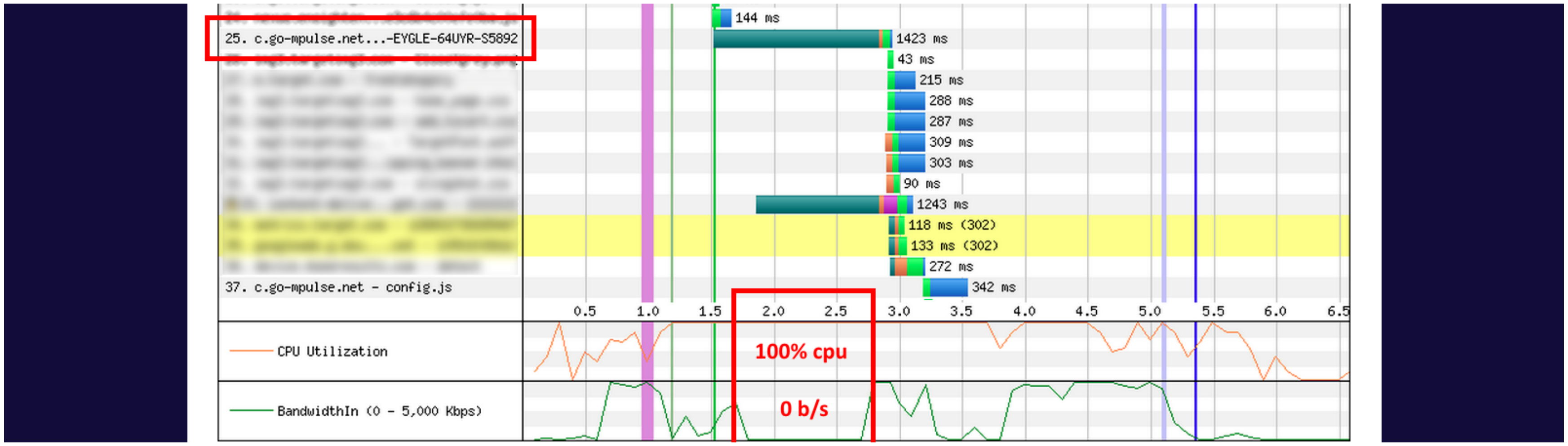
DIVE DEEPER

We looked at the 9 test runs, and found 3 more that had some sort of period where nothing happens

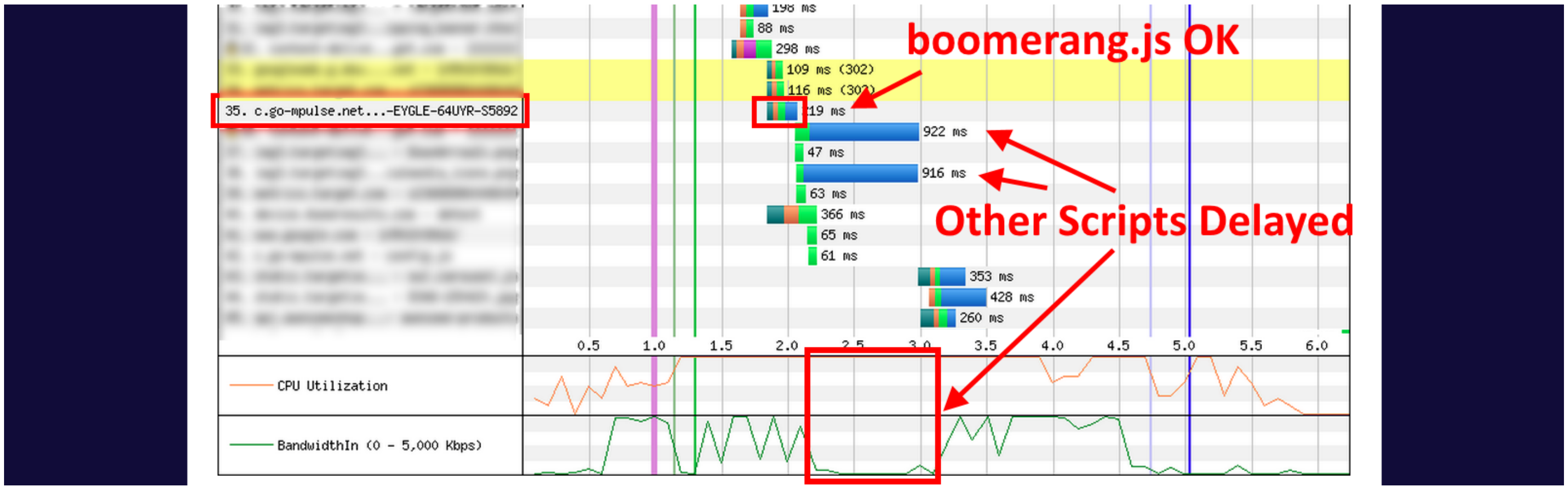
The tests show periods of time where the CPU is 100%, and bandwidth (bytes transferred) drops to 0 for 1-4 seconds.

Repro #1 and #2 show 100% CPU and no bandwidth for over a second:

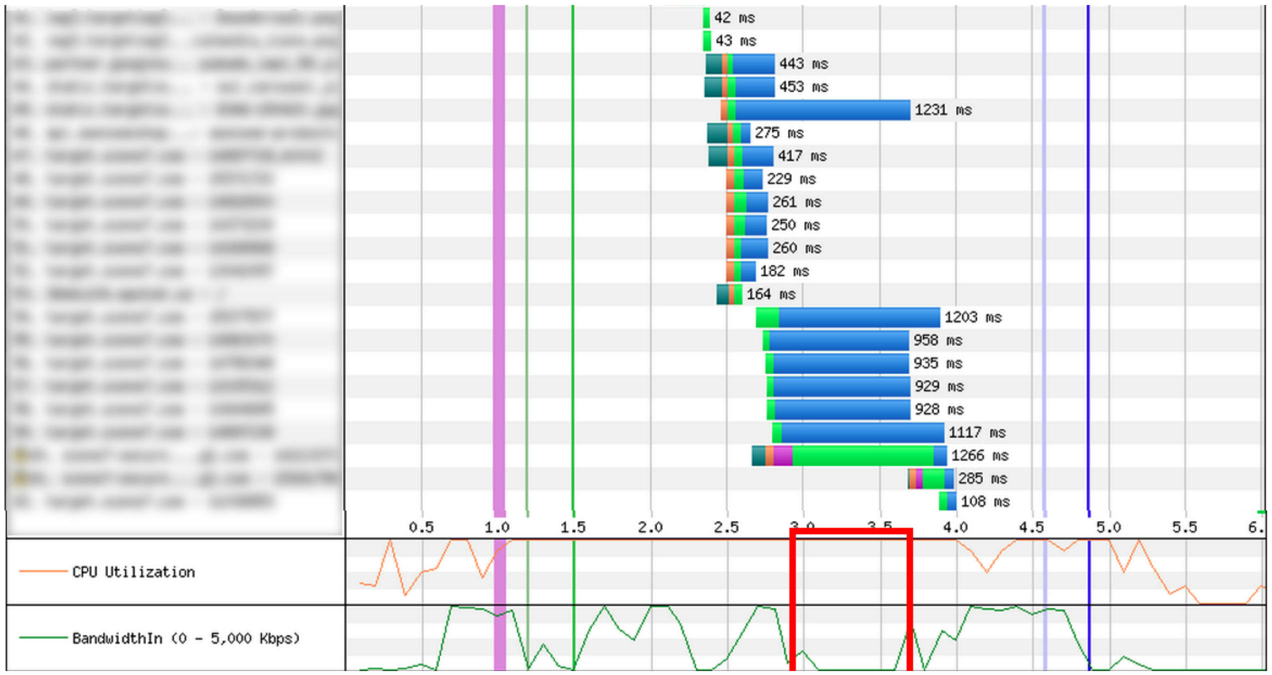




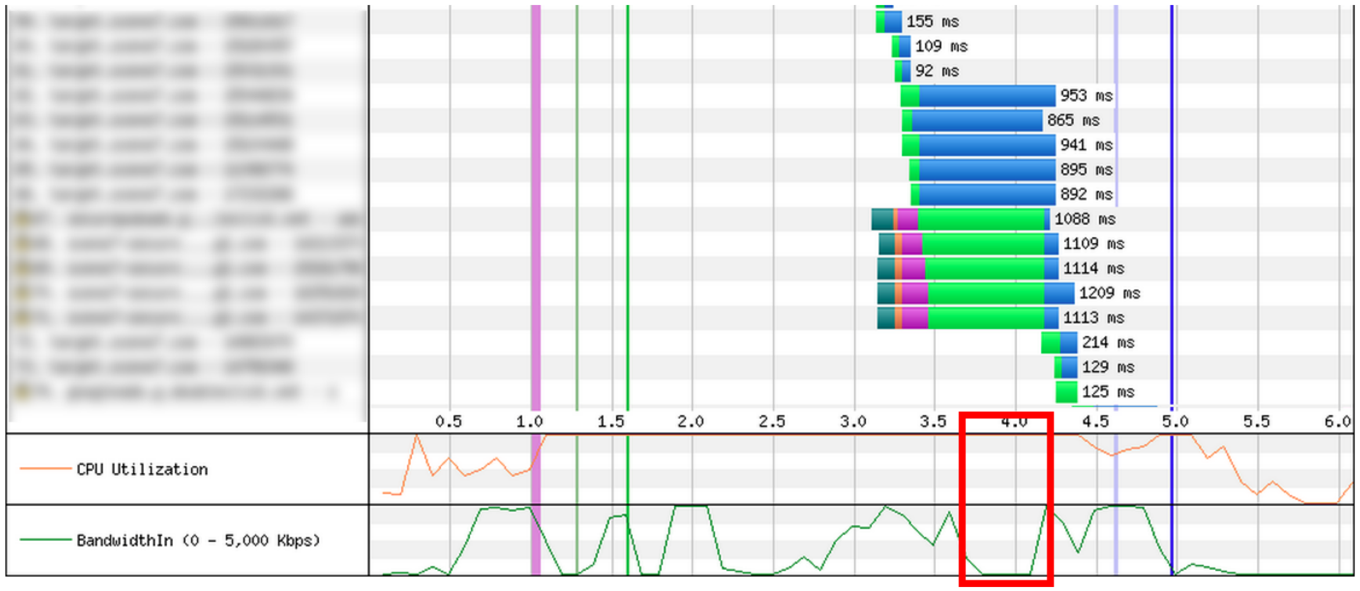
Non-repros: boomerang.js loaded quickly, but two images appeared to "hang"



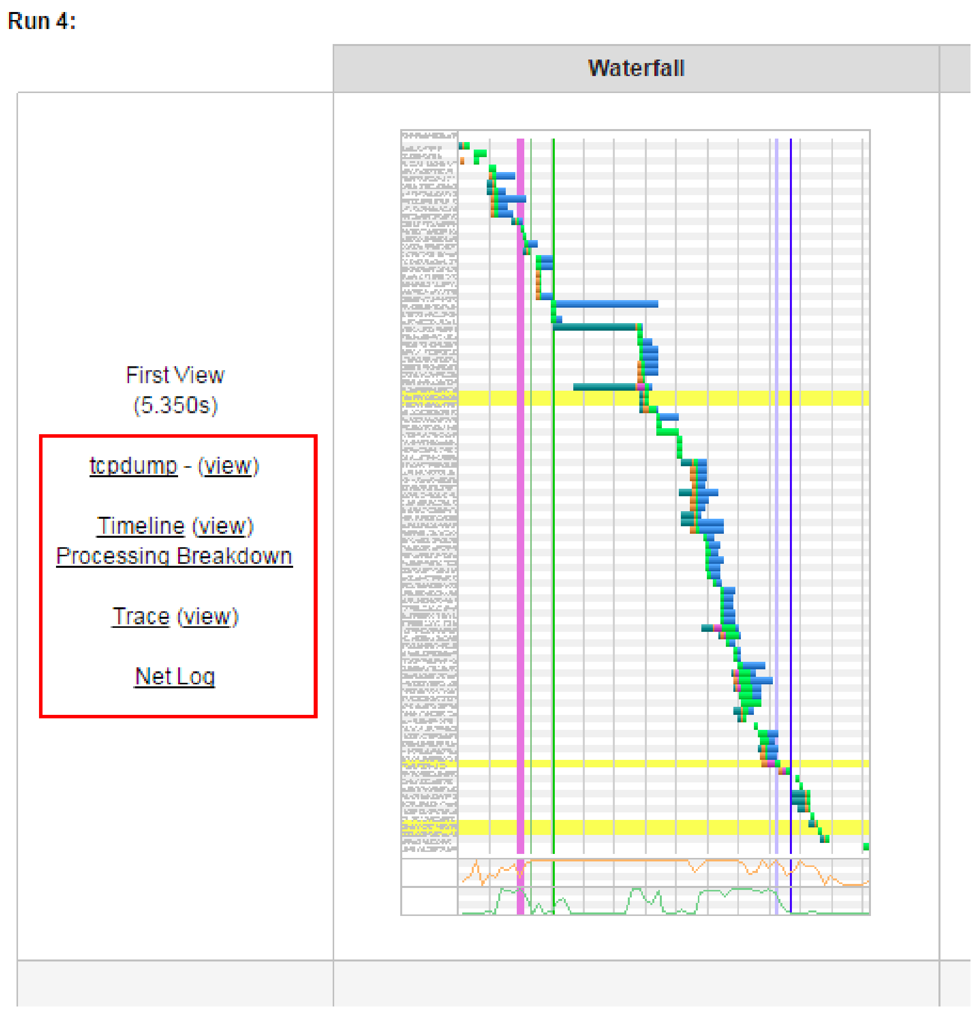
Non-repros: boomerang.js loaded much earlier, but other content appears to "hang"



Non-repros: Other content "hanging"



WebPageTest has many options for diving deeper



Run 4:

Waterfall

First View
(5.350s)

tcpdump - (view)

Timeline (view)
Processing Breakdown

Trace (view)

Net Log

WEBPAGETEST

PROCESSING BREAKDOWN

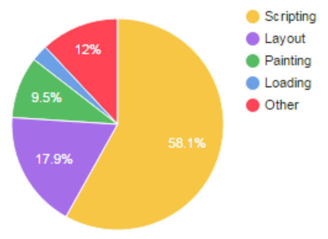
Gives a breakdown of main thread processing and timeline

PROCESSING BREAKDOWN

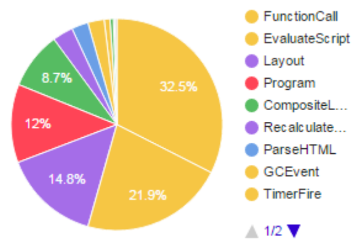
Main thread processing breakdown

Where the browser's main thread was busy, not including idle time waiting for resources (view timeline).

Processing Categories



Processing Events



Category	Time (ms)
Scripting	1325
Layout	409
Other	273
Painting	216
Loading	58

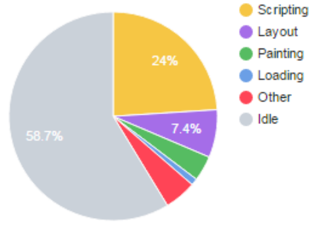
Event	Time (ms)
FunctionCall	741
EvaluateScript	500
Layout	337
Program	273
CompositeLayers	199
RecalculateStyles	72
ParseHTML	58
GCEvent	57
TimerFire	20
UpdateLayerTree	12
Paint	5
EventDispatch	3
XHRReadyStateChange	3
XHRLoad	1

PROCESSING BREAKDOWN

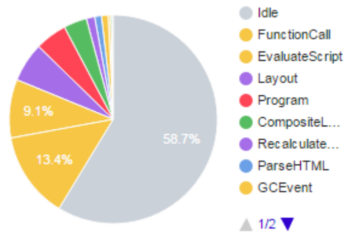
Main thread time breakdown

All of the main thread activity including idle (waiting for resources usually) (view timeline).

Processing Categories



Processing Events



Category	Time (ms)
Idle	3243
Scripting	1325
Layout	409
Other	273
Painting	216
Loading	58

Event	Time (ms)
Idle	3243
FunctionCall	741
EvaluateScript	500
Layout	337
Program	273
CompositeLayers	199
RecalculateStyles	72
ParseHTML	58
GCEvent	57
TimerFire	20
UpdateLayerTree	12
Paint	5
EventDispatch	3
XHRReadyStateChange	3
XHRLoad	1

TOOL #2

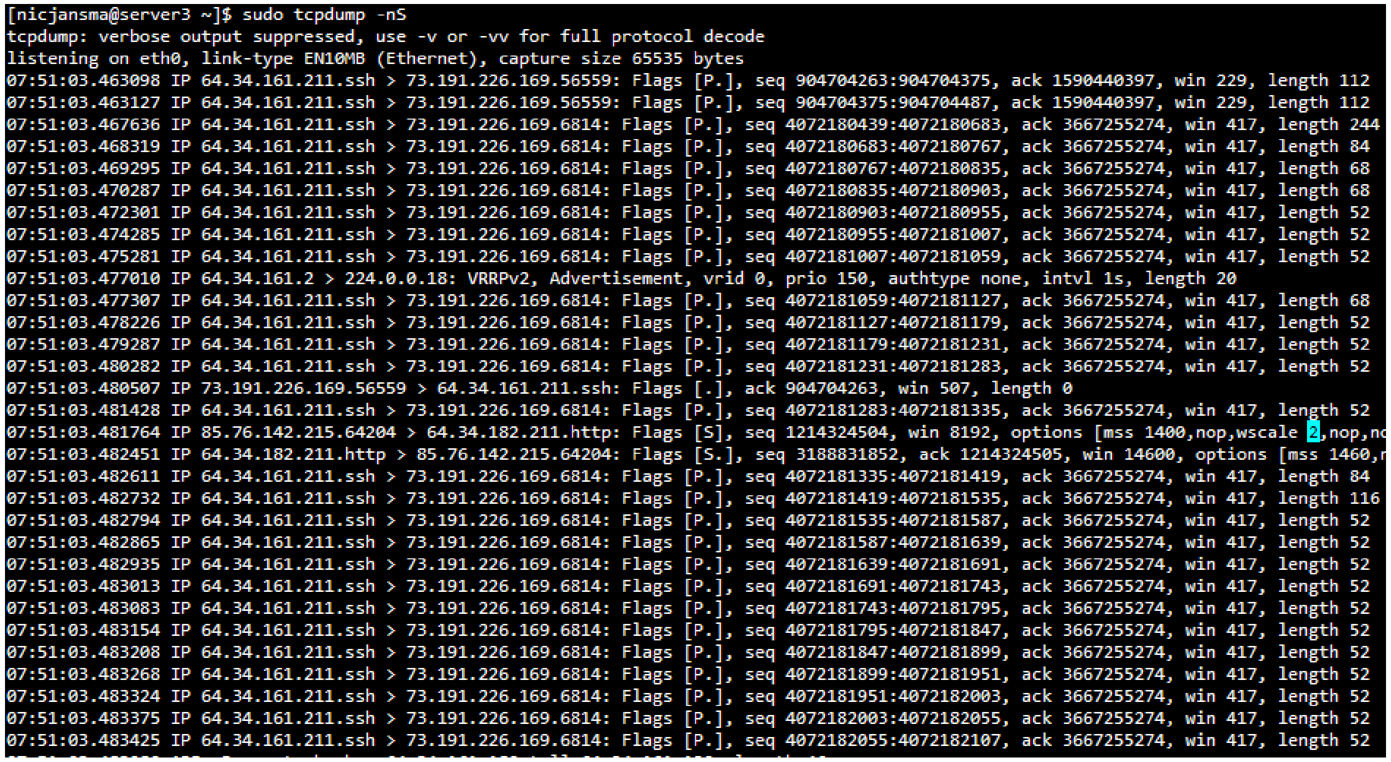
TCPDUMP

- Packet capturing, viewing and analysis
- `libpcap` is a portable library for capturing

TCPDUMP

tcpdump.org/manpages/tcpdump.1.html

`tcpdump -nS`

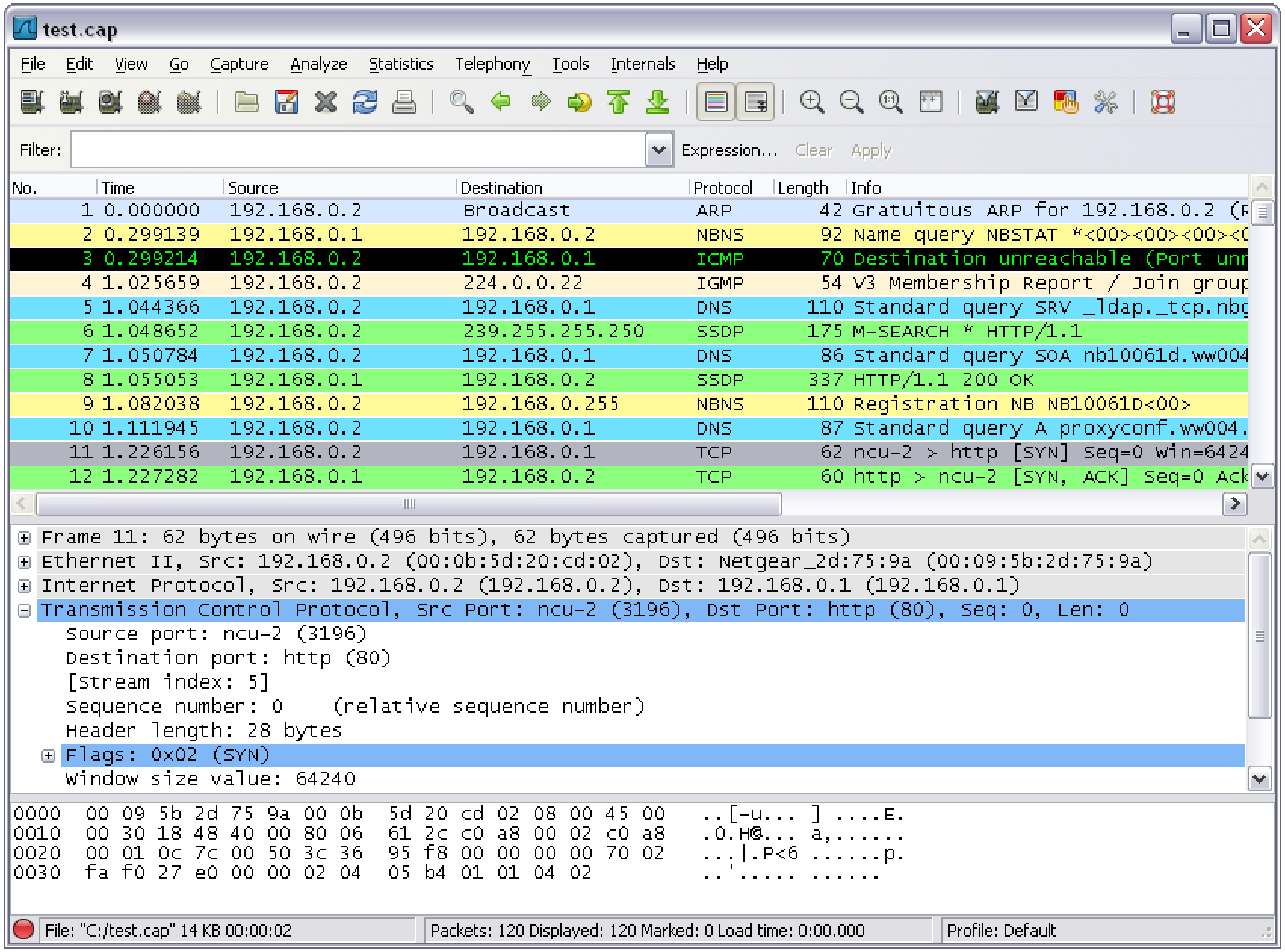


```
[nicjansma@server3 ~]$ sudo tcpdump -nS
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 65535 bytes
07:51:03.463098 IP 64.34.161.211.ssh > 73.191.226.169.56559: Flags [P.], seq 904704263:904704375, ack 1590440397, win 229, length 112
07:51:03.463127 IP 64.34.161.211.ssh > 73.191.226.169.56559: Flags [P.], seq 904704375:904704487, ack 1590440397, win 229, length 112
07:51:03.467636 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072180439:4072180683, ack 3667255274, win 417, length 244
07:51:03.468319 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072180683:4072180767, ack 3667255274, win 417, length 84
07:51:03.469295 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072180767:4072180835, ack 3667255274, win 417, length 68
07:51:03.470287 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072180835:4072180903, ack 3667255274, win 417, length 68
07:51:03.472301 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072180903:4072180955, ack 3667255274, win 417, length 52
07:51:03.474285 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072180955:4072181007, ack 3667255274, win 417, length 52
07:51:03.475281 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181007:4072181059, ack 3667255274, win 417, length 52
07:51:03.477010 IP 64.34.161.2 > 224.0.0.18: VRRPv2, Advertisement, vrid 0, prio 150, authtype none, intvl 1s, length 20
07:51:03.477307 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181059:4072181127, ack 3667255274, win 417, length 68
07:51:03.478226 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181127:4072181179, ack 3667255274, win 417, length 52
07:51:03.479287 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181179:4072181231, ack 3667255274, win 417, length 52
07:51:03.480282 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181231:4072181283, ack 3667255274, win 417, length 52
07:51:03.480507 IP 73.191.226.169.56559 > 64.34.161.211.ssh: Flags [.], ack 904704263, win 507, length 0
07:51:03.481428 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181283:4072181335, ack 3667255274, win 417, length 52
07:51:03.481764 IP 85.76.142.215.64204 > 64.34.182.211.http: Flags [S], seq 1214324504, win 8192, options [mss 1400,nop,wscale 2,nop,nc
07:51:03.482451 IP 64.34.182.211.http > 85.76.142.215.64204: Flags [S.], seq 3188831852, ack 1214324505, win 14600, options [mss 1460,r
07:51:03.482611 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181335:4072181419, ack 3667255274, win 417, length 84
07:51:03.482732 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181419:4072181535, ack 3667255274, win 417, length 116
07:51:03.482794 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181535:4072181587, ack 3667255274, win 417, length 52
07:51:03.482865 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181587:4072181639, ack 3667255274, win 417, length 52
07:51:03.482935 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181639:4072181691, ack 3667255274, win 417, length 52
07:51:03.483013 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181691:4072181743, ack 3667255274, win 417, length 52
07:51:03.483083 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181743:4072181795, ack 3667255274, win 417, length 52
07:51:03.483154 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181795:4072181847, ack 3667255274, win 417, length 52
07:51:03.483208 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181847:4072181899, ack 3667255274, win 417, length 52
07:51:03.483268 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181899:4072181951, ack 3667255274, win 417, length 52
07:51:03.483324 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072181951:4072182003, ack 3667255274, win 417, length 52
07:51:03.483375 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072182003:4072182055, ack 3667255274, win 417, length 52
07:51:03.483425 IP 64.34.161.211.ssh > 73.191.226.169.6814: Flags [P.], seq 4072182055:4072182107, ack 3667255274, win 417, length 52
```

TOOL #3
WIRESHARK

Higher-level analysis of tcpdump

WIRESHARK



```
No.  Time      Source        Destination      Protocol Length Info
   1 0.000000  192.168.0.2   Broadcast        ARP         42 Gratuitous ARP for 192.168.0.2 (R
   2 0.299139  192.168.0.1   192.168.0.2      NBNS        92 Name query NBSTAT *<00><00><00><0
   3 0.299214  192.168.0.2   192.168.0.1      ICMP        70 Destination unreachable (Port unr
   4 1.025659  192.168.0.2   224.0.0.22       IGMP        54 V3 Membership Report / Join group
   5 1.044366  192.168.0.2   192.168.0.1      DNS        110 Standard query SRV _ldap._tcp.nbg
   6 1.048652  192.168.0.2   239.255.255.250  SSDP       175 M-SEARCH * HTTP/1.1
   7 1.050784  192.168.0.2   192.168.0.1      DNS         86 Standard query SOA nb10061d.ww004
   8 1.055053  192.168.0.1   192.168.0.2      SSDP       337 HTTP/1.1 200 OK
   9 1.082038  192.168.0.2   192.168.0.255    NBNS       110 Registration NB NB10061D<00>
  10 1.111945  192.168.0.2   192.168.0.1      DNS         87 Standard query A proxyconf.ww004.
  11 1.226156  192.168.0.2   192.168.0.1      TCP         62 ncu-2 > http [SYN] Seq=0 Win=6424
  12 1.227282  192.168.0.1   192.168.0.2      TCP         60 http > ncu-2 [SYN, ACK] Seq=0 Ack
```

```
⊞ Frame 11: 62 bytes on wire (496 bits), 62 bytes captured (496 bits)
⊞ Ethernet II, Src: 192.168.0.2 (00:0b:5d:20:cd:02), Dst: Netgear_2d:75:9a (00:09:5b:2d:75:9a)
⊞ Internet Protocol, Src: 192.168.0.2 (192.168.0.2), Dst: 192.168.0.1 (192.168.0.1)
⊟ Transmission Control Protocol, Src Port: ncu-2 (3196), Dst Port: http (80), Seq: 0, Len: 0
    Source port: ncu-2 (3196)
    Destination port: http (80)
    [Stream index: 5]
    Sequence number: 0    (relative sequence number)
    Header length: 28 bytes
  ⊞ Flags: 0x02 (SYN)
    Window size value: 64240
```

```
0000  00 09 5b 2d 75 9a 00 0b  5d 20 cd 02 08 00 45 00   ..[-u... ] ....E.
0010  00 30 18 48 40 00 80 06  61 2c c0 a8 00 02 c0 a8   .0.H@... a,......
0020  00 01 0c 7c 00 50 3c 36  95 f8 00 00 00 00 70 02   ...|.P<6 ......p.
0030  fa f0 27 e0 00 00 02 04  05 b4 01 01 04 02         ..'..... ......
```

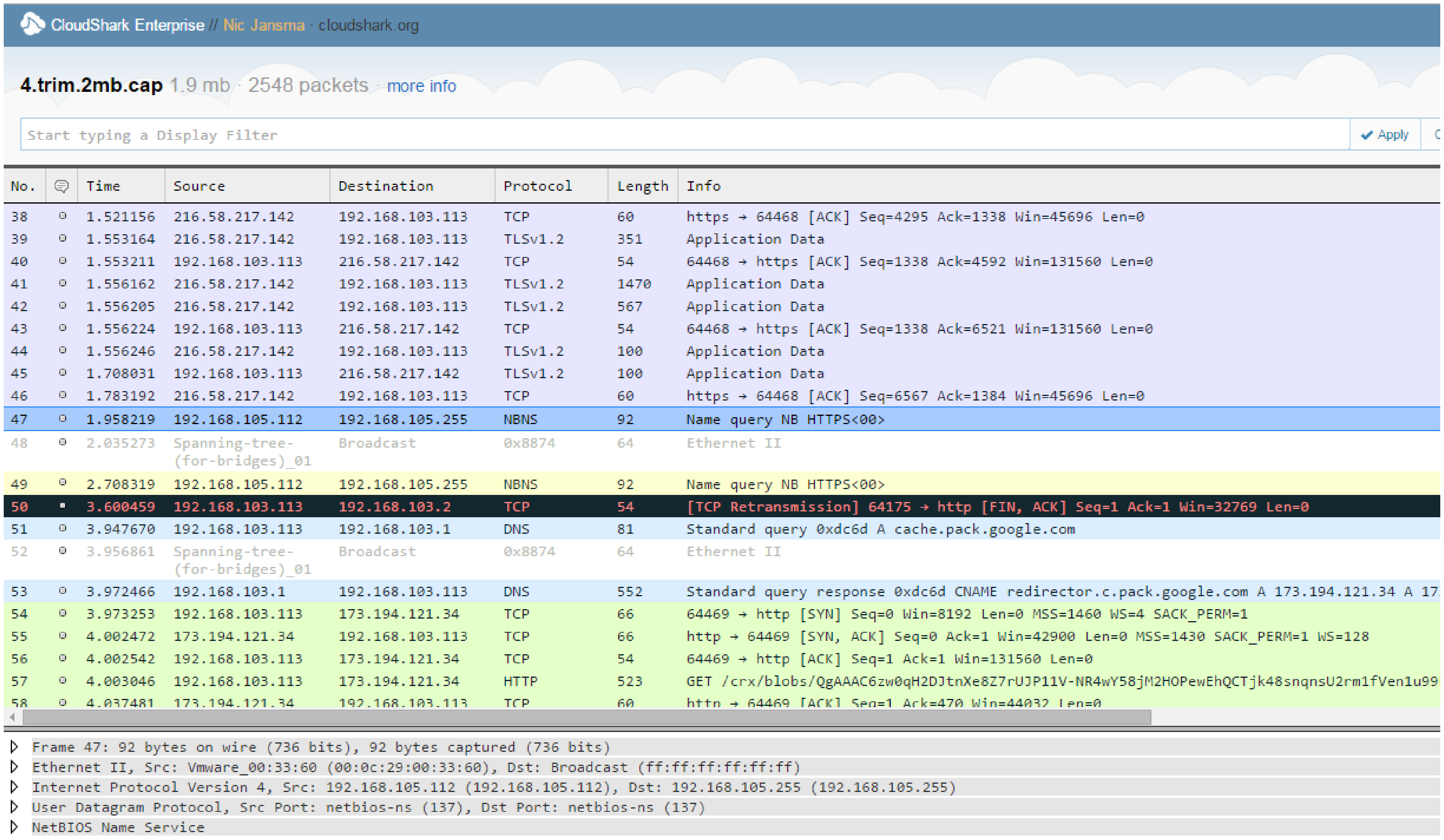
File: "C:/test.cap" 14 KB 00:00:02 | Packets: 120 Displayed: 120 Marked: 0 Load time: 0:00.000 | Profile: Default

TOOL #4

CLOUDSHARK

Analyze PCAP (tcpdump) files in your browser

CLOUDSHARK



CloudShark Enterprise // Nic Jansma · cloudshark.org

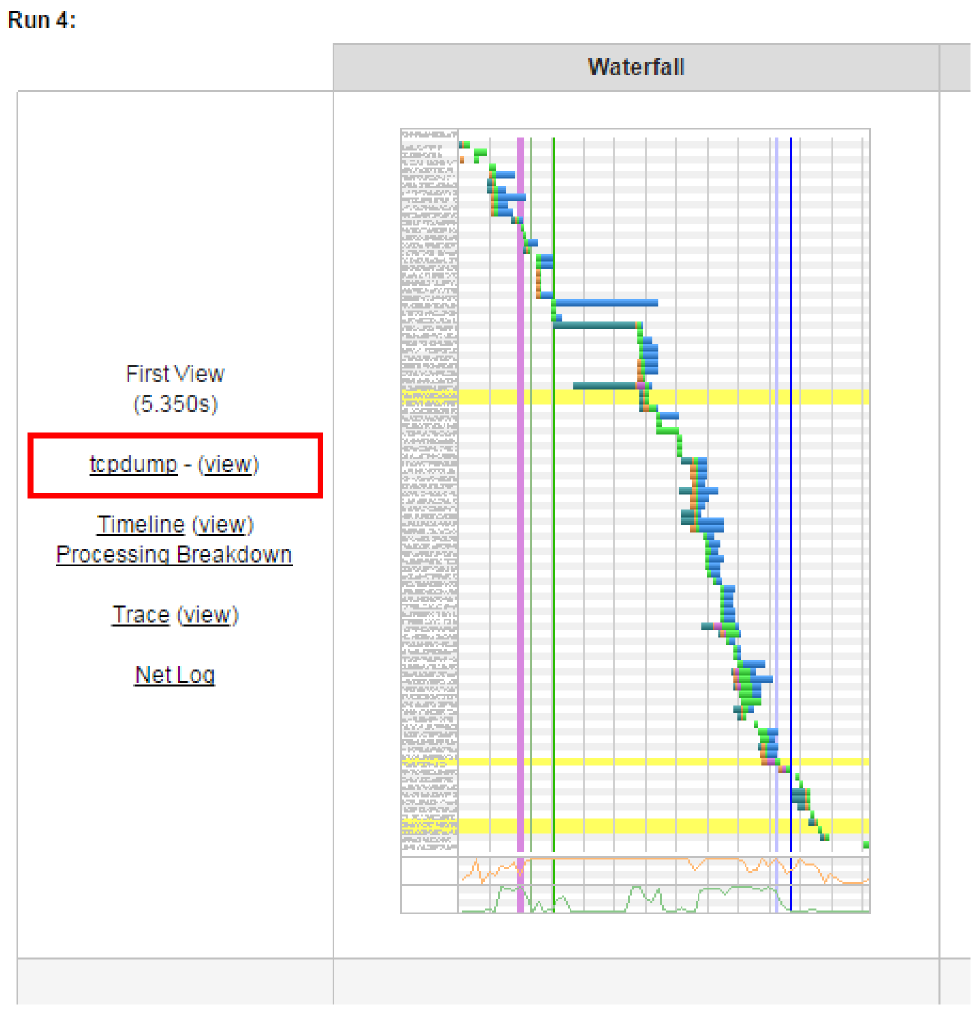
4.trim.2mb.cap 1.9 mb · 2548 packets · more info

Start typing a Display Filter

No.		Time	Source	Destination	Protocol	Length	Info
38	○	1.521156	216.58.217.142	192.168.103.113	TCP	60	https → 64468 [ACK] Seq=4295 Ack=1338 Win=45696 Len=0
39	○	1.553164	216.58.217.142	192.168.103.113	TLSv1.2	351	Application Data
40	○	1.553211	192.168.103.113	216.58.217.142	TCP	54	64468 → https [ACK] Seq=1338 Ack=4592 Win=131560 Len=0
41	○	1.556162	216.58.217.142	192.168.103.113	TLSv1.2	1470	Application Data
42	○	1.556205	216.58.217.142	192.168.103.113	TLSv1.2	567	Application Data
43	○	1.556224	192.168.103.113	216.58.217.142	TCP	54	64468 → https [ACK] Seq=1338 Ack=6521 Win=131560 Len=0
44	○	1.556246	216.58.217.142	192.168.103.113	TLSv1.2	100	Application Data
45	○	1.708031	192.168.103.113	216.58.217.142	TLSv1.2	100	Application Data
46	○	1.783192	216.58.217.142	192.168.103.113	TCP	60	https → 64468 [ACK] Seq=6567 Ack=1384 Win=45696 Len=0
47	○	1.958219	192.168.105.112	192.168.105.255	NBNS	92	Name query NB HTTPS<00>
48	○	2.035273	Spanning-tree-(for-bridges)_01	Broadcast	0x8874	64	Ethernet II
49	○	2.708319	192.168.105.112	192.168.105.255	NBNS	92	Name query NB HTTPS<00>
50	■	3.600459	192.168.103.113	192.168.103.2	TCP	54	[TCP Retransmission] 64175 → http [FIN, ACK] Seq=1 Ack=1 Win=32769 Len=0
51	○	3.947670	192.168.103.113	192.168.103.1	DNS	81	Standard query 0xdc6d A cache.pack.google.com
52	○	3.956861	Spanning-tree-(for-bridges)_01	Broadcast	0x8874	64	Ethernet II
53	○	3.972466	192.168.103.1	192.168.103.113	DNS	552	Standard query response 0xdc6d CNAME redirector.c.pack.google.com A 173.194.121.34 A 17
54	○	3.973253	192.168.103.113	173.194.121.34	TCP	66	64469 → http [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=4 SACK_PERM=1
55	○	4.002472	173.194.121.34	192.168.103.113	TCP	66	http → 64469 [SYN, ACK] Seq=0 Ack=1 Win=42900 Len=0 MSS=1430 SACK_PERM=1 WS=128
56	○	4.002542	192.168.103.113	173.194.121.34	TCP	54	64469 → http [ACK] Seq=1 Ack=1 Win=131560 Len=0
57	○	4.003046	192.168.103.113	173.194.121.34	HTTP	523	GET /crx/blobs/QgAAAC6zw0qH2DJtnXe8Z7rUJP11V-NR4wY58jM2HOPewEhQCTjk48snqnsU2rm1fVen1u99
58	○	4.037481	173.194.121.34	192.168.103.113	TCP	60	http → 64469 [ACK] Seq=1 Ack=470 Win=44032 Len=0

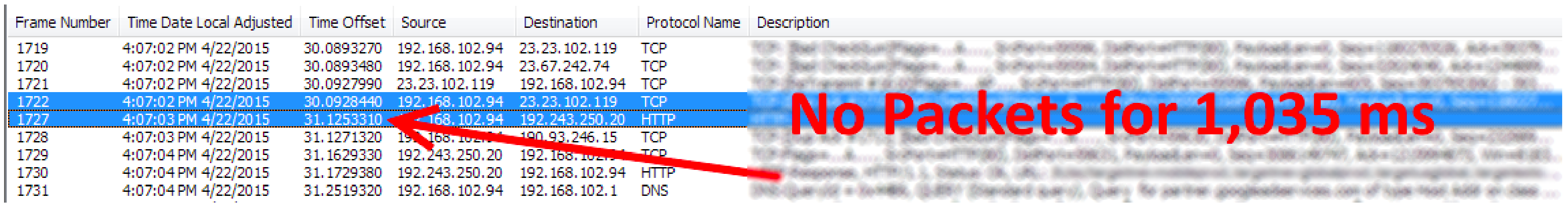
```
▷ Frame 47: 92 bytes on wire (736 bits), 92 bytes captured (736 bits)
▷ Ethernet II, Src: Vmware_00:33:60 (00:0c:29:00:33:60), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
▷ Internet Protocol Version 4, Src: 192.168.105.112 (192.168.105.112), Dst: 192.168.105.255 (192.168.105.255)
▷ User Datagram Protocol, Src Port: netbios-ns (137), Dst Port: netbios-ns (137)
▷ NetBIOS Name Service
```

At this point, we downloaded the WebPageTest tcpdump files to dive deeper into the data


Run 4:

	Waterfall
First View (5.350s) tcpdump - (view) Timeline (view) Processing Breakdown Trace (view) Net Log	

In all of the runs that showed a period of "no progress", we found *zero* network activity

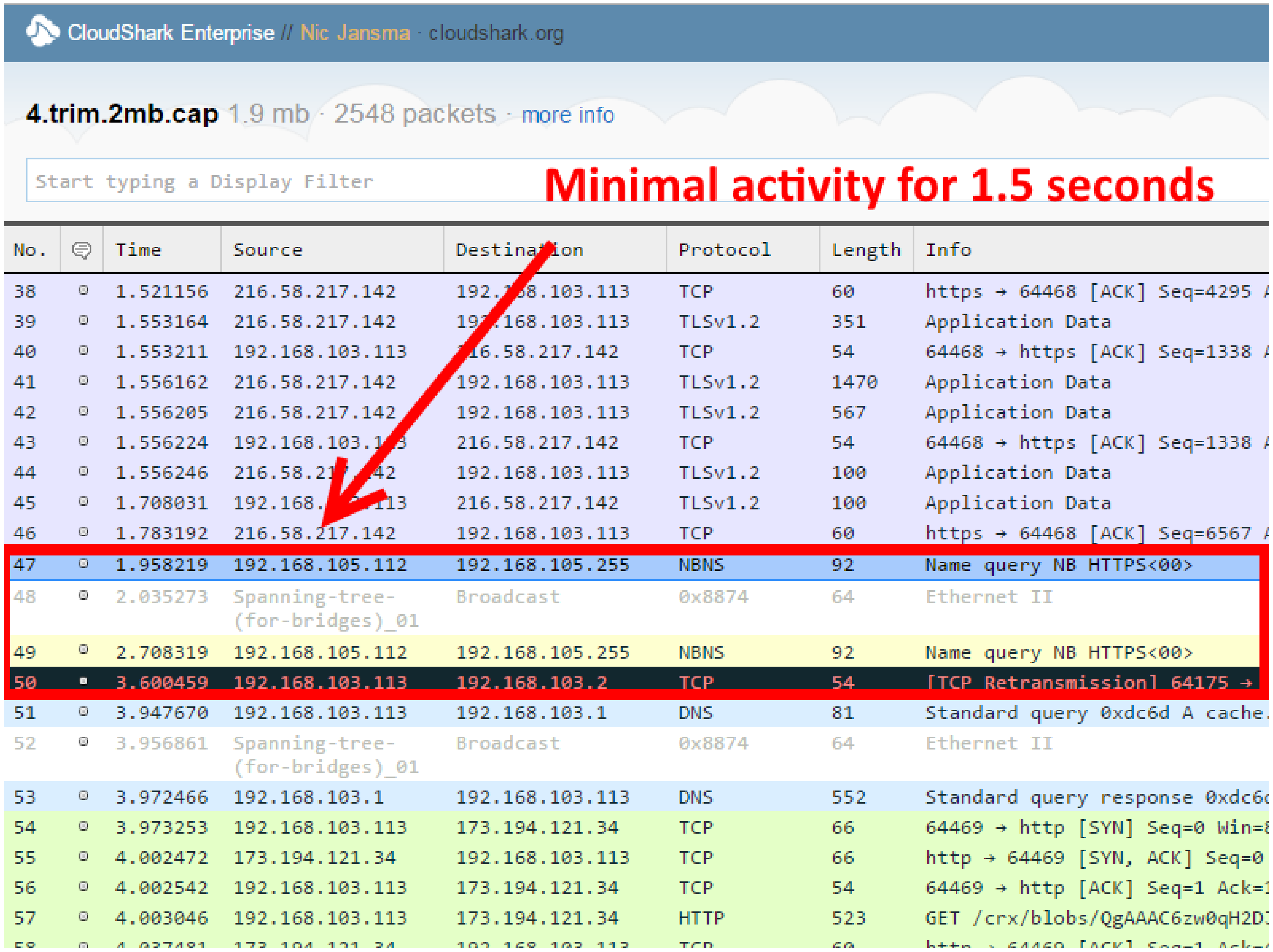


Frame Number	Time Date Local Adjusted	Time Offset	Source	Destination	Protocol Name	Description
1719	4:07:02 PM 4/22/2015	30.0893270	192.168.102.94	23.23.102.119	TCP	[illegible]
1720	4:07:02 PM 4/22/2015	30.0893480	192.168.102.94	23.67.242.74	TCP	[illegible]
1721	4:07:02 PM 4/22/2015	30.0927990	23.23.102.119	192.168.102.94	TCP	[illegible]
1722	4:07:02 PM 4/22/2015	30.0928440	192.168.102.94	23.23.102.119	TCP	[illegible]
1727	4:07:03 PM 4/22/2015	31.1253310	[illegible].168.102.94	192.243.250.20	HTTP	[illegible]
1728	4:07:03 PM 4/22/2015	31.1271320	[illegible]	190.93.246.15	TCP	[illegible]
1729	4:07:04 PM 4/22/2015	31.1629330	192.243.250.20	192.168.[illegible]	TCP	[illegible]
1730	4:07:04 PM 4/22/2015	31.1729380	192.243.250.20	192.168.102.94	HTTP	[illegible]
1731	4:07:04 PM 4/22/2015	31.2519320	192.168.102.94	192.168.102.1	DNS	[illegible]

(Repro #1)

We expect the OS network stack to continue TCP communications even if the browser was "blocked" on a script

CLOUDSHARK


CloudShark Enterprise // Nic Jansma · cloudshark.org

4.trim.2mb.cap 1.9 mb · 2548 packets · more info

Start typing a Display Filter

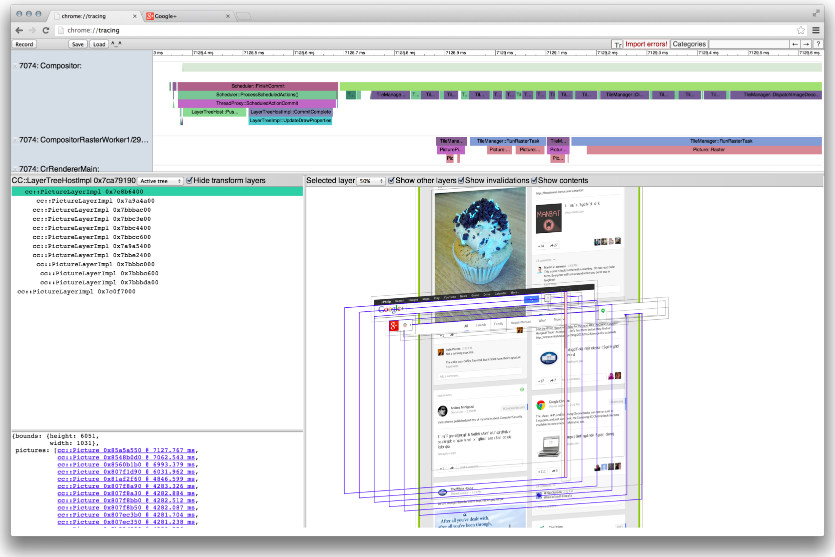
Minimal activity for 1.5 seconds

No.		Time	Source	Destination	Protocol	Length	Info
38	○	1.521156	216.58.217.142	192.168.103.113	TCP	60	https → 64468 [ACK] Seq=4295
39	○	1.553164	216.58.217.142	192.168.103.113	TLSv1.2	351	Application Data
40	○	1.553211	192.168.103.113	216.58.217.142	TCP	54	64468 → https [ACK] Seq=1338
41	○	1.556162	216.58.217.142	192.168.103.113	TLSv1.2	1470	Application Data
42	○	1.556205	216.58.217.142	192.168.103.113	TLSv1.2	567	Application Data
43	○	1.556224	192.168.103.113	216.58.217.142	TCP	54	64468 → https [ACK] Seq=1338
44	○	1.556246	216.58.217.142	192.168.103.113	TLSv1.2	100	Application Data
45	○	1.708031	192.168.103.113	216.58.217.142	TLSv1.2	100	Application Data
46	○	1.783192	216.58.217.142	192.168.103.113	TCP	60	https → 64468 [ACK] Seq=6567
47	○	1.958219	192.168.105.112	192.168.105.255	NBNS	92	Name query NB HTTPS<00>
48	○	2.035273	Spanning-tree-(for-bridges)_01	Broadcast	0x8874	64	Ethernet II
49	○	2.708319	192.168.105.112	192.168.105.255	NBNS	92	Name query NB HTTPS<00>
50	▪	3.600459	192.168.103.113	192.168.103.2	TCP	54	[TCP Retransmission] 64175 →
51	○	3.947670	192.168.103.113	192.168.103.1	DNS	81	Standard query 0xdc6d A cache.
52	○	3.956861	Spanning-tree-(for-bridges)_01	Broadcast	0x8874	64	Ethernet II
53	○	3.972466	192.168.103.1	192.168.103.113	DNS	552	Standard query response 0xdc6
54	○	3.973253	192.168.103.113	173.194.121.34	TCP	66	64469 → http [SYN] Seq=0 Win=
55	○	4.002472	173.194.121.34	192.168.103.113	TCP	66	http → 64469 [SYN, ACK] Seq=0
56	○	4.002542	192.168.103.113	173.194.121.34	TCP	54	64469 → http [ACK] Seq=1 Ack=
57	○	4.003046	192.168.103.113	173.194.121.34	HTTP	523	GET /crx/blobs/QgAAAC6zw0qH2D
58	○	4.037481	173.194.121.34	192.168.103.113	TCP	60	http → 64469 [ACK] Seq=1 Ack=

(Repro #2)

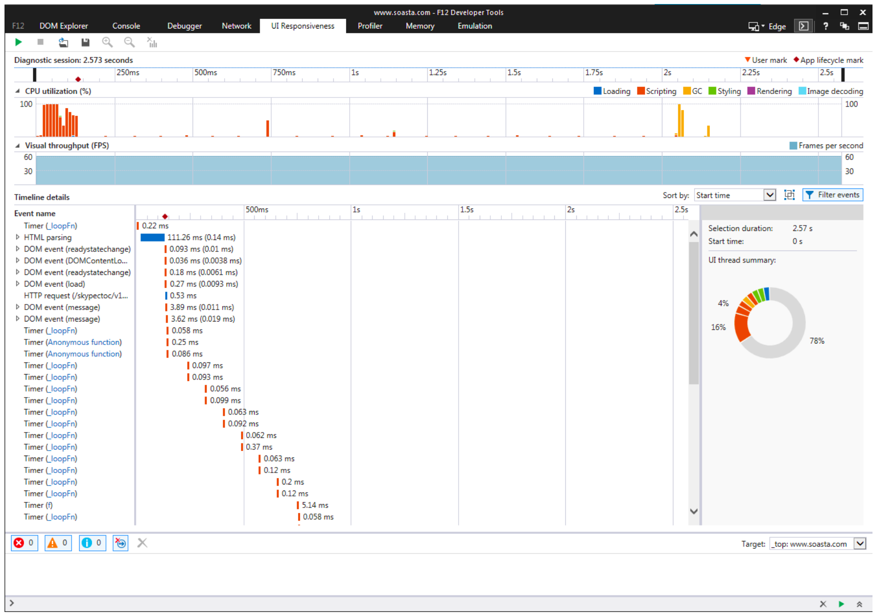
TOOL #5

BROWSER DEV TOOLS



```
CC::LayerTreeHostImpl 0x7ca79190  Active tree  ☑Hide transform layers
    cc::PictureLayerImpl 0x7e8b6400
       cc::PictureLayerImpl 0x7a9a4a00
      cc::PictureLayerImpl 0x7bbbac00
      cc::PictureLayerImpl 0x7bbc3e00
      cc::PictureLayerImpl 0x7bbc4400
      cc::PictureLayerImpl 0x7bbcc600
      cc::PictureLayerImpl 0x7a9a5400
      cc::PictureLayerImpl 0x7bbe2400
       cc::PictureLayerImpl 0x7bbbc000
        cc::PictureLayerImpl 0x7bbbc600
        cc::PictureLayerImpl 0x7bbbda00
 cc::PictureLayerImpl 0x7c0f7000

{bounds: {height: 6051,
          width: 1031},
 pictures: [cc::Picture 0x85a5a550 @ 7127.767 ms,
            cc::Picture 0x8548b0d0 @ 7062.543 ms,
            cc::Picture 0x8560b1b0 @ 6993.379 ms,
            cc::Picture 0x807f1d90 @ 6031.962 ms,
            cc::Picture 0x81af2f60 @ 4846.599 ms,
            cc::Picture 0x807f8a90 @ 4283.326 ms,
            cc::Picture 0x807f8a30 @ 4282.884 ms,
            cc::Picture 0x807f8bb0 @ 4282.512 ms,
            cc::Picture 0x807f8b50 @ 4282.087 ms,
            cc::Picture 0x807ec3b0 @ 4281.704 ms,
            cc::Picture 0x807ec350 @ 4281.238 ms,
```

chrome://tracing
Record
Save
Load
Import errors!
Categories
7074: Compositor:
7074: CompositorRasterWorker1/29...
7074: CrRendererMain:
Scheduler::ProcessScheduledActions()
ThreadProxy::ScheduledActionCommit
LayerTreeHost::Pus...
LayerTreeHostImpl::CommitComplete
LayerTreeImpl::UpdateDrawProperties
TileManager::RunRasterTask
Picture::Raster
Selected layer
Show other layers
Show invalidations
Show contents



Diagnostic session: 2.573 seconds

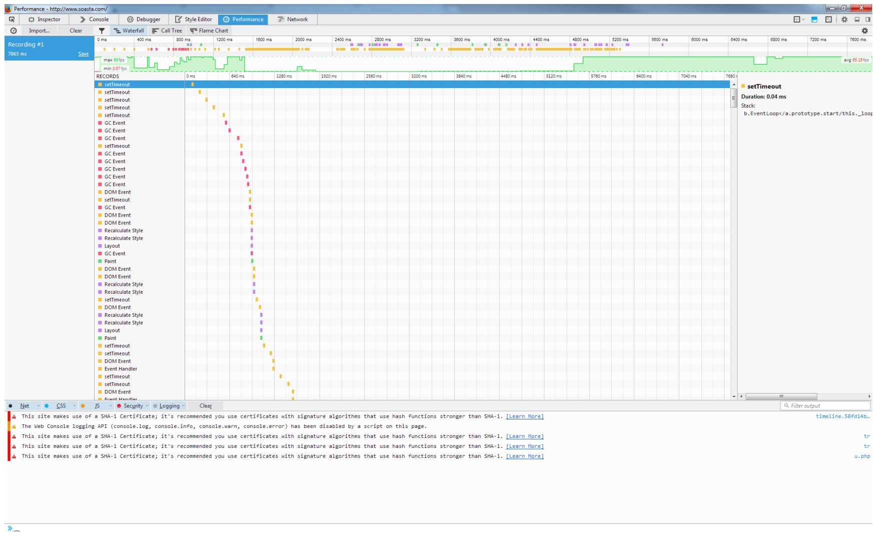
Timeline details

Event name	
Timer (_loopFn)	0.22 ms
HTML parsing	111.26 ms (0.14 ms)
DOM event (readystatechange)	0.093 ms (0.01 ms)
DOM event (DOMContentLo...	0.036 ms (0.0038 ms)
DOM event (readystatechange)	0.18 ms (0.0061 ms)
DOM event (load)	0.27 ms (0.0093 ms)
HTTP request (/skypectoc/v1...	0.53 ms
DOM event (message)	3.89 ms (0.011 ms)
DOM event (message)	3.62 ms (0.019 ms)
Timer (_loopFn)	0.058 ms
Timer (Anonymous function)	0.25 ms
Timer (Anonymous function)	0.086 ms
Timer (_loopFn)	0.097 ms
Timer (_loopFn)	0.093 ms
Timer (_loopFn)	0.056 ms
Timer (_loopFn)	0.099 ms
Timer (_loopFn)	0.063 ms
Timer (_loopFn)	0.092 ms
Timer (_loopFn)	0.062 ms
Timer (_loopFn)	0.37 ms
Timer (_loopFn)	0.063 ms
Timer (_loopFn)	0.12 ms
Timer (_loopFn)	0.2 ms
Timer (_loopFn)	0.12 ms
Timer (f)	5.14 ms
Timer (_loopFn)	0.058 ms

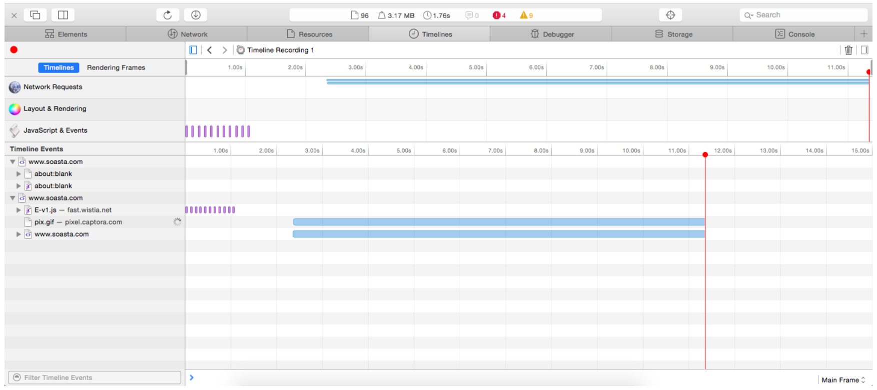
Selection duration: 2.57 s
Start time: 0 s
UI thread summary:

TOOL #5

BROWSER DEV TOOLS



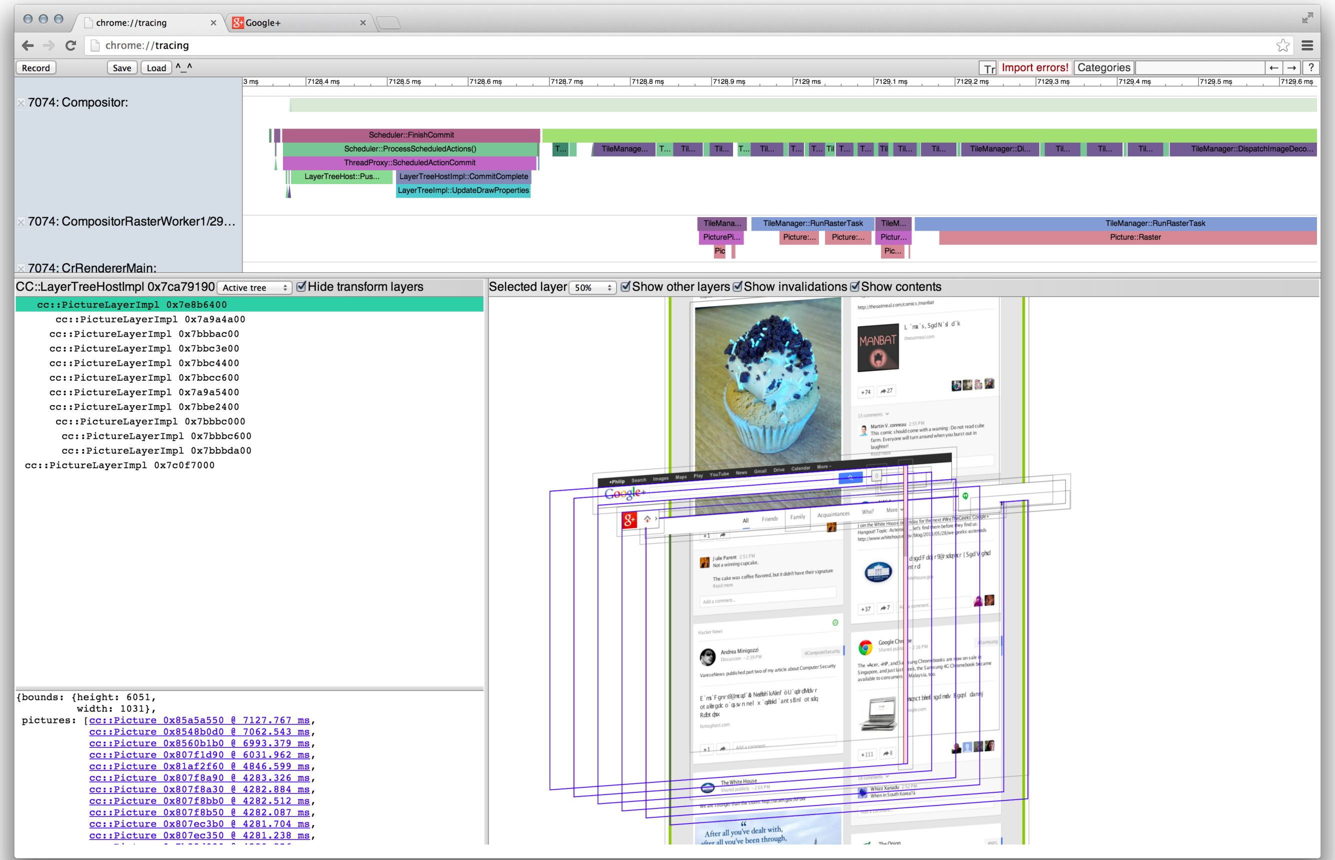
```
This site makes use of a SHA-1 Certificate; it's recommended you use certificates with signature algorithms that use hash functions stronger than SHA-1. [Learn More]   timeline.58fd14b…
The Web Console logging API (console.log, console.info, console.warn, console.error) has been disabled by a script on this page.
This site makes use of a SHA-1 Certificate; it's recommended you use certificates with signature algorithms that use hash functions stronger than SHA-1. [Learn More]   tr
This site makes use of a SHA-1 Certificate; it's recommended you use certificates with signature algorithms that use hash functions stronger than SHA-1. [Learn More]   tr
This site makes use of a SHA-1 Certificate; it's recommended you use certificates with signature algorithms that use hash functions stronger than SHA-1. [Learn More]   u.php
```



The usefulness of Browser Dev Tools could be a talk on its own, but we'll give some highlights during our investigations

TOOL #6
CHROME TRACING

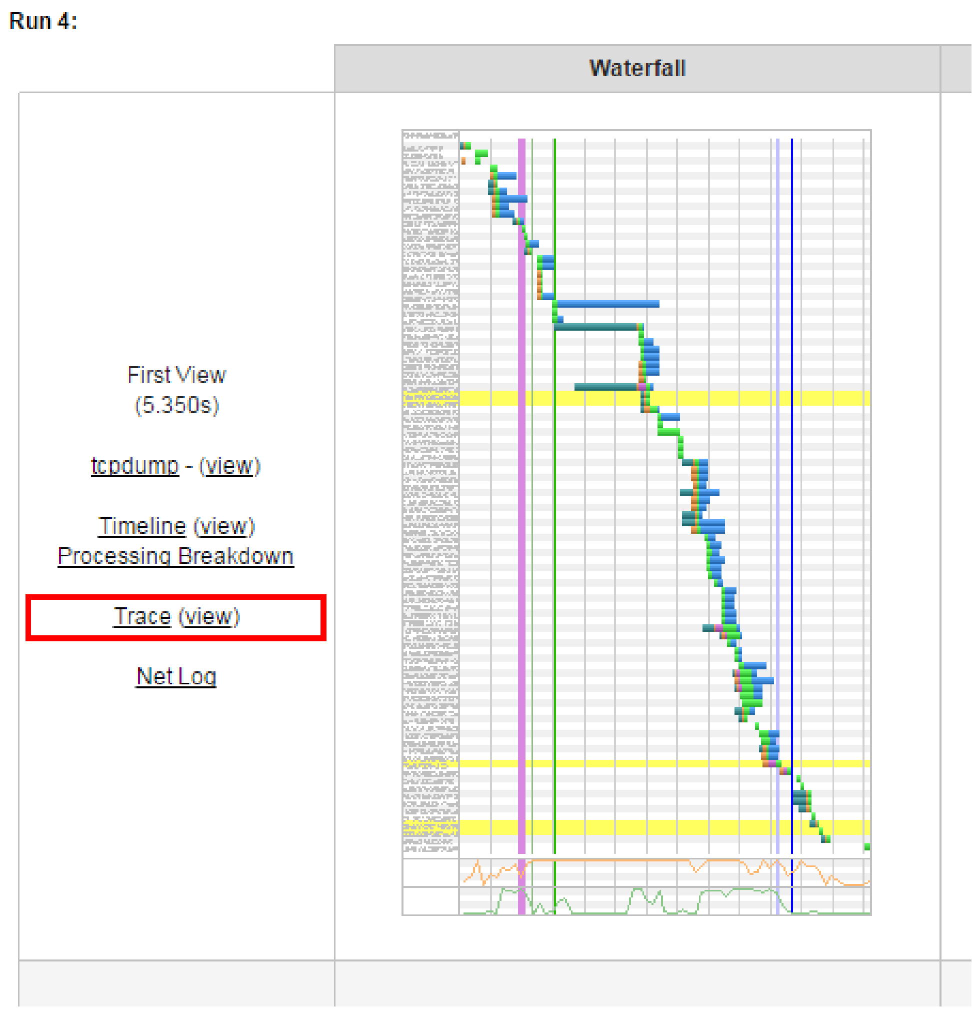
`chrome://tracing`



```
    cc::PictureLayerImpl 0x7e8b6400
       cc::PictureLayerImpl 0x7a9a4a00
      cc::PictureLayerImpl 0x7bbbac00
      cc::PictureLayerImpl 0x7bbc3e00
      cc::PictureLayerImpl 0x7bbc4400
      cc::PictureLayerImpl 0x7bbcc600
      cc::PictureLayerImpl 0x7a9a5400
      cc::PictureLayerImpl 0x7bbe2400
       cc::PictureLayerImpl 0x7bbbc000
        cc::PictureLayerImpl 0x7bbbc600
        cc::PictureLayerImpl 0x7bbbda00
 cc::PictureLayerImpl 0x7c0f7000
```

```
{bounds: {height: 6051,
          width: 1031},
 pictures: [cc::Picture 0x85a5a550 @ 7127.767 ms,
            cc::Picture 0x8548b0d0 @ 7062.543 ms,
            cc::Picture 0x8560b1b0 @ 6993.379 ms,
            cc::Picture 0x807f1d90 @ 6031.962 ms,
            cc::Picture 0x81af2f60 @ 4846.599 ms,
            cc::Picture 0x807f8a90 @ 4283.326 ms,
            cc::Picture 0x807f8a30 @ 4282.884 ms,
            cc::Picture 0x807f8bb0 @ 4282.512 ms,
            cc::Picture 0x807f8b50 @ 4282.087 ms,
            cc::Picture 0x807ec3b0 @ 4281.704 ms,
            cc::Picture 0x807ec350 @ 4281.238 ms,
```

WebPageTest provides Chrome Traces



Run 4:

Waterfall

First View
(5.350s)

tcpdump - (view)

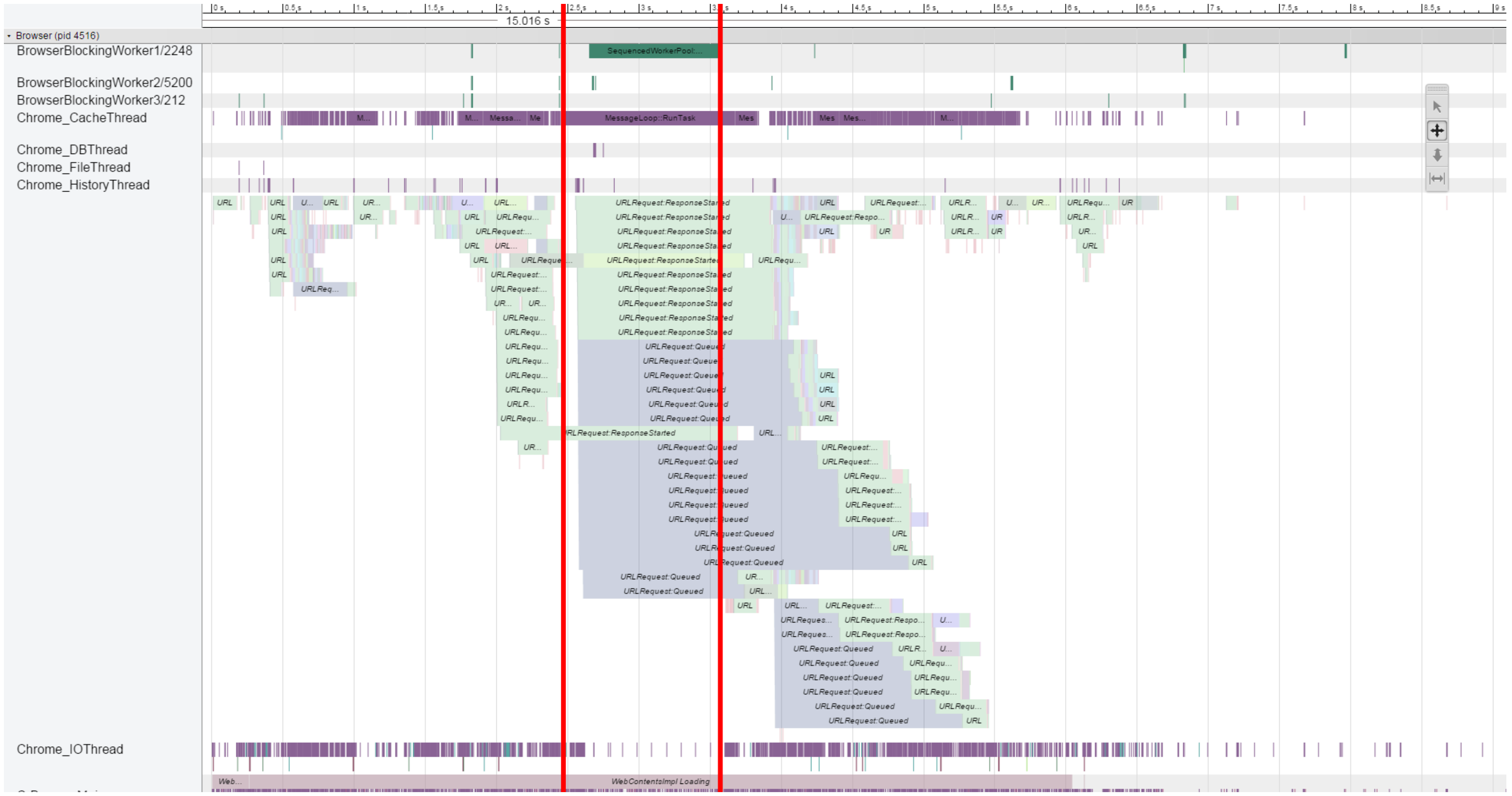
Timeline (view)
Processing Breakdown

Trace (view)

Net Log

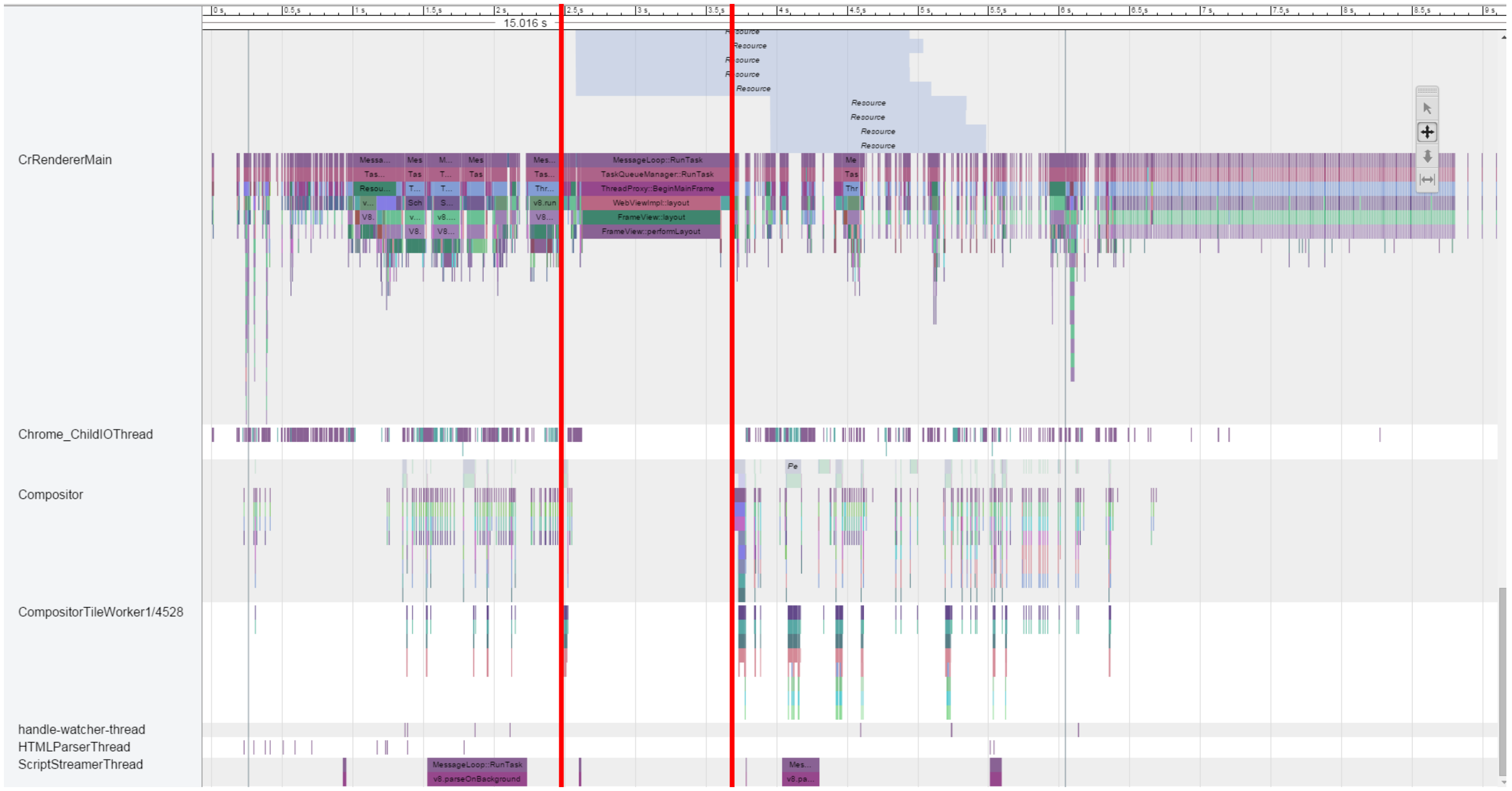
CHROME TRACE

Repro #2:



CHROME TRACE

Repro #2:



NETLOG

NetLog: Chrome’s network logging system

https://www.chromium.org/developers/design-documents/network-stack/netlog

REPRO #2: NETLOG

```
{"params":{"load_flags":2163712,"method":"GET","priority":"LOWEST",
    "url":"http://c.go-mpulse.net/boomerang/KQTS5-4NBTD-EYGLE-64UYR-S5892"},
    "phase":1,"source":{"id":588,"type":1},"time":"5454412310","type":91},
{"phase":1,"source":{"id":588,"type":1},"time":"5454412310","type":93},
{"phase":2,"source":{"id":588,"type":1},"time":"5454412310","type":93},
{"phase":1,"source":{"id":588,"type":1},"time":"5454412310","type":101},
{"phase":2,"source":{"id":588,"type":1},"time":"5454412310","type":101},
{"phase":1,"source":{"id":588,"type":1},"time":"5454412310","type":102},
{"params":{"byte_count":1460},"phase":0,"source":{"id":275,"type":4},
    "time":"5454412311","type":62},
{"phase":2,"source":{"id":529,"type":1},"time":"5454412311","type":143},
{"phase":1,"source":{"id":529,"type":1},"time":"5454412311","type":143},
{"params":{"byte_count":443},"phase":0,"source":{"id":275,"type":4},
    "time":"5454412313","type":62},
{"phase":2,"source":{"id":529,"type":1},"time":"5454412313","type":143},
{"phase":1,"source":{"id":529,"type":1},"time":"5454412313","type":143},
{"phase":2,"source":{"id":275,"type":4},"time":"5454412313","type":37},
{"phase":2,"source":{"id":529,"type":1},"time":"5454412313","type":143},
```

STEP #2
DIVE DEEPER

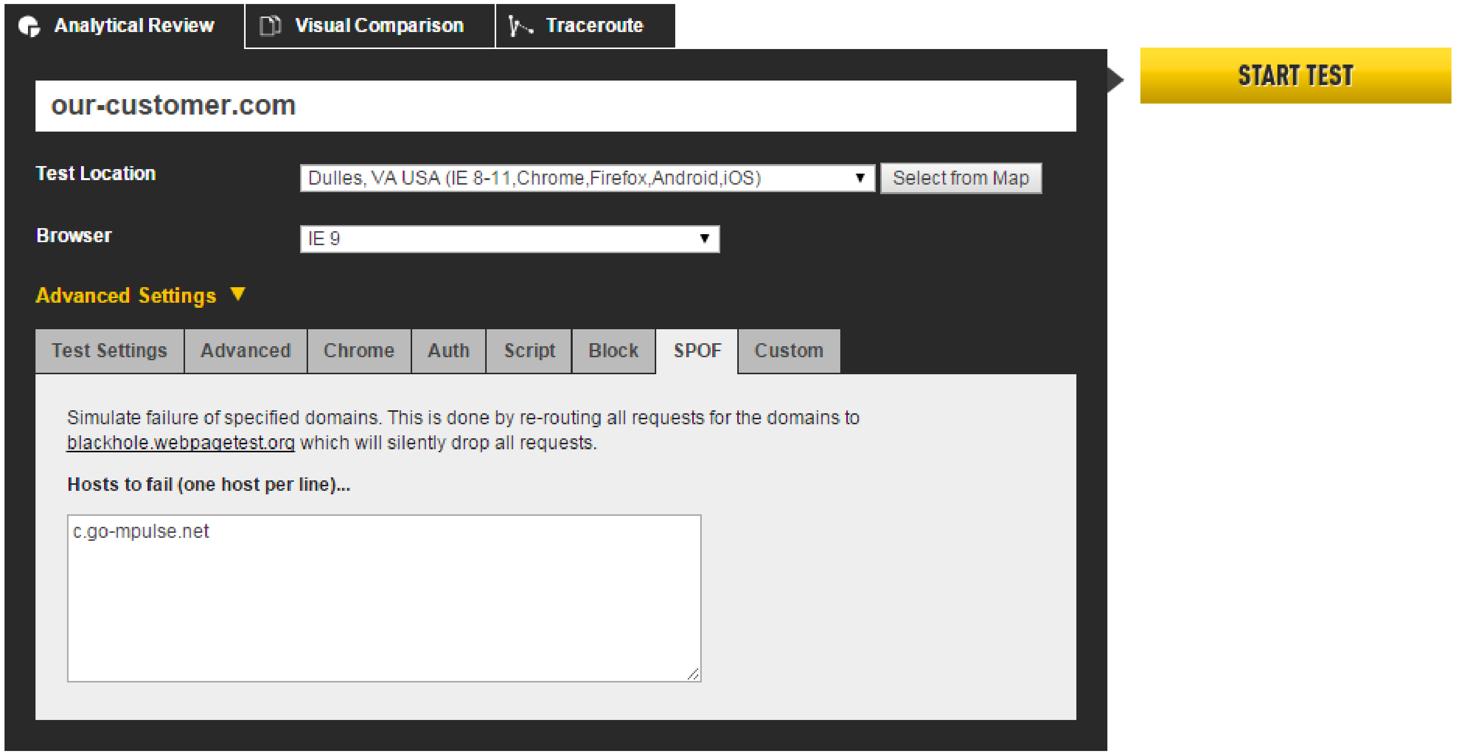
It will be great to (re)prove that our script loader works even if our CDN is down, or if there are delays in the network

How can we do this? There are a couple tools that can help with **Single Point of Failure** (SPOF) testing

WEBPAGETEST SPOF

`blackhole.webpagetest.org` drops all traffic

```
setDnsName c.go-mpulse.net blackhole.webpagetest.org
navigate our-customer.com
```



our-customer.com

Test Location: Dulles, VA USA (IE 8-11,Chrome,Firefox,Android,iOS)

Browser: IE 9

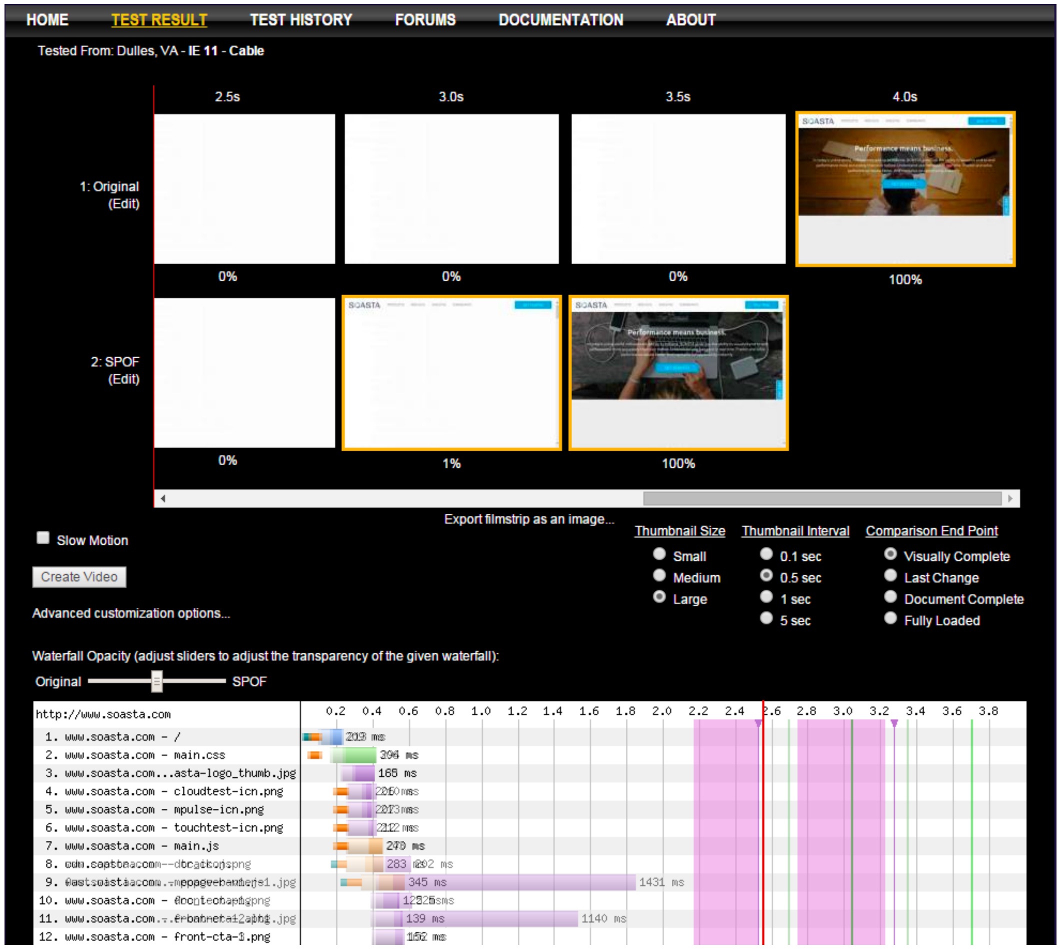
Simulate failure of specified domains. This is done by re-routing all requests for the domains to blackhole.webpagetest.org which will silently drop all requests.

Hosts to fail (one host per line)...

c.go-mpulse.net

WEBPAGETEST SPOF

No issues with blocking our CDN `c.go-mpulse.net`



Tested From: Dulles, VA - IE 11 - Cable

	2.5s	3.0s	3.5s	4.0s
1: Original (Edit)	0%	0%	0%	100%
2: SPOF (Edit)	0%	1%	100%	

Export filmstrip as an image...

Slow Motion

Create Video

Advanced customization options...

Thumbnail Size: Small / Medium / [✓ Large]

Thumbnail Interval: 0.1 sec / [✓ 0.5 sec] / 1 sec / 5 sec

Comparison End Point: [✓ Visually Complete] / Last Change / Document Complete / Fully Loaded

Waterfall Opacity (adjust sliders to adjust the transparency of the given waterfall):

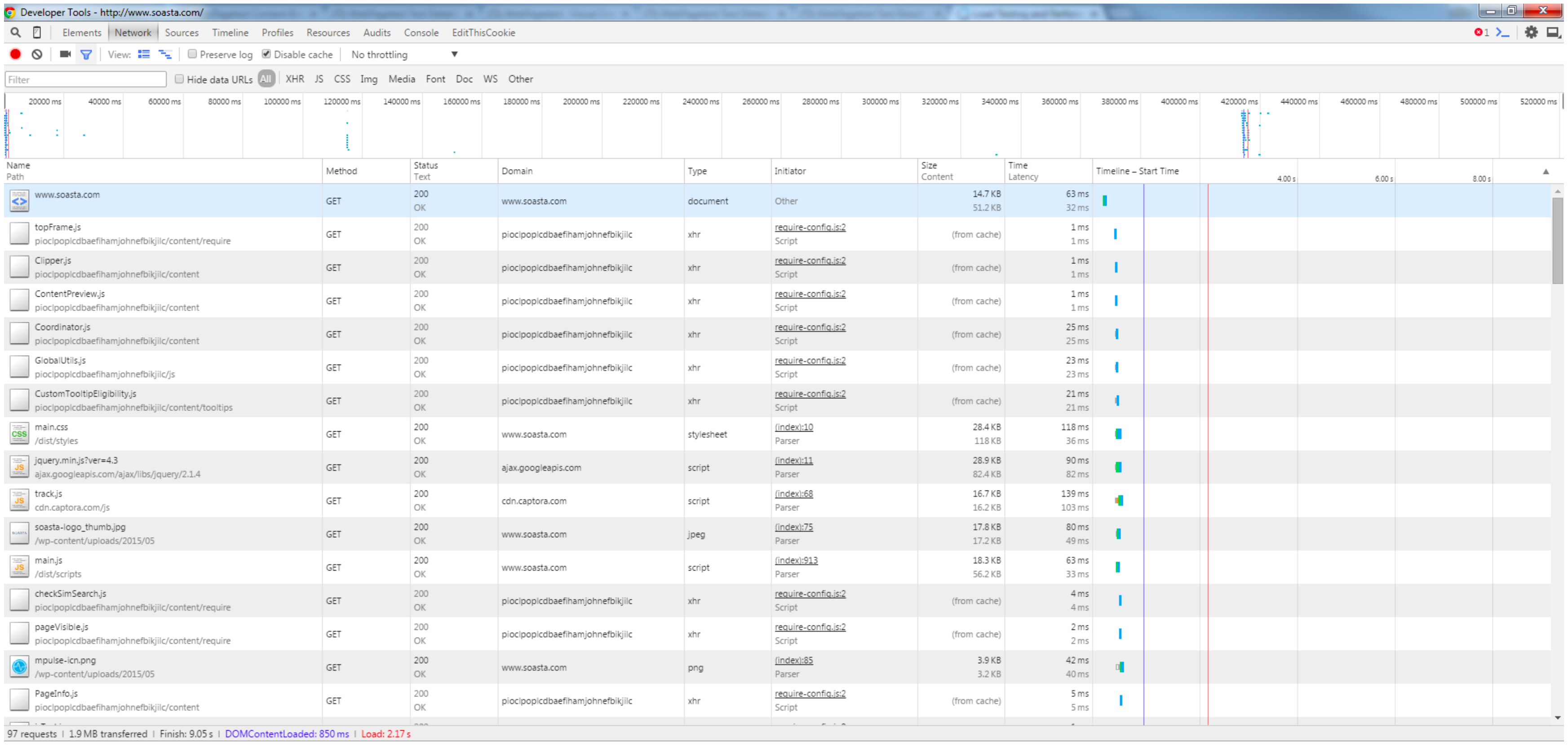
Original — SPOF

```
http://www.soasta.com
 1. www.soasta.com - /                          203 ms
 2. www.soasta.com - main.css                   306 ms
 3. www.soasta.com...asta-logo_thumb.jpg        165 ms
 4. www.soasta.com - cloudtest-icn.png          210 ms
 5. www.soasta.com - mpulse-icn.png             217 ms
 6. www.soasta.com - touchtest-icn.png          212 ms
 7. www.soasta.com - main.js                    270 ms
 8. cdn.soasta.com - [illegible]                283 ms   202 ms
 9. [illegible]...pagebanner1.jpg               345 ms   1431 ms
10. www.soasta.com - [illegible].png            125 ms
11. www.soasta.com...[illegible].jpg            139 ms   1140 ms
12. www.soasta.com - front-cta-1.png            152 ms
```

Let's try to do SPOF on our local machine as well

BROWSER DEV TOOLS

WATERFALL



Developer Tools - http://www.soasta.com/

Elements | Network | Sources | Timeline | Profiles | Resources | Audits | Console | EditThisCookie

Preserve log | ☑ Disable cache | No throttling

Hide data URLs | All | XHR | JS | CSS | Img | Media | Font | Doc | WS | Other

Name / Path	Method	Status / Text	Domain	Type	Initiator	Size / Content	Time / Latency
www.soasta.com	GET	200 OK	www.soasta.com	document	Other	14.7 KB / 51.2 KB	63 ms / 32 ms
topFrame.js / pioclpoplcdbaefihamjohnefbikjilc/content/require	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	1 ms / 1 ms
Clipper.js / pioclpoplcdbaefihamjohnefbikjilc/content	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	1 ms / 1 ms
ContentPreview.js / pioclpoplcdbaefihamjohnefbikjilc/content	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	1 ms / 1 ms
Coordinator.js / pioclpoplcdbaefihamjohnefbikjilc/content	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	25 ms / 25 ms
GlobalUtils.js / pioclpoplcdbaefihamjohnefbikjilc/js	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	23 ms / 23 ms
CustomTooltipEligibility.js / pioclpoplcdbaefihamjohnefbikjilc/content/tooltips	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	21 ms / 21 ms
main.css / /dist/styles	GET	200 OK	www.soasta.com	stylesheet	(index):10 Parser	28.4 KB / 118 KB	118 ms / 36 ms
jquery.min.js?ver=4.3 / ajax.googleapis.com/ajax/libs/jquery/2.1.4	GET	200 OK	ajax.googleapis.com	script	(index):11 Parser	28.9 KB / 82.4 KB	90 ms / 82 ms
track.js / cdn.captora.com/js	GET	200 OK	cdn.captora.com	script	(index):68 Parser	16.7 KB / 16.2 KB	139 ms / 103 ms
soasta-logo_thumb.jpg / /wp-content/uploads/2015/05	GET	200 OK	www.soasta.com	jpeg	(index):75 Parser	17.8 KB / 17.2 KB	80 ms / 49 ms
main.js / /dist/scripts	GET	200 OK	www.soasta.com	script	(index):913 Parser	18.3 KB / 56.2 KB	63 ms / 33 ms
checkSimSearch.js / pioclpoplcdbaefihamjohnefbikjilc/content/require	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	4 ms / 4 ms
pageVisible.js / pioclpoplcdbaefihamjohnefbikjilc/content/require	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	2 ms / 2 ms
mpulse-icn.png / /wp-content/uploads/2015/05	GET	200 OK	www.soasta.com	png	(index):85 Parser	3.9 KB / 3.2 KB	42 ms / 40 ms
PageInfo.js / pioclpoplcdbaefihamjohnefbikjilc/content	GET	200 OK	pioclpoplcdbaefihamjohnefbikjilc	xhr	require-config.js:2 Script	(from cache)	5 ms / 5 ms

97 requests | 1.9 MB transferred | Finish: 9.05 s | DOMContentLoaded: 850 ms | Load: 2.17 s

TOOL #7

`/etc/hosts`

- Great for quickly redirecting traffic to your local machine
- Or for sending traffic to a blackhole

On Windows:

```
C:\windows\system32\drivers\etc\hosts
```

/ETC/HOSTS

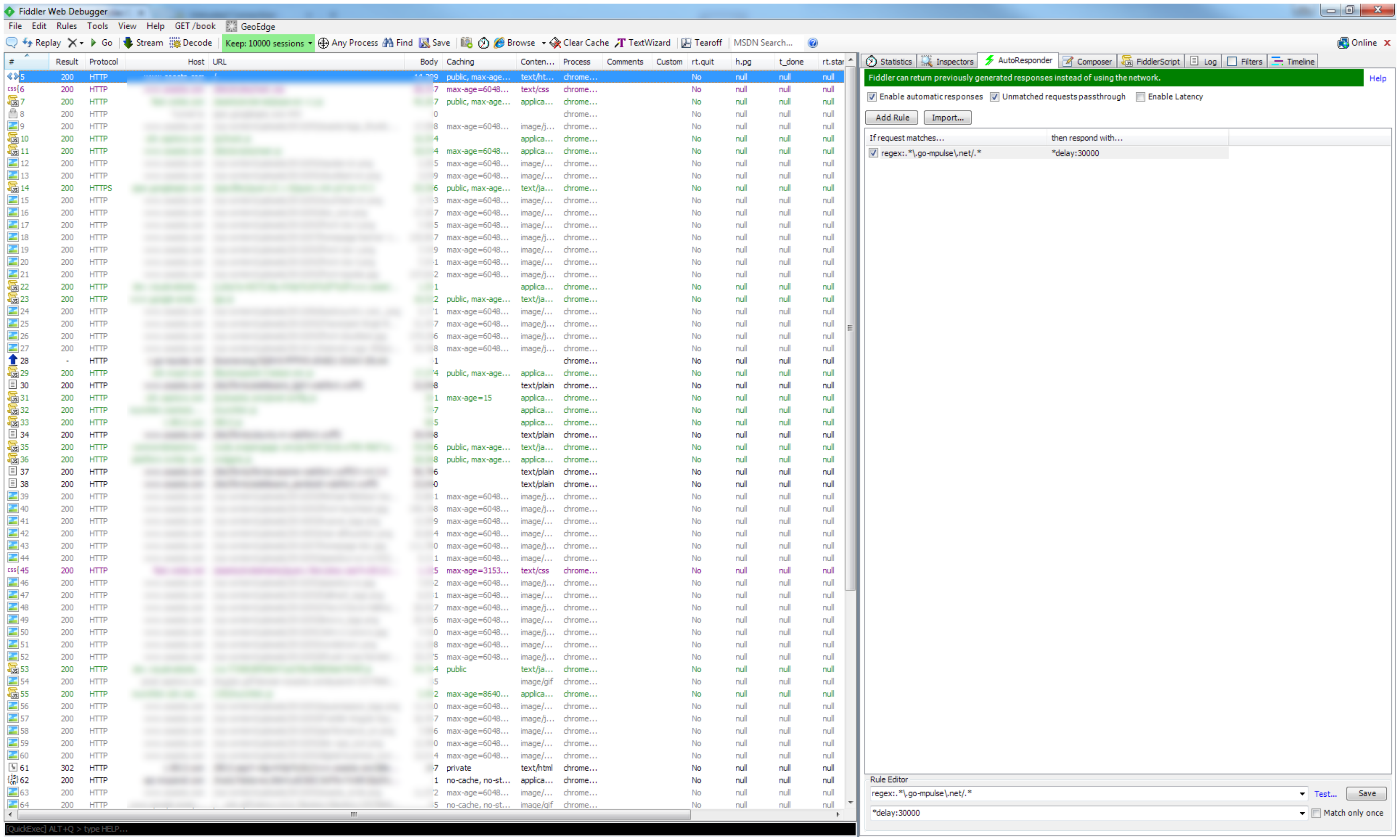
`blackhole.webpagetest.org == 72.66.115.13`

```
72.66.115.13 apis.google.com
72.66.115.13 www.google-analytics.com
72.66.115.13 c.go-mpulse.net
```

TOOL #8
FIDDLER

- For monitoring all traffic from desktop or mobile devices
- For injecting different content into live sites
- For artifically delaying traffic

FIDDLER



Fiddler Web Debugger

File Edit Rules Tools View Help GET /book GeoEdge

Replay X Go Stream Decode Keep: 10000 sessions Any Process Find Save Browse Clear Cache TextWizard Tearoff MSDN Search...

#	Result	Protocol	Host	URL	Body	Caching	Conten...	Process	Comments	Custom	rt.quit	h.pg	t_done	rt.star
5	200	HTTP	[redacted]	[redacted]	[redacted]9	public, max-age...	text/ht...	chrome...			No	null	null	null
6	200	HTTP	[redacted]	[redacted]	[redacted]7	max-age=6048...	text/css	chrome...			No	null	null	null
7	200	HTTP	[redacted]	[redacted]	[redacted]7	public, max-age...	applica...	chrome...			No	null	null	null
8	200	HTTP	[redacted]	[redacted]	[redacted]0			chrome...			No	null	null	null
9	200	HTTP	[redacted]	[redacted]	[redacted]8	max-age=6048...	image/j...	chrome...			No	null	null	null
10	200	HTTP	[redacted]	[redacted]	[redacted]4		applica...	chrome...			No	null	null	null
11	200	HTTP	[redacted]	[redacted]	[redacted]4	max-age=6048...	applica...	chrome...			No	null	null	null
12	200	HTTP	[redacted]	[redacted]	[redacted]5	max-age=6048...	image/...	chrome...			No	null	null	null
13	200	HTTP	[redacted]	[redacted]	[redacted]9	max-age=6048...	image/...	chrome...			No	null	null	null
14	200	HTTPS	[redacted]	[redacted]	[redacted]6	public, max-age...	text/ja...	chrome...			No	null	null	null
15	200	HTTP	[redacted]	[redacted]	[redacted]3	max-age=6048...	image/...	chrome...			No	null	null	null
16	200	HTTP	[redacted]	[redacted]	[redacted]7	max-age=6048...	image/...	chrome...			No	null	null	null
17	200	HTTP	[redacted]	[redacted]	[redacted]5	max-age=6048...	image/...	chrome...			No	null	null	null
18	200	HTTP	[redacted]	[redacted]	[redacted]7	max-age=6048...	image/j...	chrome...			No	null	null	null
19	200	HTTP	[redacted]	[redacted]	[redacted]9	max-age=6048...	image/...	chrome...			No	null	null	null
20	200	HTTP	[redacted]	[redacted]	[redacted]1	max-age=6048...	image/...	chrome...			No	null	null	null
21	200	HTTP	[redacted]	[redacted]	[redacted]2	max-age=6048...	image/j...	chrome...			No	null	null	null
22	200	HTTP	[redacted]	[redacted]	[redacted]1		applica...	chrome...			No	null	null	null
23	200	HTTP	[redacted]	[redacted]	[redacted]2	public, max-age...	text/ja...	chrome...			No	null	null	null
24	200	HTTP	[redacted]	[redacted]	[redacted]1	max-age=6048...	image/...	chrome...			No	null	null	null
25	200	HTTP	[redacted]	[redacted]	[redacted]7	max-age=6048...	image/j...	chrome...			No	null	null	null
26	200	HTTP	[redacted]	[redacted]	[redacted]6	max-age=6048...	image/j...	chrome...			No	null	null	null
27	200	HTTP	[redacted]	[redacted]	[redacted]8	max-age=6048...	image/j...	chrome...			No	null	null	null
28	-	HTTP	[redacted]	[redacted]	[redacted]1			chrome...			No	null	null	null
29	200	HTTP	[redacted]	[redacted]	[redacted]4	public, max-age...	applica...	chrome...			No	null	null	null
30	200	HTTP	[redacted]	[redacted]	[redacted]8		text/plain	chrome...			No	null	null	null
31	200	HTTP	[redacted]	[redacted]	[redacted]1	max-age=15	applica...	chrome...			No	null	null	null
32	200	HTTP	[redacted]	[redacted]	[redacted]7		applica...	chrome...			No	null	null	null
33	200	HTTP	[redacted]	[redacted]	[redacted]5		applica...	chrome...			No	null	null	null
34	200	HTTP	[redacted]	[redacted]	[redacted]8		text/plain	chrome...			No	null	null	null
35	200	HTTP	[redacted]	[redacted]	[redacted]6	public, max-age...	text/ja...	chrome...			No	null	null	null
36	200	HTTP	[redacted]	[redacted]	[redacted]8	public, max-age...	applica...	chrome...			No	null	null	null
37	200	HTTP	[redacted]	[redacted]	[redacted]6		text/plain	chrome...			No	null	null	null
38	200	HTTP	[redacted]	[redacted]	[redacted]0		text/plain	chrome...			No	null	null	null
39	200	HTTP	[redacted]	[redacted]	[redacted]1	max-age=6048...	image/j...	chrome...			No	null	null	null
40	200	HTTP	[redacted]	[redacted]	[redacted]8	max-age=6048...	image/j...	chrome...			No	null	null	null
41	200	HTTP	[redacted]	[redacted]	[redacted]9	max-age=6048...	image/...	chrome...			No	null	null	null
42	200	HTTP	[redacted]	[redacted]	[redacted]4	max-age=6048...	image/...	chrome...			No	null	null	null
43	200	HTTP	[redacted]	[redacted]	[redacted]0	max-age=6048...	image/j...	chrome...			No	null	null	null
44	200	HTTP	[redacted]	[redacted]	[redacted]1	max-age=6048...	image/...	chrome...			No	null	null	null
45	200	HTTP	[redacted]	[redacted]	[redacted]5	max-age=3153...	text/css	chrome...			No	null	null	null
46	200	HTTP	[redacted]	[redacted]	[redacted]2	max-age=6048...	image/j...	chrome...			No	null	null	null
47	200	HTTP	[redacted]	[redacted]	[redacted]1	max-age=6048...	image/...	chrome...			No	null	null	null
48	200	HTTP	[redacted]	[redacted]	[redacted]7	max-age=6048...	image/j...	chrome...			No	null	null	null
49	200	HTTP	[redacted]	[redacted]	[redacted]6	max-age=6048...	image/...	chrome...			No	null	null	null
50	200	HTTP	[redacted]	[redacted]	[redacted]0	max-age=6048...	image/j...	chrome...			No	null	null	null
51	200	HTTP	[redacted]	[redacted]	[redacted]8	max-age=6048...	image/...	chrome...			No	null	null	null
52	200	HTTP	[redacted]	[redacted]	[redacted]5	max-age=6048...	image/j...	chrome...			No	null	null	null
53	200	HTTP	[redacted]	[redacted]	[redacted]4	public	text/ja...	chrome...			No	null	null	null
54	200	HTTP	[redacted]	[redacted]	[redacted]5		image/gif	chrome...			No	null	null	null
55	200	HTTP	[redacted]	[redacted]	[redacted]2	max-age=8640...	applica...	chrome...			No	null	null	null
56	200	HTTP	[redacted]	[redacted]	[redacted]0	max-age=6048...	image/...	chrome...			No	null	null	null
57	200	HTTP	[redacted]	[redacted]	[redacted]7	max-age=6048...	image/j...	chrome...			No	null	null	null
58	200	HTTP	[redacted]	[redacted]	[redacted]6	max-age=6048...	image/...	chrome...			No	null	null	null
59	200	HTTP	[redacted]	[redacted]	[redacted]0	max-age=6048...	image/...	chrome...			No	null	null	null
60	200	HTTP	[redacted]	[redacted]	[redacted]4	max-age=6048...	image/...	chrome...			No	null	null	null
61	302	HTTP	[redacted]	[redacted]	[redacted]7	private	text/html	chrome...			No	null	null	null
62	200	HTTP	[redacted]	[redacted]	1	no-cache, no-st...	applica...	chrome...			No	null	null	null
63	200	HTTP	[redacted]	[redacted]	[redacted]2	max-age=6048...	image/...	chrome...			No	null	null	null
64	200	HTTP	[redacted]	[redacted]	[redacted]5	no-cache, no-st...	image/gif	chrome...			No	null	null	null

[QuickExec] ALT+Q > type HELP...

Online

Statistics Inspectors AutoResponder Composer FiddlerScript Log Filters Timeline

Fiddler can return previously generated responses instead of using the network. Help

[✓] Enable automatic responses [✓] Unmatched requests passthrough [ ] Enable Latency

Add Rule Import...

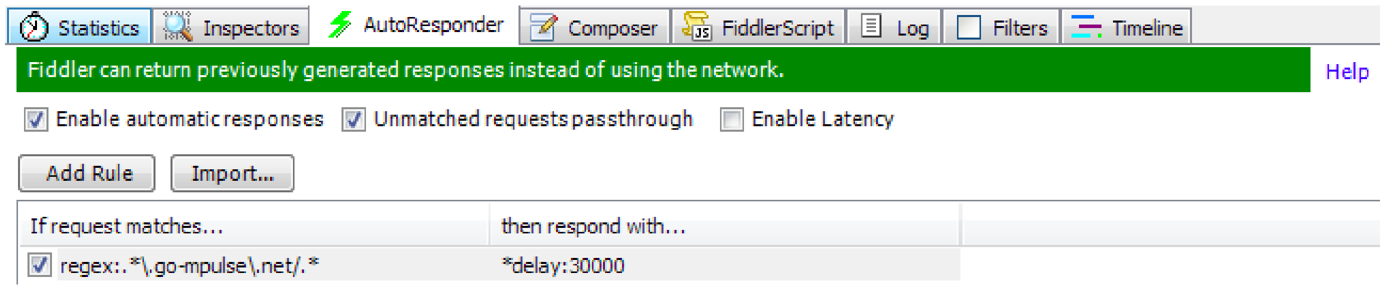
If request matches...	then respond with...
[✓] regex:.*\.go-mpulse\.net/.*	*delay:30000

Rule Editor

regex:.*\.go-mpulse\.net/.* Test... Save

*delay:30000 [ ] Match only once

FIDDLER SPOF

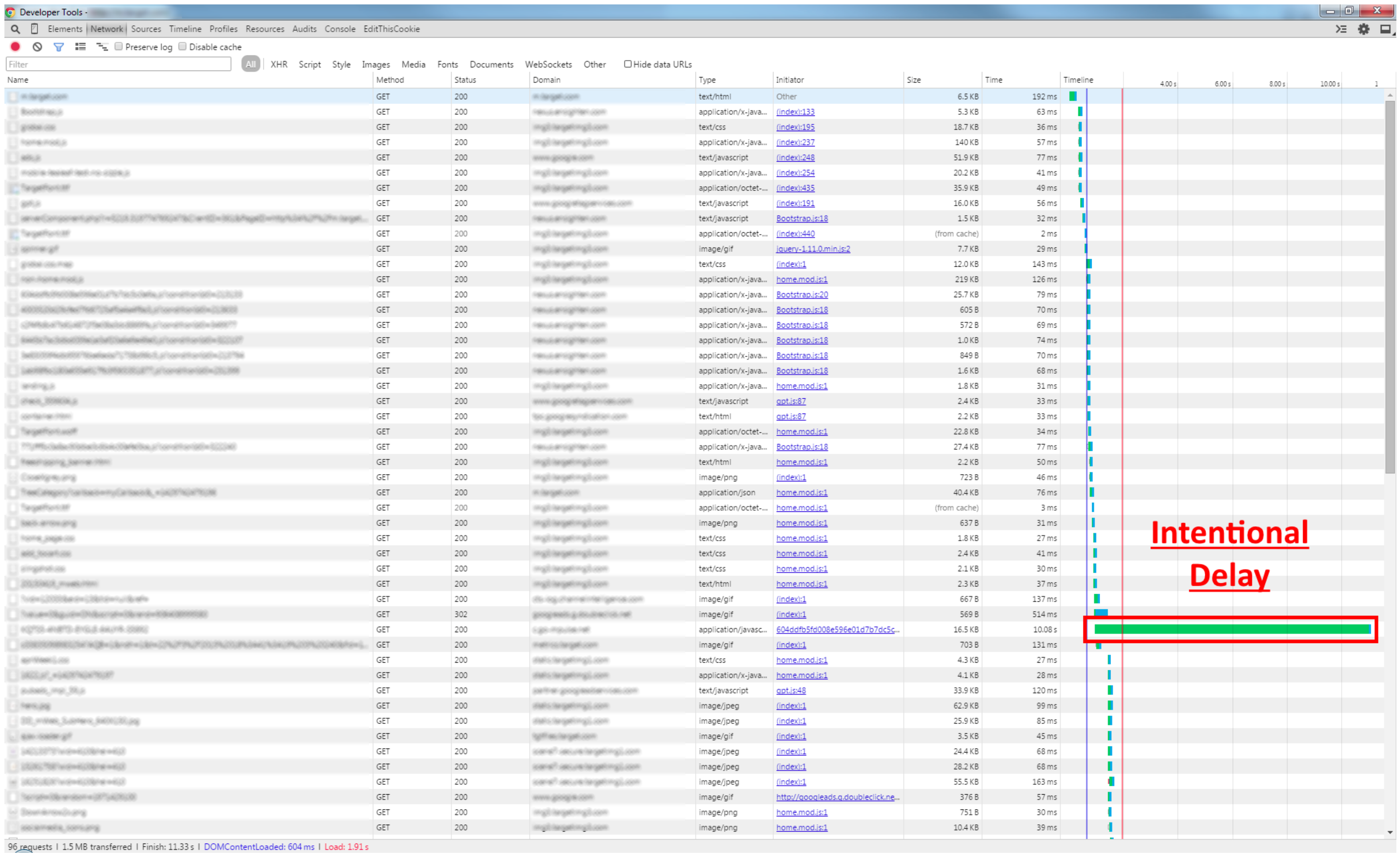


Fiddler can return previously generated responses instead of using the network.

[✓] Enable automatic responses [✓] Unmatched requests passthrough [ ] Enable Latency

If request matches...	then respond with...
[✓] regex:.*\.go-mpulse\.net/.*	*delay:30000

FIDDLER SPOF



Name	Method	Status	Domain	Type	Initiator	Size	Time
[redacted]	GET	200	[redacted]	text/html	Other	6.5 KB	192 ms
[redacted]	GET	200	[redacted]	application/x-java...	(index):133	5.3 KB	63 ms
[redacted]	GET	200	[redacted]	text/css	(index):195	18.7 KB	36 ms
[redacted]	GET	200	[redacted]	application/x-java...	(index):237	140 KB	57 ms
[redacted]	GET	200	[redacted]	text/javascript	(index):248	51.9 KB	77 ms
[redacted]	GET	200	[redacted]	application/x-java...	(index):254	20.2 KB	41 ms
[redacted]	GET	200	[redacted]	application/octet-...	(index):435	35.9 KB	49 ms
[redacted]	GET	200	[redacted]	text/javascript	(index):191	16.0 KB	56 ms
[redacted]	GET	200	[redacted]	text/javascript	Bootstrap.js:18	1.5 KB	32 ms
[redacted]	GET	200	[redacted]	application/octet-...	(index):440	(from cache)	2 ms
[redacted]	GET	200	[redacted]	image/gif	jquery-1.11.0.min.js:2	7.7 KB	29 ms
[redacted]	GET	200	[redacted]	text/css	(index):1	12.0 KB	143 ms
[redacted]	GET	200	[redacted]	application/x-java...	home.mod.js:1	219 KB	126 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:20	25.7 KB	79 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:18	605 B	70 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:18	572 B	69 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:18	1.0 KB	74 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:18	849 B	70 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:18	1.6 KB	68 ms
[redacted]	GET	200	[redacted]	application/x-java...	home.mod.js:1	1.8 KB	31 ms
[redacted]	GET	200	[redacted]	text/javascript	gpt.js:87	2.4 KB	33 ms
[redacted]	GET	200	[redacted]	text/html	gpt.js:87	2.2 KB	33 ms
[redacted]	GET	200	[redacted]	application/octet-...	home.mod.js:1	22.8 KB	34 ms
[redacted]	GET	200	[redacted]	application/x-java...	Bootstrap.js:18	27.4 KB	77 ms
[redacted]	GET	200	[redacted]	text/html	home.mod.js:1	2.2 KB	50 ms
[redacted]	GET	200	[redacted]	image/png	(index):1	723 B	46 ms
[redacted]	GET	200	[redacted]	application/json	home.mod.js:1	40.4 KB	76 ms
[redacted]	GET	200	[redacted]	application/octet-...	home.mod.js:1	(from cache)	3 ms
[redacted]	GET	200	[redacted]	image/png	home.mod.js:1	637 B	31 ms
[redacted]	GET	200	[redacted]	text/css	home.mod.js:1	1.8 KB	27 ms
[redacted]	GET	200	[redacted]	text/css	home.mod.js:1	2.4 KB	41 ms
[redacted]	GET	200	[redacted]	text/css	home.mod.js:1	2.1 KB	30 ms
[redacted]	GET	200	[redacted]	text/html	home.mod.js:1	2.3 KB	37 ms
[redacted]	GET	200	[redacted]	image/gif	(index):1	667 B	137 ms
[redacted]	GET	302	[redacted]	image/gif	(index):1	569 B	514 ms
[redacted]	GET	200	[redacted]	application/javasc...	604ddfb5fd008e596e01d7b7dc5c...	16.5 KB	10.08 s
[redacted]	GET	200	[redacted]	image/gif	(index):1	703 B	131 ms
[redacted]	GET	200	[redacted]	text/css	home.mod.js:1	4.3 KB	27 ms
[redacted]	GET	200	[redacted]	application/x-java...	home.mod.js:1	4.1 KB	28 ms
[redacted]	GET	200	[redacted]	text/javascript	gpt.js:48	33.9 KB	120 ms
[redacted]	GET	200	[redacted]	image/jpeg	(index):1	62.9 KB	99 ms
[redacted]	GET	200	[redacted]	image/jpeg	(index):1	25.9 KB	85 ms
[redacted]	GET	200	[redacted]	image/gif	(index):1	3.5 KB	45 ms
[redacted]	GET	200	[redacted]	image/jpeg	(index):1	24.4 KB	68 ms
[redacted]	GET	200	[redacted]	image/jpeg	(index):1	28.2 KB	68 ms
[redacted]	GET	200	[redacted]	image/jpeg	(index):1	55.5 KB	163 ms
[redacted]	GET	200	[redacted]	image/gif	http://googleads.g.doubleclick.ne...	376 B	57 ms
[redacted]	GET	200	[redacted]	image/png	home.mod.js:1	751 B	30 ms
[redacted]	GET	200	[redacted]	image/png	home.mod.js:1	10.4 KB	39 ms

96 requests | 1.5 MB transferred | Finish: 11.33 s | DOMContentLoaded: 604 ms | Load: 1.91 s

SCENARIO #1

Conclusion:

- Able to reproduce the issue on WebPageTest that day, but **not later**
- Saw periods of **no CPU activity**
- Saw periods of **no TCP activity**
- Boomerang had already reached the network interface, so something else was blocking it on the box
- Customer had multiple tag managers

SCENARIO #1

Conclusion:

- We ran SPOF checks with WebPageTest, `/etc/hosts`, and Fiddler
- Via WPT and Fiddler SPOF, we show our script is non-blocking

SCENARIO #2

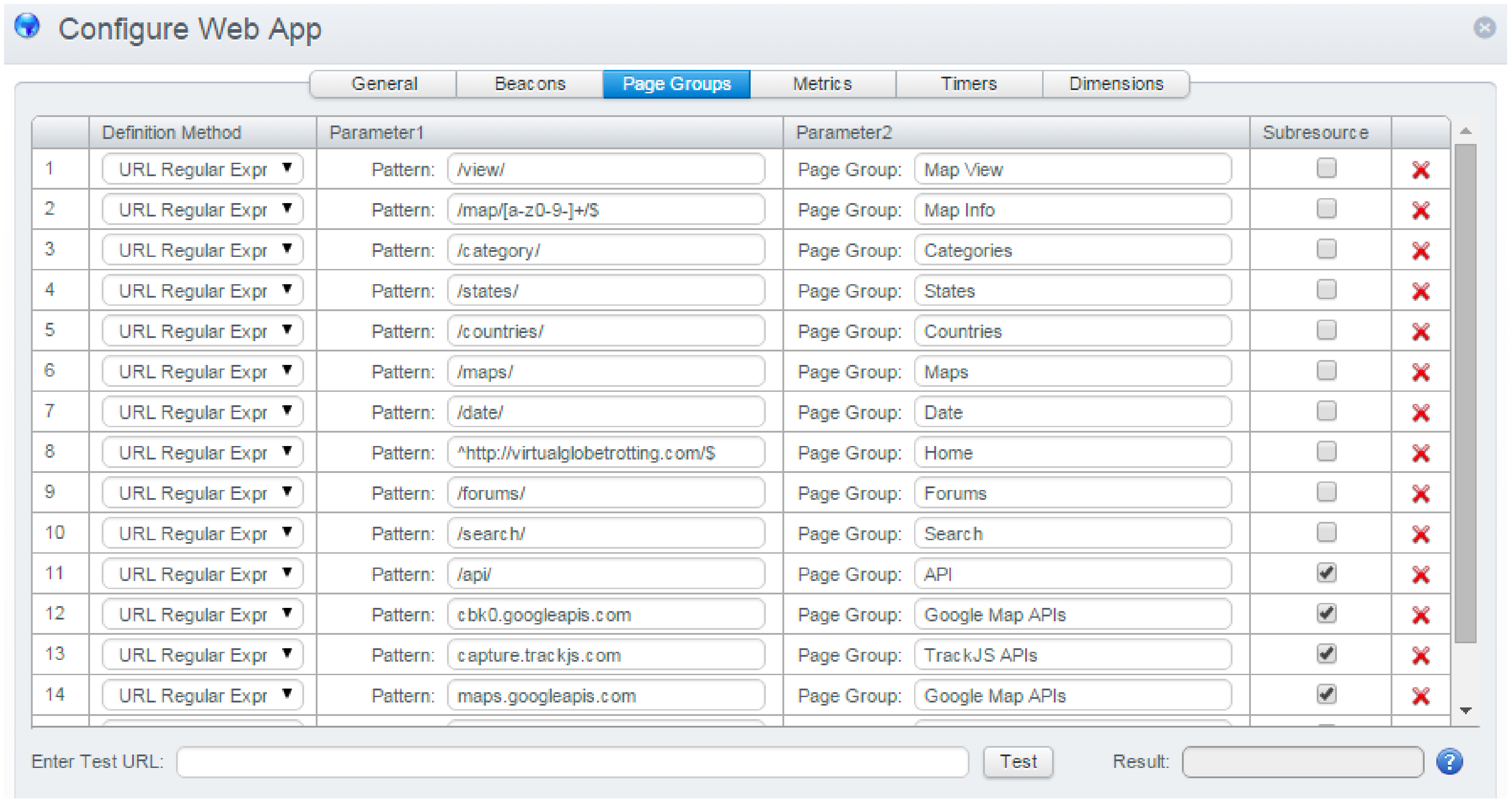
PRE-RENDER SHENANIGANS

Customer:

"I'm seeing pages that should match showing up in No Page Group again"

- You can define **rules** in mPulse for **URLs** to be matched to a **Page Group** dimension
- Customer was seeing a high number of hits to a `(No Page Group)` category that should have matched a URL

PAGE GROUPS



	Definition Method	Parameter1	Parameter2	Subresource	
1	URL Regular Expr	Pattern: /view/	Page Group: Map View	☐	✗
2	URL Regular Expr	Pattern: /map/[a-z0-9-]+/$	Page Group: Map Info	☐	✗
3	URL Regular Expr	Pattern: /category/	Page Group: Categories	☐	✗
4	URL Regular Expr	Pattern: /states/	Page Group: States	☐	✗
5	URL Regular Expr	Pattern: /countries/	Page Group: Countries	☐	✗
6	URL Regular Expr	Pattern: /maps/	Page Group: Maps	☐	✗
7	URL Regular Expr	Pattern: /date/	Page Group: Date	☐	✗
8	URL Regular Expr	Pattern: ^http://virtualglobetrotting.com/$	Page Group: Home	☐	✗
9	URL Regular Expr	Pattern: /forums/	Page Group: Forums	☐	✗
10	URL Regular Expr	Pattern: /search/	Page Group: Search	☐	✗
11	URL Regular Expr	Pattern: /api/	Page Group: API	✓	✗
12	URL Regular Expr	Pattern: cbk0.googleapis.com	Page Group: Google Map APIs	✓	✗
13	URL Regular Expr	Pattern: capture.trackjs.com	Page Group: TrackJS APIs	✓	✗
14	URL Regular Expr	Pattern: maps.googleapis.com	Page Group: Google Map APIs	✓	✗

Enter Test URL: Test Result:

TOOL #9
RUM

- Real User Monitoring (RUM) tools
- **Real world** data
- Look at data in aggregate

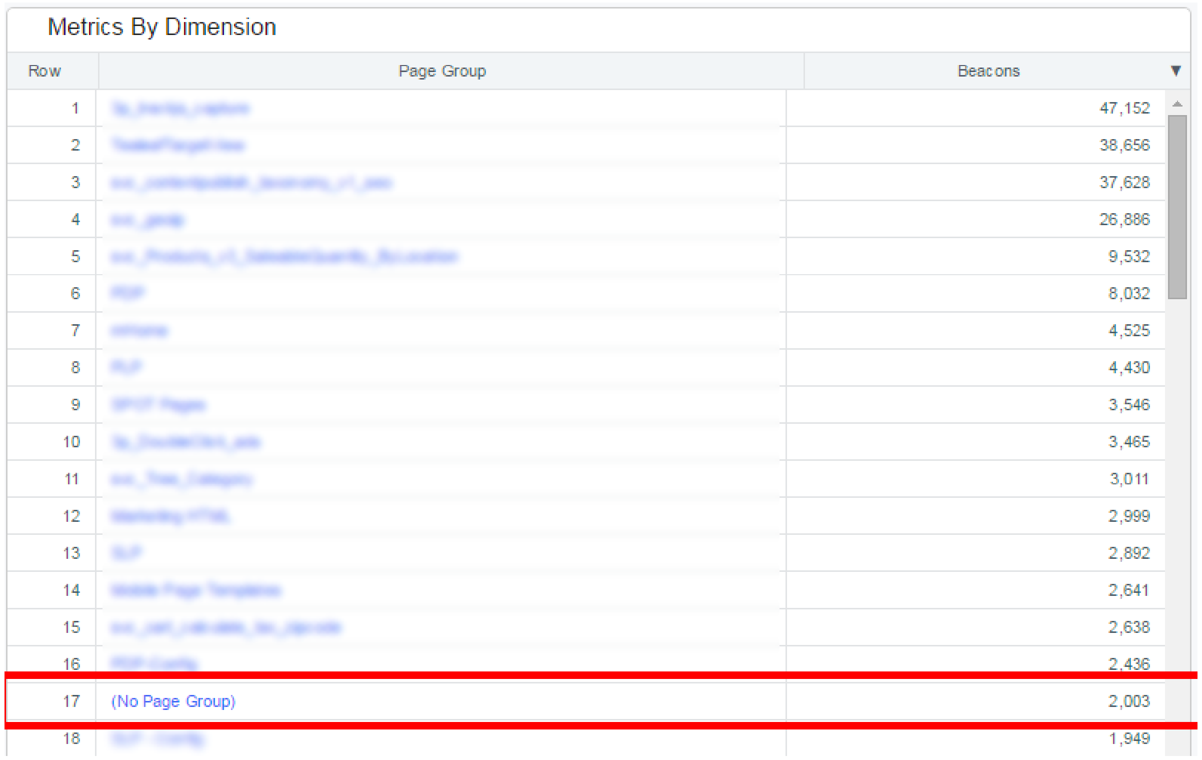
DISCLAIMER

We obviously work for SOASTA, and mPulse is our RUM product

RUM

AGGREGATE DATA

RUM lets you view your real-world customer data from an aggregate level



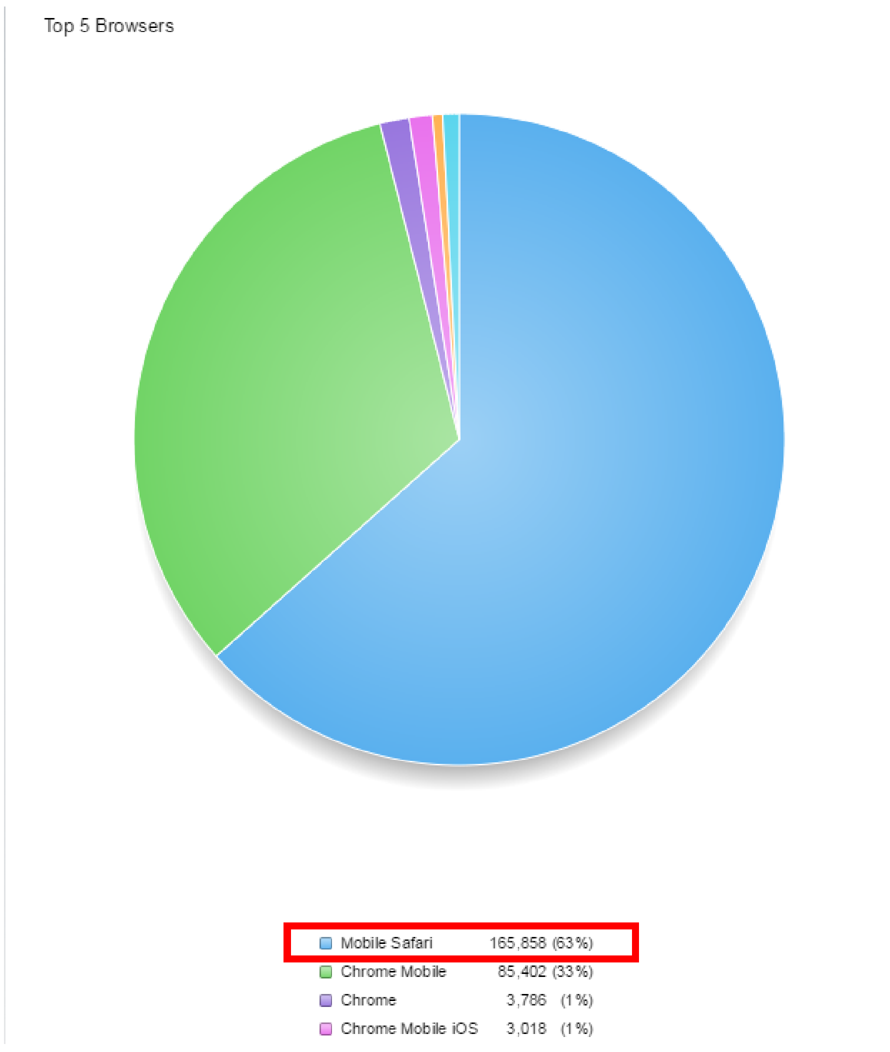
Metrics By Dimension

Row	Page Group	Beacons
1	[redacted]	47,152
2	[redacted]	38,656
3	[redacted]	37,628
4	[redacted]	26,886
5	[redacted]	9,532
6	[redacted]	8,032
7	[redacted]	4,525
8	[redacted]	4,430
9	[redacted]	3,546
10	[redacted]	3,465
11	[redacted]	3,011
12	[redacted]	2,999
13	[redacted]	2,892
14	[redacted]	2,641
15	[redacted]	2,638
16	[redacted]	2,436
17	(No Page Group)	2,003
18	[redacted]	1,949

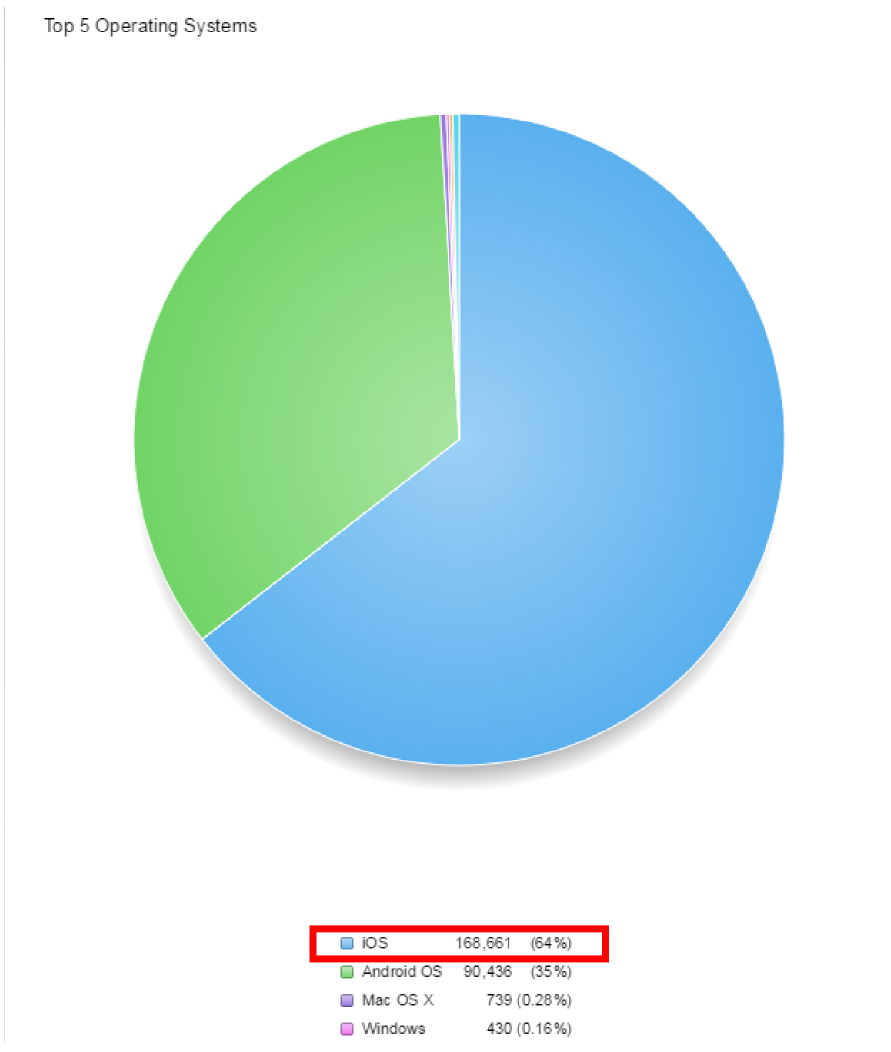
RUM

What are the most common causes of `(No Page Group)`?

iOS Mobile Safari sticks out:



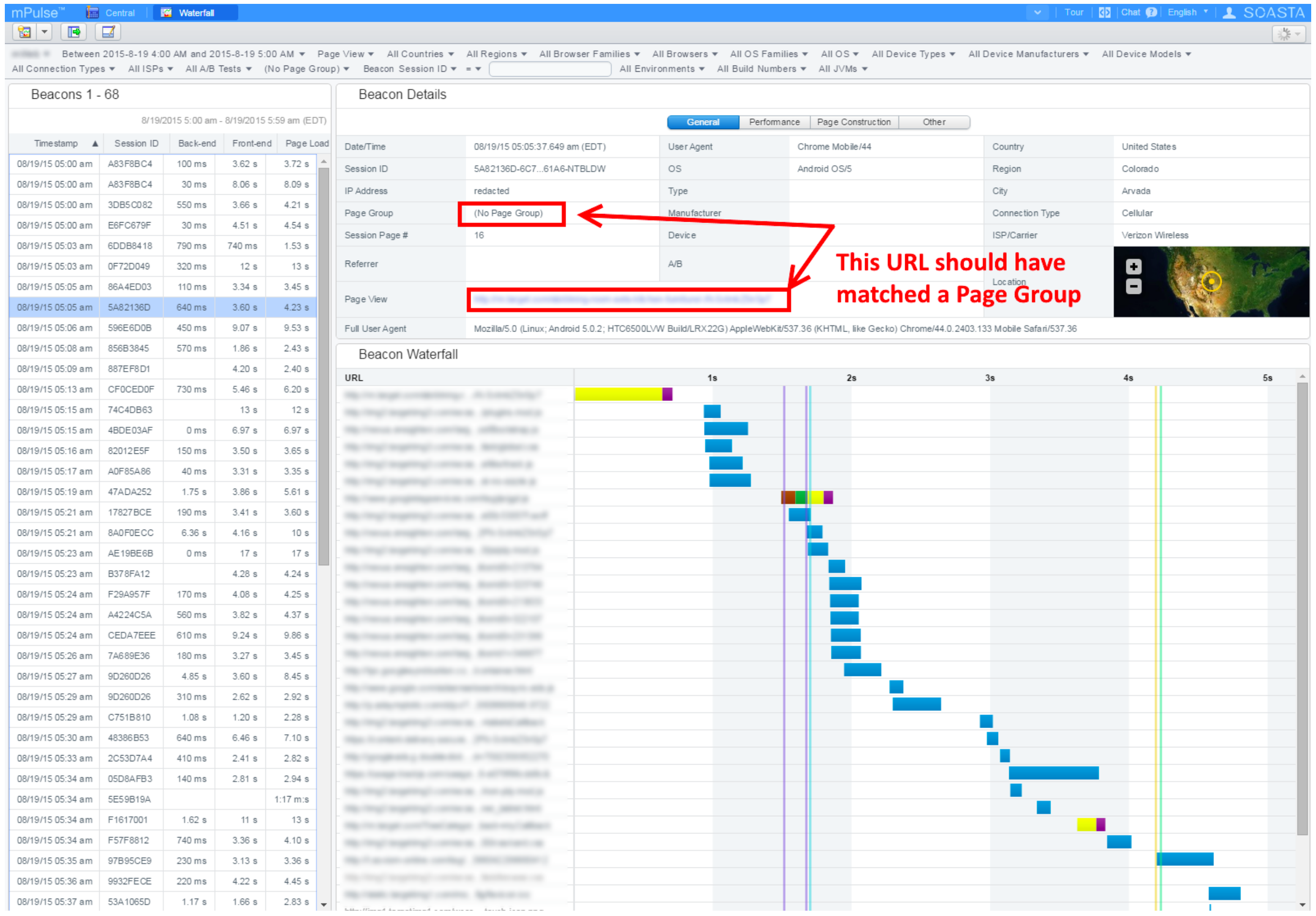
🟦	Mobile Safari	165,858	(63%)
🟩	Chrome Mobile	85,402	(33%)
🟪	Chrome	3,786	(1%)
🟪	Chrome Mobile iOS	3,018	(1%)



🟦	iOS	168,661	(64%)
🟩	Android OS	90,436	(35%)
🟪	Mac OS X	739	(0.28%)
🟪	Windows	430	(0.16%)

RUM WATERFALLS

RUM Waterfalls let you look at real-world **individual page loads**



Beacons 1 - 68

8/19/2015 5:00 am - 8/19/2015 5:59 am (EDT)

Timestamp ▲	Session ID	Back-end	Front-end	Page Load
08/19/15 05:00 am	A83F8BC4	100 ms	3.62 s	3.72 s
08/19/15 05:00 am	A83F8BC4	30 ms	8.06 s	8.09 s
08/19/15 05:00 am	3DB5C082	550 ms	3.66 s	4.21 s
08/19/15 05:00 am	E6FC679F	30 ms	4.51 s	4.54 s
08/19/15 05:03 am	6DDB8418	790 ms	740 ms	1.53 s
08/19/15 05:03 am	0F72D049	320 ms	12 s	13 s
08/19/15 05:05 am	86A4ED03	110 ms	3.34 s	3.45 s
08/19/15 05:05 am	5A82136D	640 ms	3.60 s	4.23 s
08/19/15 05:06 am	596E6D0B	450 ms	9.07 s	9.53 s
08/19/15 05:08 am	856B3845	570 ms	1.86 s	2.43 s
08/19/15 05:09 am	887EF8D1		4.20 s	2.40 s
08/19/15 05:13 am	CF0CED0F	730 ms	5.46 s	6.20 s
08/19/15 05:15 am	74C4DB63		13 s	12 s
08/19/15 05:15 am	4BDE03AF	0 ms	6.97 s	6.97 s
08/19/15 05:16 am	82012E5F	150 ms	3.50 s	3.65 s
08/19/15 05:17 am	A0F85A86	40 ms	3.31 s	3.35 s
08/19/15 05:19 am	47ADA252	1.75 s	3.86 s	5.61 s
08/19/15 05:21 am	17827BCE	190 ms	3.41 s	3.60 s
08/19/15 05:21 am	8A0F0ECC	6.36 s	4.16 s	10 s
08/19/15 05:23 am	AE19BE6B	0 ms	17 s	17 s
08/19/15 05:23 am	B378FA12		4.28 s	4.24 s
08/19/15 05:24 am	F29A957F	170 ms	4.08 s	4.25 s
08/19/15 05:24 am	A4224C5A	560 ms	3.82 s	4.37 s
08/19/15 05:24 am	CEDA7EEE	610 ms	9.24 s	9.86 s
08/19/15 05:26 am	7A689E36	180 ms	3.27 s	3.45 s
08/19/15 05:27 am	9D260D26	4.85 s	3.60 s	8.45 s
08/19/15 05:29 am	9D260D26	310 ms	2.62 s	2.92 s
08/19/15 05:29 am	C751B810	1.08 s	1.20 s	2.28 s
08/19/15 05:30 am	48386B53	640 ms	6.46 s	7.10 s
08/19/15 05:33 am	2C53D7A4	410 ms	2.41 s	2.82 s
08/19/15 05:34 am	05D8AFB3	140 ms	2.81 s	2.94 s
08/19/15 05:34 am	5E59B19A			1:17 m:s
08/19/15 05:34 am	F1617001	1.62 s	11 s	13 s
08/19/15 05:34 am	F57F8812	740 ms	3.36 s	4.10 s
08/19/15 05:35 am	97B95CE9	230 ms	3.13 s	3.36 s
08/19/15 05:36 am	9932FECE	220 ms	4.22 s	4.45 s
08/19/15 05:37 am	53A1065D	1.17 s	1.66 s	2.83 s

Beacon Details

General | Performance | Page Construction | Other

Date/Time	08/19/15 05:05:37.649 am (EDT)	User Agent	Chrome Mobile/44	Country	United States
Session ID	5A82136D-6C7...61A6-NTBLDW	OS	Android OS/5	Region	Colorado
IP Address	redacted	Type		City	Arvada
Page Group	(No Page Group)	Manufacturer		Connection Type	Cellular
Session Page #	16	Device		ISP/Carrier	Verizon Wireless
Referrer		A/B		Location	
Page View	[redacted]				
Full User Agent	Mozilla/5.0 (Linux; Android 5.0.2; HTC6500LVW Build/LRX22G) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/44.0.2403.133 Mobile Safari/537.36				

Beacon Waterfall

URL | 1s | 2s | 3s | 4s | 5s

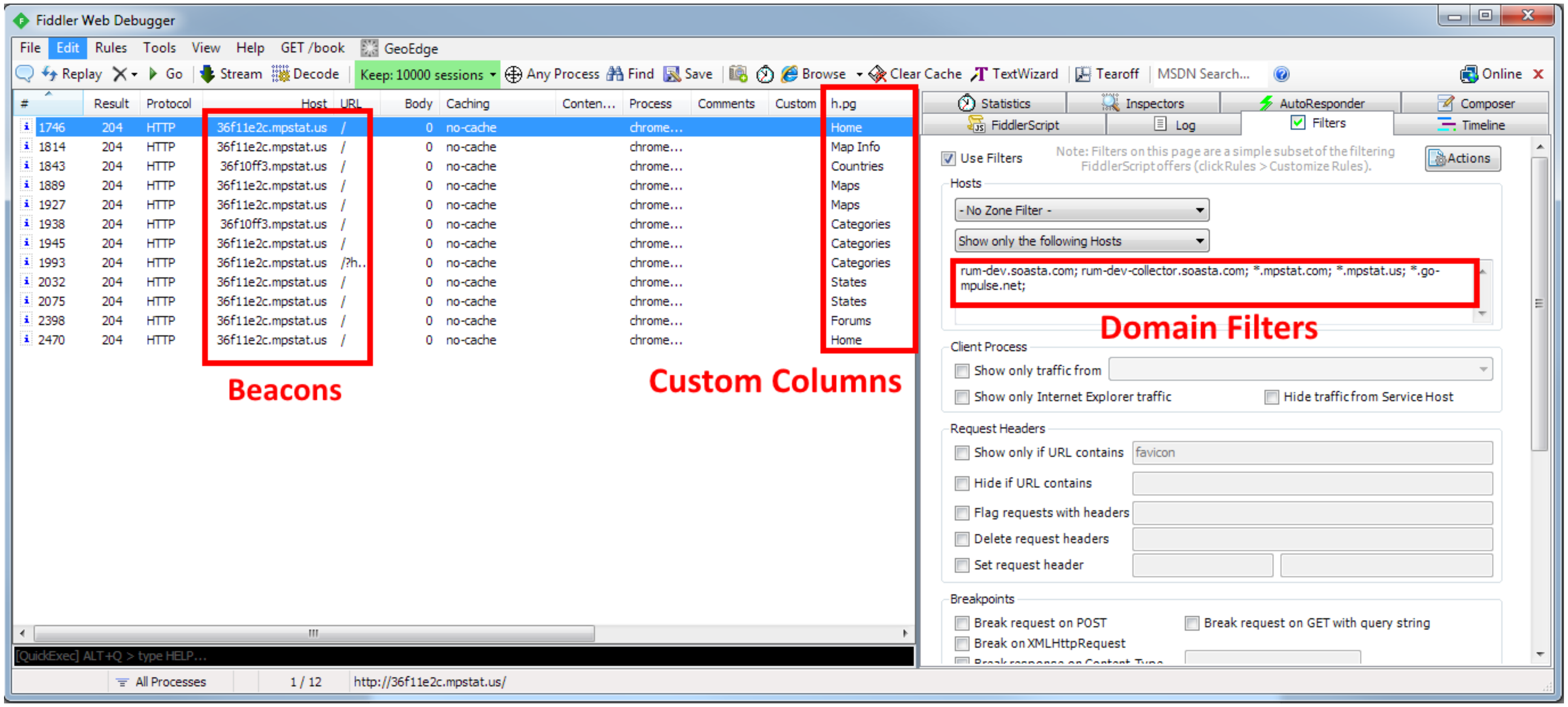
[redacted]

STEP #1
REPRODUCE THE ISSUE

- From RUM data, the issue was most common on the **home page** from **iOS** devices.
- Time to reproduce the issue on an iPad!

FIDDLER

One great use of Fiddler is to monitor external browser traffic without having Browser Dev Tools open (including mobile traffic!)



Fiddler Web Debugger
File Edit Rules Tools View Help GET /book GeoEdge
Replay Go Stream Decode Keep: 10000 sessions Any Process Find Save Browse Clear Cache TextWizard Tearoff MSDN Search... Online
Statistics Inspectors AutoResponder Composer FiddlerScript Log Filters Timeline
Beacons
Custom Columns
Domain Filters

#	Result	Protocol	Host	URL	Body	Caching	Conten...	Process	Comments	Custom	h.pg
1746	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Home
1814	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Map Info
1843	204	HTTP	36f10ff3.mpstat.us	/	0	no-cache		chrome...			Countries
1889	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Maps
1927	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Maps
1938	204	HTTP	36f10ff3.mpstat.us	/	0	no-cache		chrome...			Categories
1945	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Categories
1993	204	HTTP	36f11e2c.mpstat.us	/?h..	0	no-cache		chrome...			Categories
2032	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			States
2075	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			States
2398	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Forums
2470	204	HTTP	36f11e2c.mpstat.us	/	0	no-cache		chrome...			Home

[QuickExec] ALT+Q > type HELP...

All Processes 1 / 12 http://36f11e2c.mpstat.us/

[✓] Use Filters

Note: Filters on this page are a simple subset of the filtering FiddlerScript offers (click Rules > Customize Rules).

Actions

Hosts

- No Zone Filter -

Show only the following Hosts

rum-dev.soasta.com; rum-dev-collector.soasta.com; *.mpstat.com; *.mpstat.us; *.go-mpulse.net;

Client Process

☐ Show only traffic from

☐ Show only Internet Explorer traffic ☐ Hide traffic from Service Host

Request Headers

☐ Show only if URL contains favicon

☐ Hide if URL contains

☐ Flag requests with headers

☐ Delete request headers

☐ Set request header

Breakpoints

☐ Break request on POST ☐ Break request on GET with query string

☐ Break on XMLHttpRequest

At this point, we sat with an iPad, reloading the home page hundreds of times to try to get a repro…

And tried...

And tried…

... an hour later, after trying many ways of loading the home page, we finally got a hit!

THE REPRO

- It just so happens I was typing `www.customer.com` in the address bar, but got a phone call, so didn't hit `Go` yet
- Saw a beacon go through *without* a Page Group attached, but clearly for the customer's home page
- Ran the same scenario again, same result. Repro!
- Mobile Safari was **pre-rendering** the page I was typing into the address bar

STEP #2
DIVE DEEPER

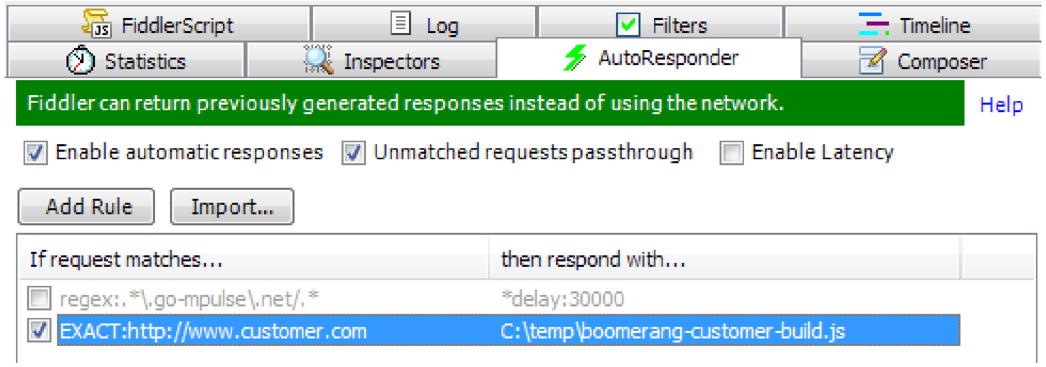
Now that we had a repro, we were able to narrow down the issue to a bug in Boomerang that didn't deal with **pre-render** state transitions properly.

The fix was pretty straightforward, but we needed to test it.

FIX VALIDATION

Fiddler allows you to inject your own content in place other **live** content on any host

We injected our fixed version into the customer' site, and validated that it worked



Fiddler can return previously generated responses instead of using the network.

☑ Enable automatic responses ☑ Unmatched requests passthrough ☐ Enable Latency

If request matches...	then respond with...
☐ regex:.*\.go-mpulse\.net/.*	*delay:30000
☑ EXACT:http://www.customer.com	C:\temp\boomerang-customer-build.js

SCENARIO #2

Conclusion:

- We used RUM to narrow down the problem
- We used RUM waterfalls to validate the problem happens in real-world data
- We used tools like Fiddler help reproduce the issue
- We used tools like Fiddler to help validate the fix

SCENARIO #3

Stop messing with my `readyState`

SCENARIO #3

- We were loading `www.customer.com` and found that Boomerang wasn't reliably sending a Page Load beacon
- Boomerang should run on `window.onload` and fire a beacon, but this wasn't happening

STEP #1
REPRODUCE THE ISSUE

- After injecting a debug version of Boomerang (via Fiddler) onto the customer's site, we found some interesting logging statements
- For example, `document.readyState == "loading"` even though `window.onload` had fired
- `window.pageshow` was firing before `window.onload` -- `window.onload` should be first

STEP #2
DIVE DEEPER

Our guess was that there was a script running on our customer's site that was messing with some of the document loading states, but had to prove it

One way is to fetch, unminify and analyze all of the site's JavaScript, but there are a couple easier ways if you want to use the Browser Dev Tools to work for you

TOOL #9
TAMPERMONKEY

- "Userscript" manager for Chrome, Opera and Android
- Allows you to inject your own code in other sites without a proxy

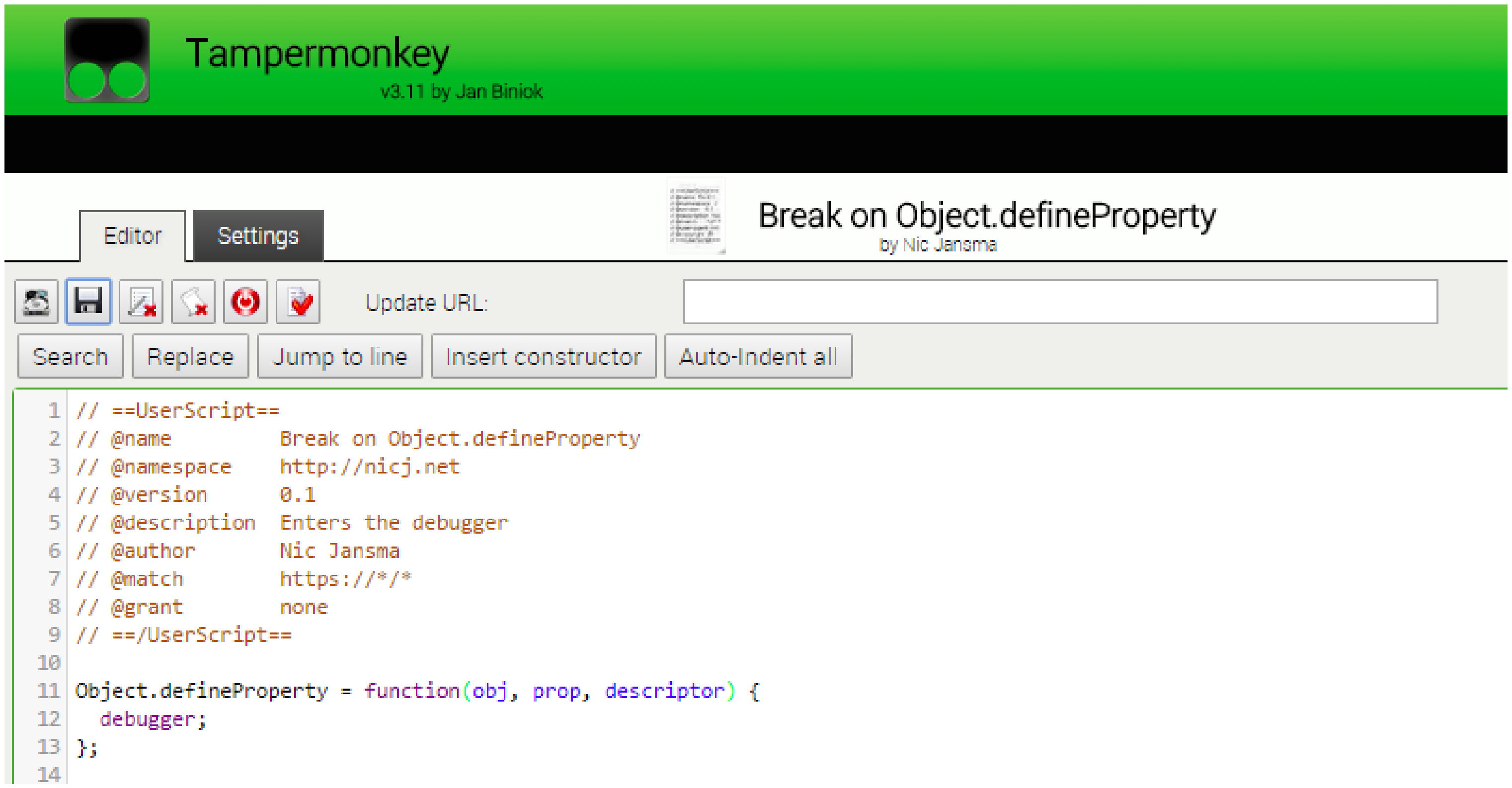
We started out with a guess that something was changing `window.onload` or `document.readyState`

EASY WAY TO SEE

One way of modifying pre-existing DOM properties is via `Object.defineProperty`

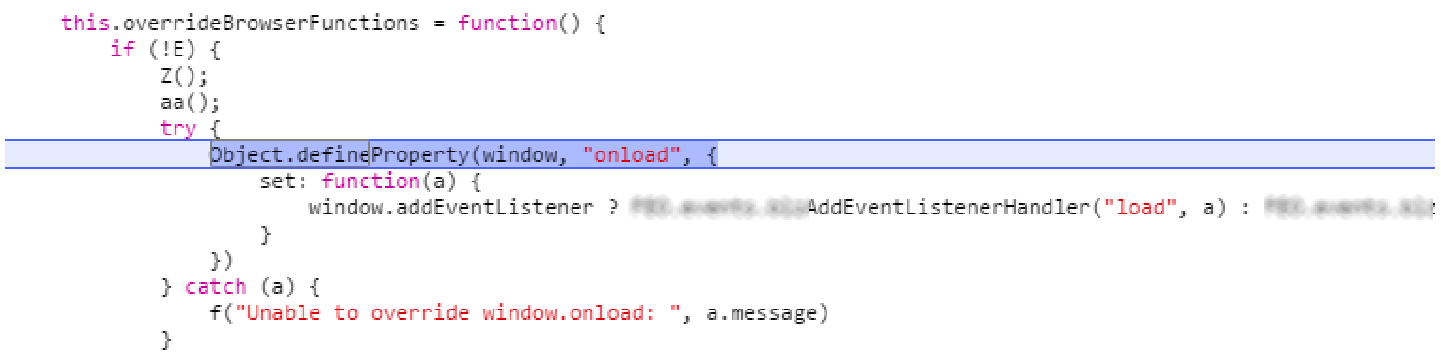
Inject this in the page to find anyone using it:

```
Object.defineProperty = function(obj, prop, descriptor) {
  debugger;
};
```



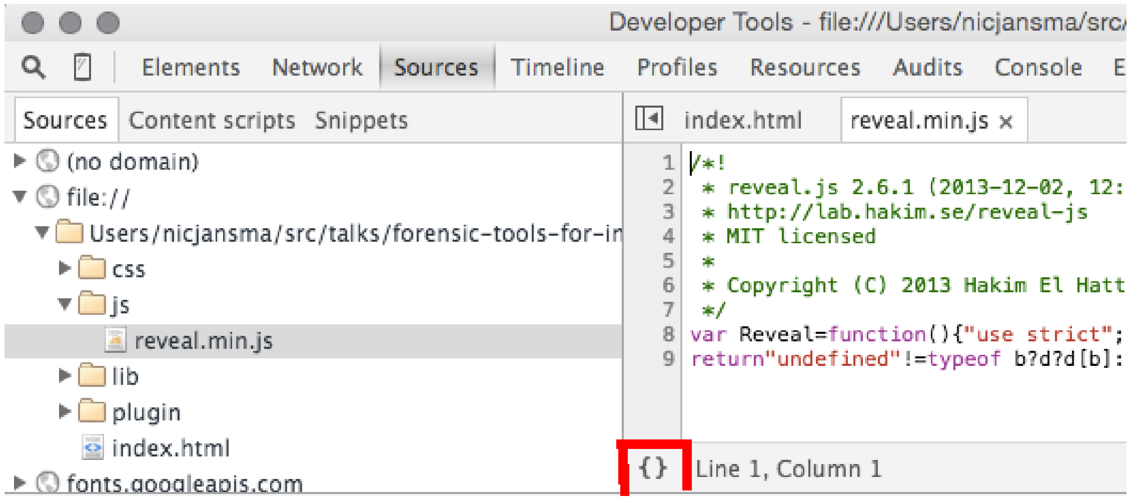
```
// ==UserScript==
// @name         Break on Object.defineProperty
// @namespace    http://nicj.net
// @version      0.1
// @description  Enters the debugger
// @author       Nic Jansma
// @match        https://*/*
// @grant        none
// ==/UserScript==

Object.defineProperty = function(obj, prop, descriptor) {
  debugger;
};

```

HIT!



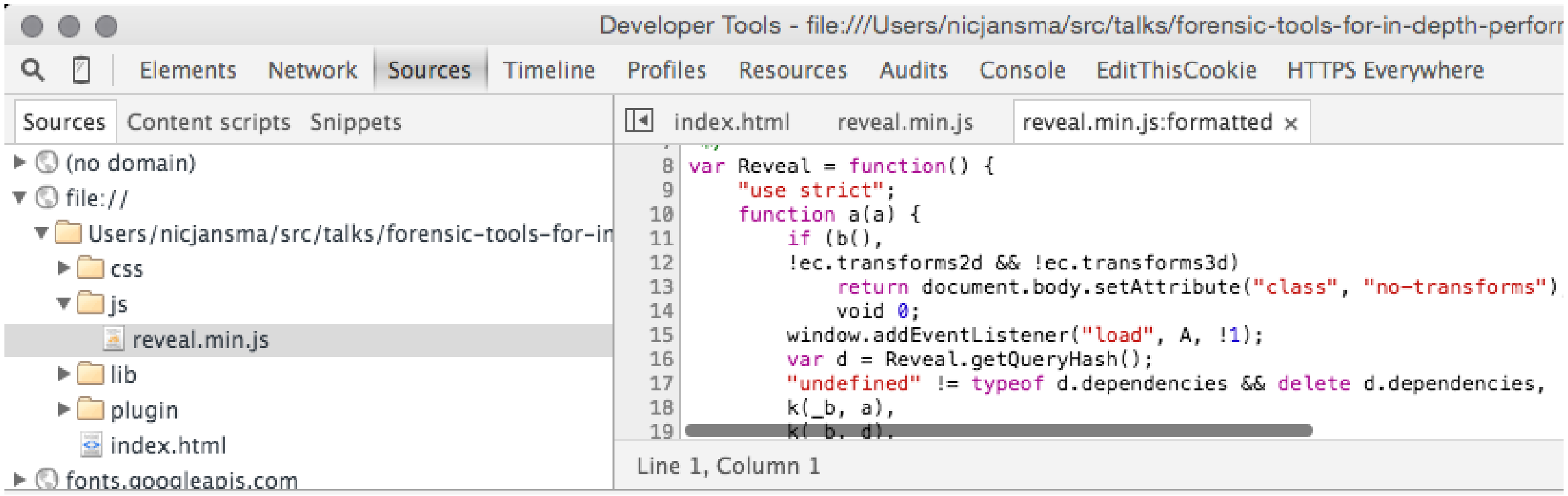
```
this.overrideBrowserFunctions = function() {
    if (!E) {
        Z();
        aa();
        try {
            Object.defineProperty(window, "onload", {
                set: function(a) {
                    window.addEventListener ? [redacted]AddEventListenerHandler("load", a) : [redacted]
                }
            })
        } catch (a) {
            f("Unable to override window.onload: ", a.message)
        }
```

Chrome/IE/FF pretty-print (unminify) is **the greatest thing**


Developer Tools - file:///Users/nicjansma/src/
Elements Network Sources Timeline Profiles Resources Audits Console E
Sources Content scripts Snippets
(no domain)
file://
Users/nicjansma/src/talks/forensic-tools-for-in
css
js
reveal.min.js
lib
plugin
index.html
fonts.googleapis.com
index.html
reveal.min.js ×
{}
Line 1, Column 1

```
/*!
 * reveal.js 2.6.1 (2013-12-02, 12:
 * http://lab.hakim.se/reveal-js
 * MIT licensed
 *
 * Copyright (C) 2013 Hakim El Hatt
 */
var Reveal=function(){"use strict";
return"undefined"!=typeof b?d?d[b]:
```

Chrome/IE/FF pretty-print (unminify) is **the greatest thing**



```
var Reveal = function() {
    "use strict";
    function a(a) {
        if (b(),
        !ec.transforms2d && !ec.transforms3d)
            return document.body.setAttribute("class", "no-transforms")
            void 0;
        window.addEventListener("load", A, !1);
        var d = Reveal.getQueryHash();
        "undefined" != typeof d.dependencies && delete d.dependencies,
        k(_b, a),
        k(_b, d),
```

We also a similar change of `document.readyState`

```
Object.defineProperty(
  document,
  "readyState",
  {
    get:
      function()
      {
        return document.someOtherReadyState;
      }
  });
```

SCENARIO #3

Conclusion:

- Changes to `window.onload` and `document.readyState` were intentional by another third-party script for FEO optimization
- We worked with that third-party to ensure our performance instrumentation wouldn't be affected

SCENARIO #4

Premature optimization is the root of all good intentions

SCENARIO #4

- Our mPulse beacons are protected against CSRF by a token and timestamp that gets sent with each beacon
- The CSRF token times out after 5 minutes
- A new token/timestamp is fetched from our servers every 5 minutes to ensure long-running apps can continue to send beacons

SCENARIO #4

- We were finding that there was an increasing occurence of the timestamp being "too old" -- that the CSRF timestamp on beacons were over 5 minutes old
- These beacons get **dropped**, but we needed to figure out **why**

STEP #1
REPRODUCE THE ISSUE

- Every beacon that gets sent to mPulse is permanently persisted (stripped of PII), so we can easily go back and investigate the raw data
- Every **dropped** beacon is logged along with *why* it was dropped
- These dropped beacons don't hit our reporting infrastructure, but we still want to be able to look for trends among the dropped beacons

TOOL #10: NODEJS

- Great for writing throw-away analysis scripts
- JavaScript lets you quickly iterate
- Tons of NPM modules for command-line use

NODEJS

We use NodeJS for many things at SOASTA:

- boomerang.js build, deployment and testing (Grunt/Jenkins)
- Infrastructure tools
- Raw data analysis

NODEJS

Useful NodeJS NPM modules for command-line scripts:

- `jetty`: ANSI control sequences
- `fast-stats`: Statistical analysis of numeric datasets
- `cli-table`: Tables for the command-line
- `commander`: Command-line argument parsing
- `line-by-line`: Reads large files without buffering into memory

STEP #2

DIVE DEEPER

We fetched gigabytes of dropped-beacon log files, and started doing some statistical analysis on the causes

DROPPED-BEACON BREAKDOWN

We can break down the dropped-beacons data by dimensions to help guide us towards finding a repro:

- By browser
- By OS
- By beacon type
- By URL

DROPPED-BEACON BREAKDOWN

NodeJS `cli-table` output. By browser:

```
┌──────────────────────────────────┬───────────┬───────────┐
│ URL                              │ Count     │ %         │
├──────────────────────────────────┼───────────┼───────────┤
│ IE/7.0                           │ 1559      │ 66.65     │
├──────────────────────────────────┼───────────┼───────────┤
│ IE/9.0                           │ 293       │ 12.53     │
├──────────────────────────────────┼───────────┼───────────┤
│ Safari/5.1.9                     │ 283       │ 12.10     │
└──────────────────────────────────┴───────────┴───────────┘
```

DROPPED-BEACON BREAKDOWN

NodeJS `cli-table` output. By beacon type:

```
┌────────────────────────────────┬───────────┬───────────┐
│ URL                            │ Count     │ %         │
├────────────────────────────────┼───────────┼───────────┤
│ xhr                            │ 2222      │ 95.00     │
├────────────────────────────────┼───────────┼───────────┤
│ navigation                     │ 37        │ 1.58      │
├────────────────────────────────┼───────────┼───────────┤
│ ...                            │ 7         │ 0.30      │
├────────────────────────────────┼───────────┼───────────┤
│ Total                          │ 2339      │ 100       │
└────────────────────────────────┴───────────┴───────────┘
```

DROPPED-BEACON BREAKDOWN

NodeJS `cli-table` output. By URL:

```
┌────────────────────────────────────┬──────────┬──────────┐
│ URL                                │ Count    │ %        │
├────────────────────────────────────┼──────────┼──────────┤
│ http://www.customer.com/api/foo    │ 2187     │ 93.50    │
├────────────────────────────────────┼──────────┼──────────┤
│ http://www.customer.com/anotherurl │ 9        │ 0.38     │
└────────────────────────────────────┴──────────┴──────────┘
```

THE REPRO

- From our raw data, the "too old" beacons were mostly caused by **IE 7 and IE 9**, from **XHRs** to the customer's `/api/foo` endpoint

TOOL #11
VIRTUALIZATION

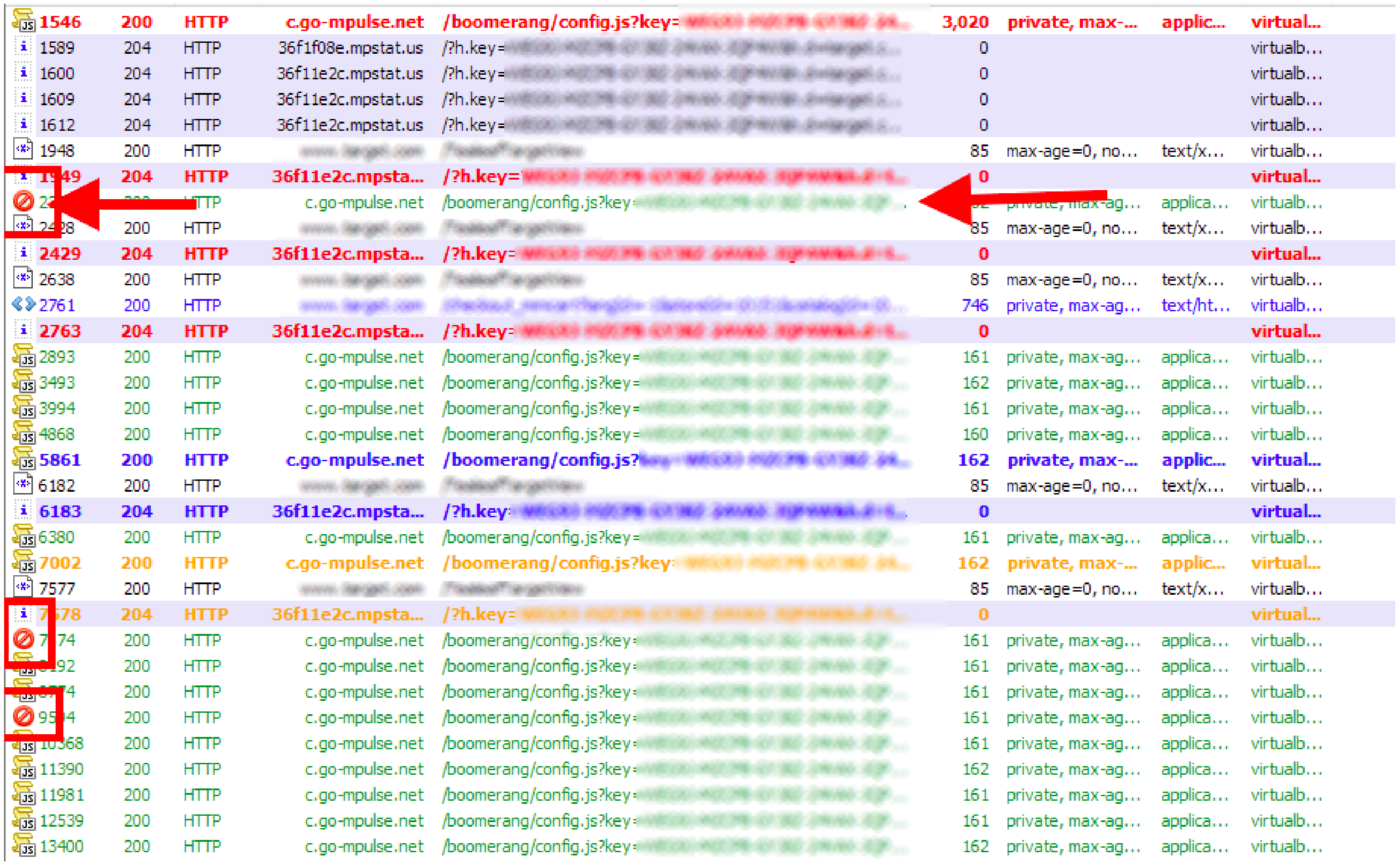
- VirtualBox, VMWare, Parallels, etc
- All great ways to test older browsers
- modern.ie has VMs for IE 6, 7, 8, 9, 10, 11 and Edge

THE REPRO

We sat our VirtualBox IE 9 browser on `www.customer.com` for a while, watching XHRs and beacons flow past

THE REPRO

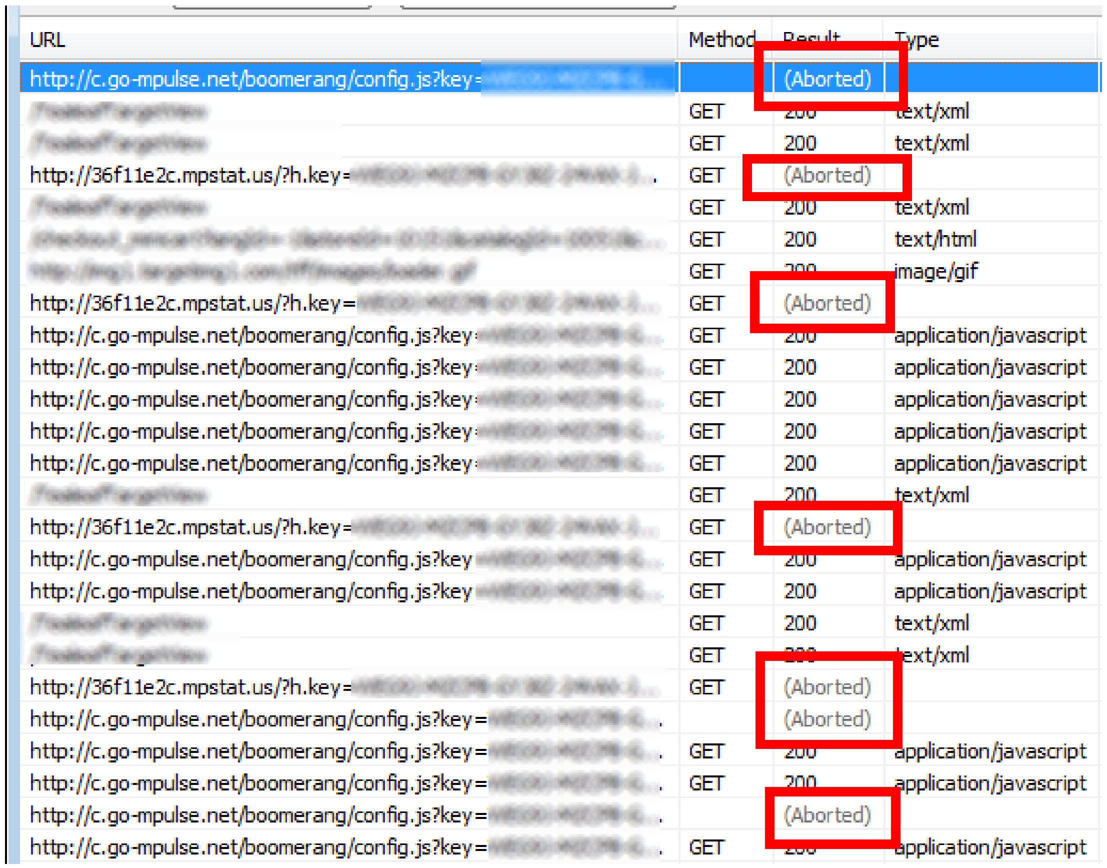
Both IE 9 Developer Tools and Fiddler showed something interesting:



1546	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	3,020	private, max-...	applic...	virtual...
1589	204	HTTP	36f1f08e.mpstat.us	/?h.key=[redacted]	0			virtualb...
1600	204	HTTP	36f11e2c.mpstat.us	/?h.key=[redacted]	0			virtualb...
1609	204	HTTP	36f11e2c.mpstat.us	/?h.key=[redacted]	0			virtualb...
1612	204	HTTP	36f11e2c.mpstat.us	/?h.key=[redacted]	0			virtualb...
1948	200	HTTP	[redacted]	[redacted]	85	max-age=0, no...	text/x...	virtualb...
1[illegible]49	204	HTTP	36f11e2c.mpsta...	/?h.key=[redacted]	0			virtual...
22[illegible]	[illegible]	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	[illegible]	private, max-ag...	applica...	virtualb...
2[illegible]28	200	HTTP	[redacted]	[redacted]	85	max-age=0, no...	text/x...	virtualb...
2429	204	HTTP	36f11e2c.mpsta...	/?h.key=[redacted]	0			virtual...
2638	200	HTTP	[redacted]	[redacted]	85	max-age=0, no...	text/x...	virtualb...
2761	200	HTTP	[redacted]	[redacted]	746	private, max-ag...	text/ht...	virtualb...
2763	204	HTTP	36f11e2c.mpsta...	/?h.key=[redacted]	0			virtual...
2893	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
3493	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	162	private, max-ag...	applica...	virtualb...
3994	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
4868	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	160	private, max-ag...	applica...	virtualb...
5861	200	HTTP	c.go-mpulse.net	/boomerang/config.js?[redacted]	162	private, max-...	applic...	virtual...
6182	200	HTTP	[redacted]	[redacted]	85	max-age=0, no...	text/x...	virtualb...
6183	204	HTTP	36f11e2c.mpsta...	/?h.key=[redacted]	0			virtual...
6380	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
7002	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	162	private, max-...	applic...	virtual...
7577	200	HTTP	[redacted]	[redacted]	85	max-age=0, no...	text/x...	virtualb...
[illegible]578	204	HTTP	36f11e2c.mpsta...	/?h.key=[redacted]	0			virtual...
7[illegible]74	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
[illegible]92	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
[illegible]4	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
95[illegible]4	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
10368	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
11390	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	162	private, max-ag...	applica...	virtualb...
11981	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
12539	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	161	private, max-ag...	applica...	virtualb...
13400	200	HTTP	c.go-mpulse.net	/boomerang/config.js?key=[redacted]	162	private, max-ag...	applica...	virtualb...

THE REPRO

IE 9 Developer Tools showing aborted requests to our injected `<javascript>` that updates the token and timestamp:



URL	Method	Result	Type
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]		(Aborted)	
[redacted]	GET	200	text/xml
[redacted]	GET	200	text/xml
http://36f11e2c.mpstat.us/?h.key=[redacted]	GET	(Aborted)	
[redacted]	GET	200	text/xml
[redacted]	GET	200	text/html
[redacted]	GET	200	image/gif
http://36f11e2c.mpstat.us/?h.key=[redacted]	GET	(Aborted)	
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
[redacted]	GET	200	text/xml
http://36f11e2c.mpstat.us/?h.key=[redacted]	GET	(Aborted)	
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
[redacted]	GET	200	text/xml
[redacted]	GET	200	text/xml
http://36f11e2c.mpstat.us/?h.key=[redacted]	GET	(Aborted)	
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]		(Aborted)	
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]		(Aborted)	
http://c.go-mpulse.net/boomerang/config.js?key=[redacted]	GET	200	application/javascript

SCENARIO #4

Conclusion:

- We had recently made a change in boomerang.js to quickly remove the `<javascript>` node that was fetching the updated CSRF token and timestamp
- In some older browsers, this causes the network request to abort
- We were able to validate the fix (keeping the `<javascript>` node around for a bit) via the same tools

SCENARIO #5

The many ways to send a beacon

… and the many ways to **not** send a beacon

SCENARIO #5

We send the boomerang.js beacon to mPulse via several methods:

- If the payload is small, we create a hidden `IMG` element with a `img.src` containing the payload in the query string
- If the payload is large (greater than 2083 bytes), we create a hidden `FORM` element and call `form.submit()` on it

SCENARIO #5

Windows 10 and Edge had just been released, and a customer reported that their site was hanging in Edge on some pages, and that it no longer did when boomerang.js was removed from their site

We had tested Windows 10 Techincal Preview (the previous Edge build) thoroughly, but something in the final release was causing problems

STEP #1

REPRODUCE THE ISSUE

Sure enough, loading `customer.com` would hang Edge for up to 30 seconds.

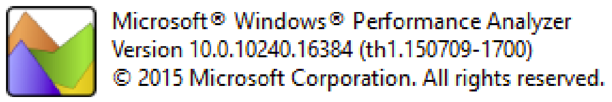
Since the browser was hung, it was hard to use the Edge debugger

STEP #2

DIVE DEEPER

Time to dive into system-level tracing!

TOOL #12
EVENT TRACING FOR WINDOWS



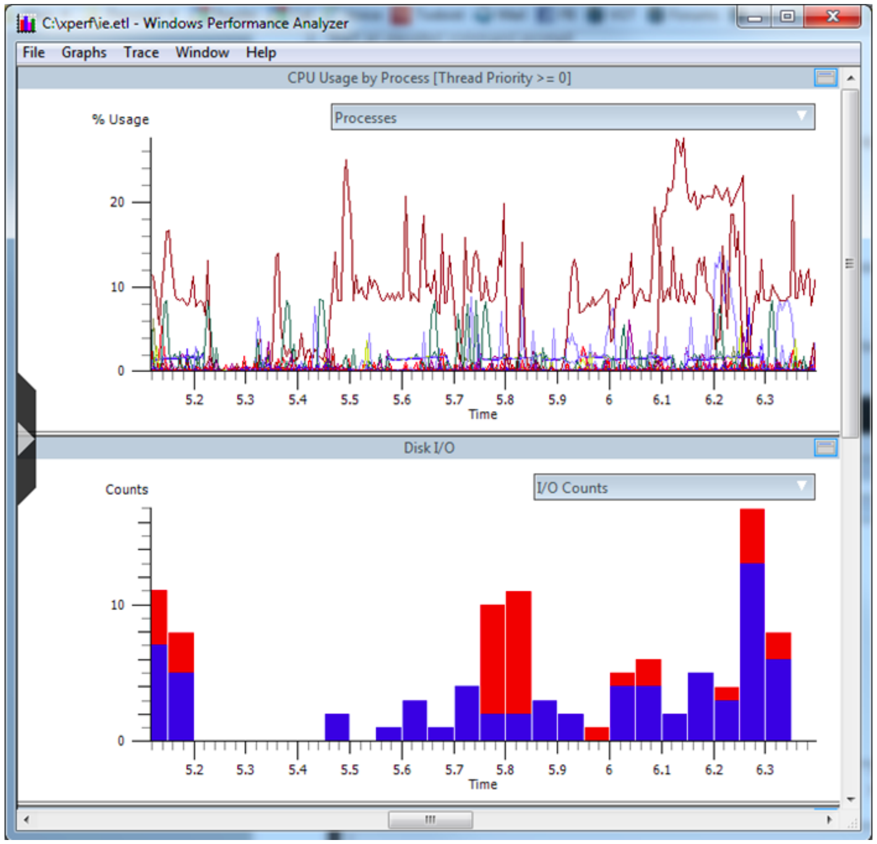
Microsoft® Windows® Performance Analyzer
Version 10.0.10240.16384 (th1.150709-1700)
© 2015 Microsoft Corporation. All rights reserved.

- Event Tracing for Windows (**ETW**) is built into all versions of Windows from XP onward
- Enables the OS and applications to efficiently generate runtime tracing events
- **xperf** and the newer **Windows Performance Analyzer (WPA)** are tools used to generate ETW traces and then analyze them

ETW

Available tracing:

- CPU usage
- Disk usage
- Hard faults
- DPCs/ISRs
- TCP
- Sampled Profiling
- Custom app events (IE7+, Chrome)
- With stacks!


C:\xperf\ie.etl - Windows Performance Analyzer
File Graphs Trace Window Help
CPU Usage by Process [Thread Priority >= 0]
% Usage
Processes
Time
Disk I/O
Counts
I/O Counts
Time

ETW - DOWNLOADING

- Part of the **Windows Performance Toolkit**
- Included in the Windows Assessment and Deployment Kit
- Friendly interface via UIforETW: github.com/google/UIforETW

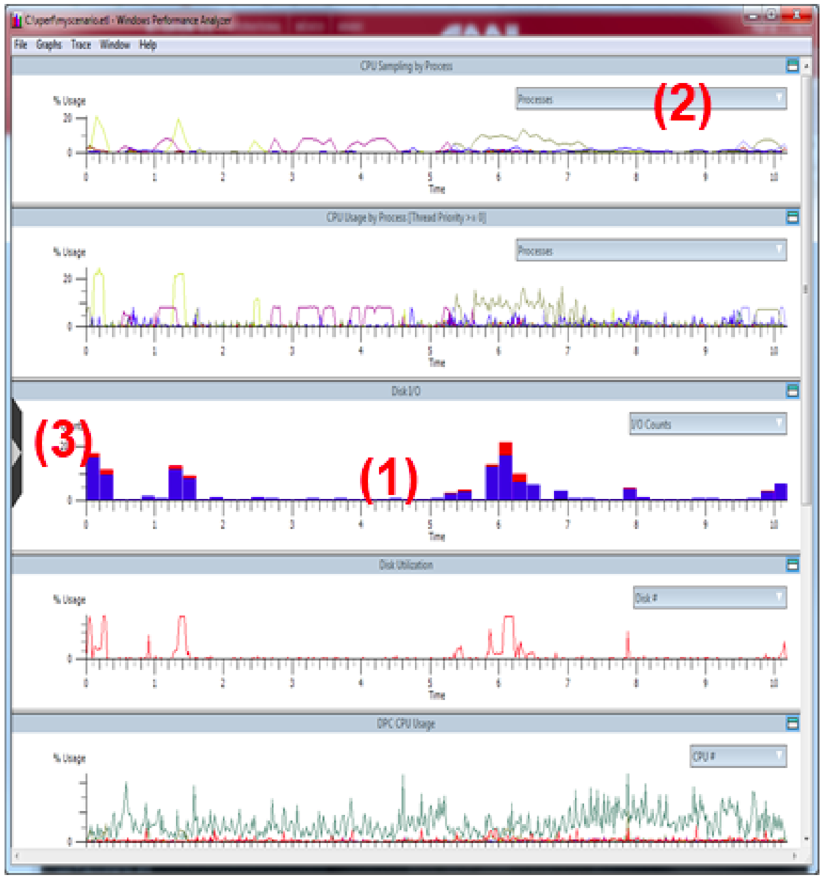
ETW - USAGE

Simple trace of system evenst:

```
xperf.exe -on latency -stackwalk profile
// [run scenario]
xperf.exe -stop -d myscenario.etl
```

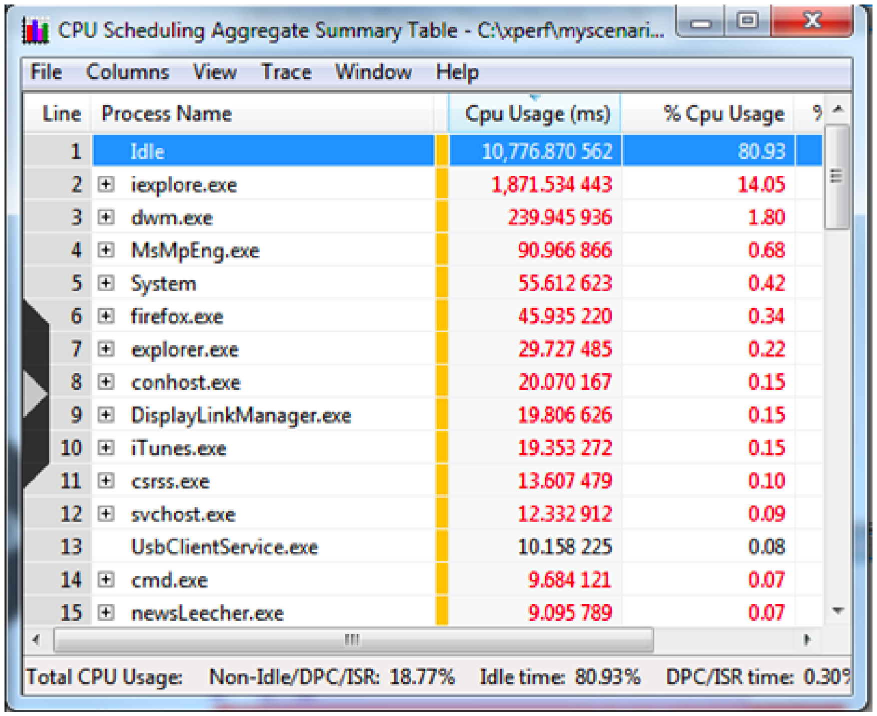
ETW - XPERFVIEW

1. Timeline of events
2. Filter processes
3. Graph selection


C:\xperf\myscenario.etl - Windows Performance Analyzer
File Graphs Trace Window Help
CPU Sampling by Process
Processes
(2)
% Usage
Time
CPU Usage by Process [Thread Priority >= 0]
Processes
Disk I/O
I/O Counts
(3)
(1)
Disk Utilization
Disk #
DPC CPU Usage
CPU #

XPERF - SUMMARY TABLES

- All of the graphs can be interacted with - zoom, popups, right-clicks
- Summary Tables show data in tabular form

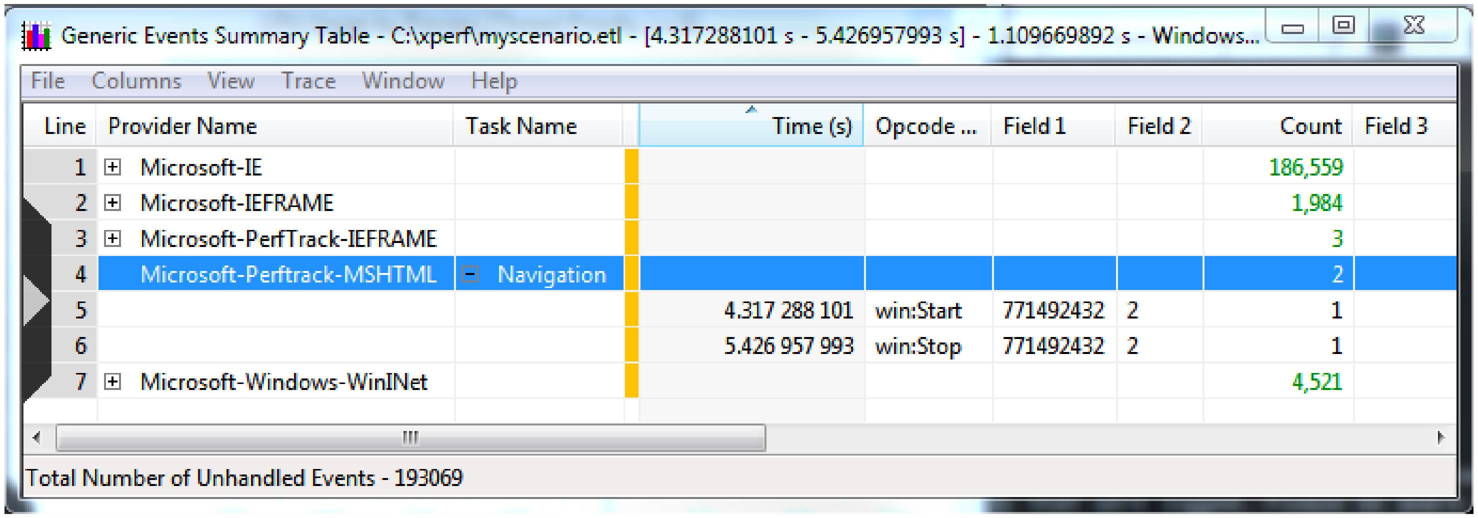

CPU Scheduling Aggregate Summary Table - C:\xperf\myscenari...
File Columns View Trace Window Help

Line	Process Name	Cpu Usage (ms)	% Cpu Usage
1	Idle	10,776.870 562	80.93
2	iexplore.exe	1,871.534 443	14.05
3	dwm.exe	239.945 936	1.80
4	MsMpEng.exe	90.966 866	0.68
5	System	55.612 623	0.42
6	firefox.exe	45.935 220	0.34
7	explorer.exe	29.727 485	0.22
8	conhost.exe	20.070 167	0.15
9	DisplayLinkManager.exe	19.806 626	0.15
10	iTunes.exe	19.353 272	0.15
11	csrss.exe	13.607 479	0.10
12	svchost.exe	12.332 912	0.09
13	UsbClientService.exe	10.158 225	0.08
14	cmd.exe	9.684 121	0.07
15	newsLeecher.exe	9.095 789	0.07

Total CPU Usage: Non-Idle/DPC/ISR: 18.77% Idle time: 80.93% DPC/ISR time: 0.30

ETW - BROWSER EVENTS

Internet Explorer and Chrome both fire ETW events that you can overlay in the charts and see in the tables


Generic Events Summary Table - C:\xperf\myscenario.etl - [4.317288101 s - 5.426957993 s] - 1.109669892 s - Windows...
File Columns View Trace Window Help

Line	Provider Name	Task Name	Time (s)	Opcode ...	Field 1	Field 2	Count	Field 3
1	⊞ Microsoft-IE						186,559	
2	⊞ Microsoft-IEFRAME						1,984	
3	⊞ Microsoft-PerfTrack-IEFRAME						3	
4	Microsoft-Perftrack-MSHTML	⊟ Navigation					2	
5			4.317 288 101	win:Start	771492432	2	1	
6			5.426 957 993	win:Stop	771492432	2	1	
7	⊞ Microsoft-Windows-WinINet						4,521	

Total Number of Unhandled Events - 193069

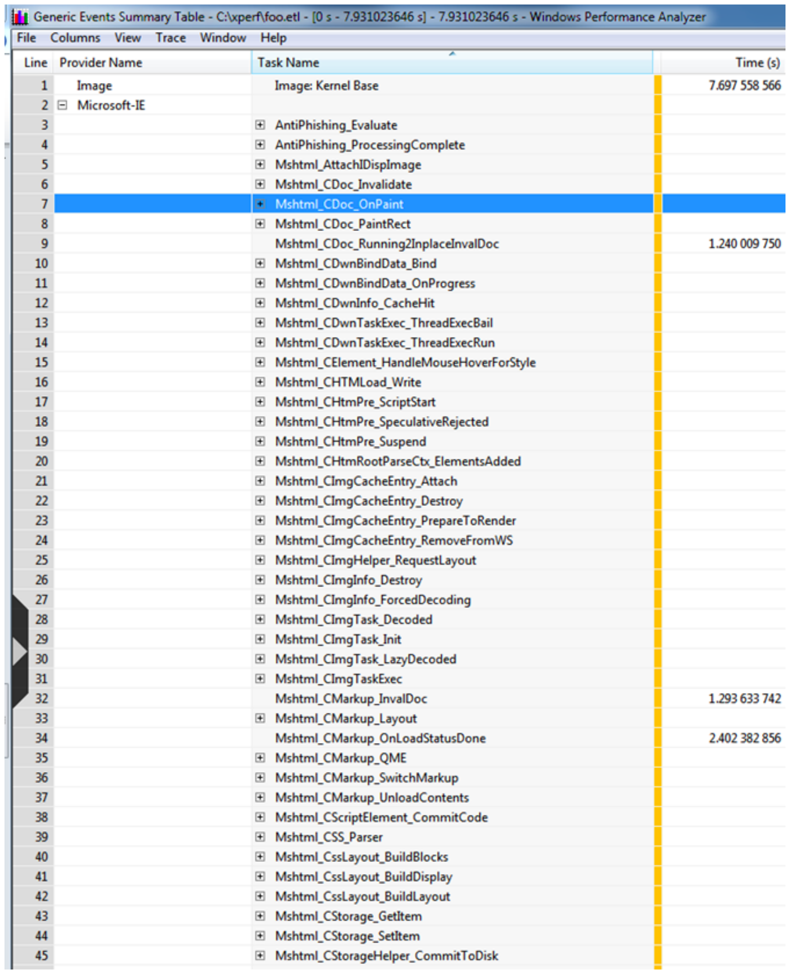
ETW - IE EVENTS

Microsoft-IE events:

- CMarkup_OnLoadStatusDone: Page load is complete
- CDoc_OnPaint: Paints
- CDwnBindData_Bind: Downloads
- + 100s more

Microsoft-IEFRAME:

- Frame events for tabs, navigations, history, extensions

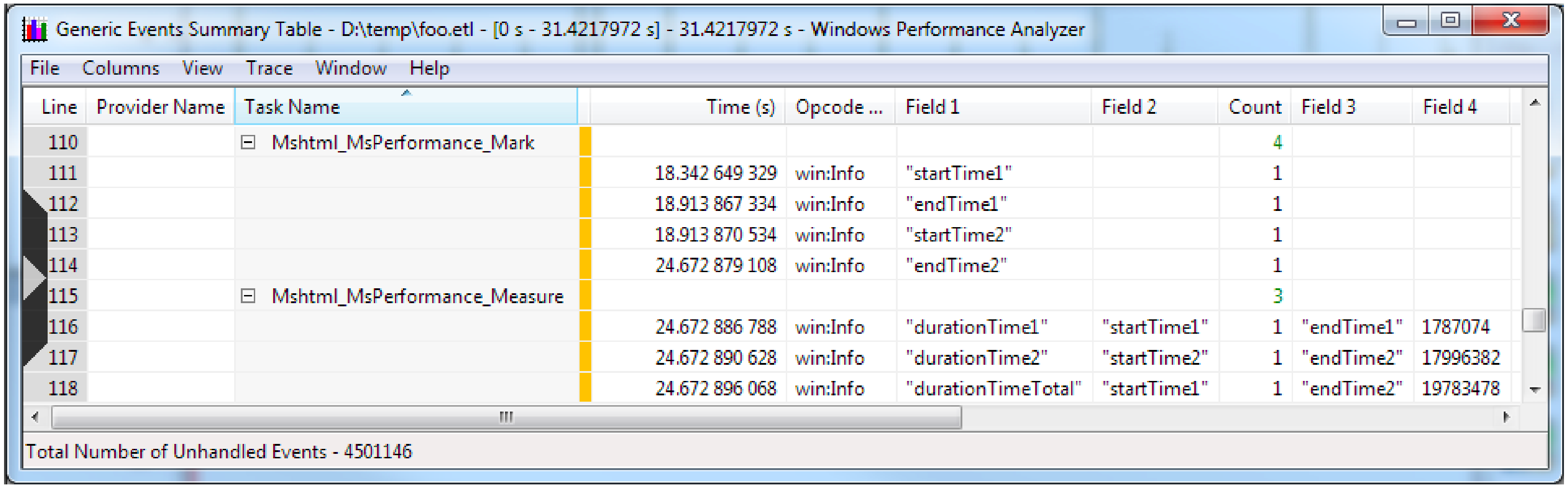


Generic Events Summary Table - C:\xperf\foo.etl - [0 s - 7.931023646 s] - 7.931023646 s - Windows Performance Analyzer

Line	Provider Name	Task Name	Time (s)
1	Image	Image: Kernel Base	7.697 558 566
2	Microsoft-IE		
3		AntiPhishing_Evaluate	
4		AntiPhishing_ProcessingComplete	
5		Mshtml_AttachDispImage	
6		Mshtml_CDoc_Invalidate	
7		Mshtml_CDoc_OnPaint	
8		Mshtml_CDoc_PaintRect	
9		Mshtml_CDoc_Running2InplaceInvalDoc	1.240 009 750
10		Mshtml_CDwnBindData_Bind	
11		Mshtml_CDwnBindData_OnProgress	
12		Mshtml_CDwnInfo_CacheHit	
13		Mshtml_CDwnTaskExec_ThreadExecBail	
14		Mshtml_CDwnTaskExec_ThreadExecRun	
15		Mshtml_CElement_HandleMouseHoverForStyle	
16		Mshtml_CHTMLoad_Write	
17		Mshtml_CHtmPre_ScriptStart	
18		Mshtml_CHtmPre_SpeculativeRejected	
19		Mshtml_CHtmPre_Suspend	
20		Mshtml_CHtmRootParseCtx_ElementsAdded	
21		Mshtml_CImgCacheEntry_Attach	
22		Mshtml_CImgCacheEntry_Destroy	
23		Mshtml_CImgCacheEntry_PrepareToRender	
24		Mshtml_CImgCacheEntry_RemoveFromWS	
25		Mshtml_CImgHelper_RequestLayout	
26		Mshtml_CImgInfo_Destroy	
27		Mshtml_CImgInfo_ForcedDecoding	
28		Mshtml_CImgTask_Decoded	
29		Mshtml_CImgTask_Init	
30		Mshtml_CImgTask_LazyDecoded	
31		Mshtml_CImgTaskExec	
32		Mshtml_CMarkup_InvalDoc	1.293 633 742
33		Mshtml_CMarkup_Layout	
34		Mshtml_CMarkup_OnLoadStatusDone	2.402 382 856
35		Mshtml_CMarkup_QME	
36		Mshtml_CMarkup_SwitchMarkup	
37		Mshtml_CMarkup_UnloadContents	
38		Mshtml_CScriptElement_CommitCode	
39		Mshtml_CSS_Parser	
40		Mshtml_CssLayout_BuildBlocks	
41		Mshtml_CssLayout_BuildDisplay	
42		Mshtml_CssLayout_BuildLayout	
43		Mshtml_CStorage_GetItem	
44		Mshtml_CStorage_SetItem	
45		Mshtml_CStorageHelper_CommitToDisk	

USERTIMING IN ETW

```
performance.mark("startTime1");
performance.mark("endTime1");
performance.mark("startTime2");
performance.mark("endTime2");
performance.measure("durationTime1", "startTime1", "endTime1");
performance.measure("durationTime2", "startTime2", "endTime2");
```



Generic Events Summary Table - D:\temp\foo.etl - [0 s - 31.4217972 s] - 31.4217972 s - Windows Performance Analyzer

Line	Provider Name	Task Name	Time (s)	Opcode ...	Field 1	Field 2	Count	Field 3	Field 4
110		⊟ Mshtml_MsPerformance_Mark					4		
111			18.342 649 329	win:Info	"startTime1"		1		
112			18.913 867 334	win:Info	"endTime1"		1		
113			18.913 870 534	win:Info	"startTime2"		1		
114			24.672 879 108	win:Info	"endTime2"		1		
115		⊟ Mshtml_MsPerformance_Measure					3		
116			24.672 886 788	win:Info	"durationTime1"	"startTime1"	1	"endTime1"	1787074
117			24.672 890 628	win:Info	"durationTime2"	"startTime2"	1	"endTime2"	17996382
118			24.672 896 068	win:Info	"durationTimeTotal"	"startTime1"	1	"endTime2"	19783478

Total Number of Unhandled Events - 4501146

ETW - STACKS

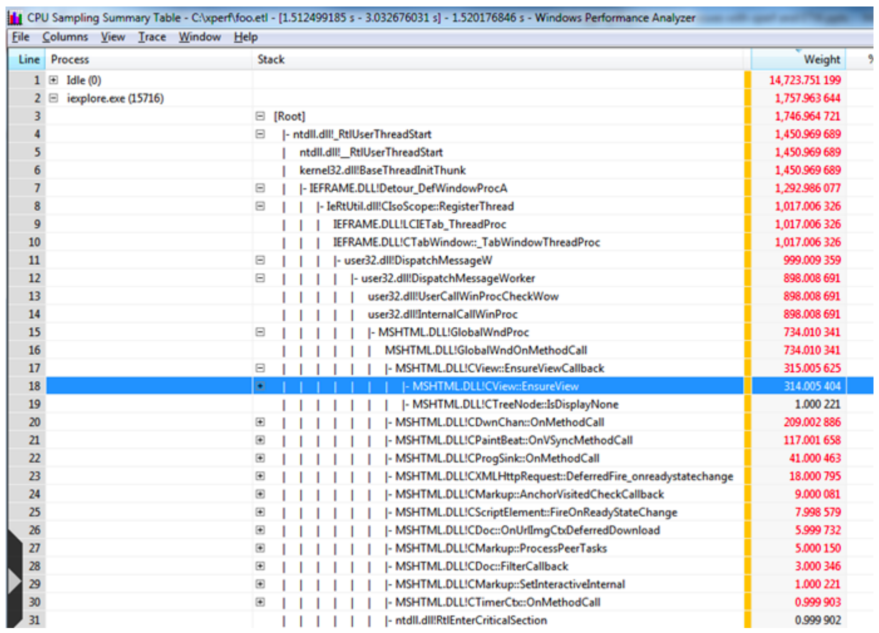
By using `-stackwalk` on the command line, you can enable stacks on many events

Public symbol servers:

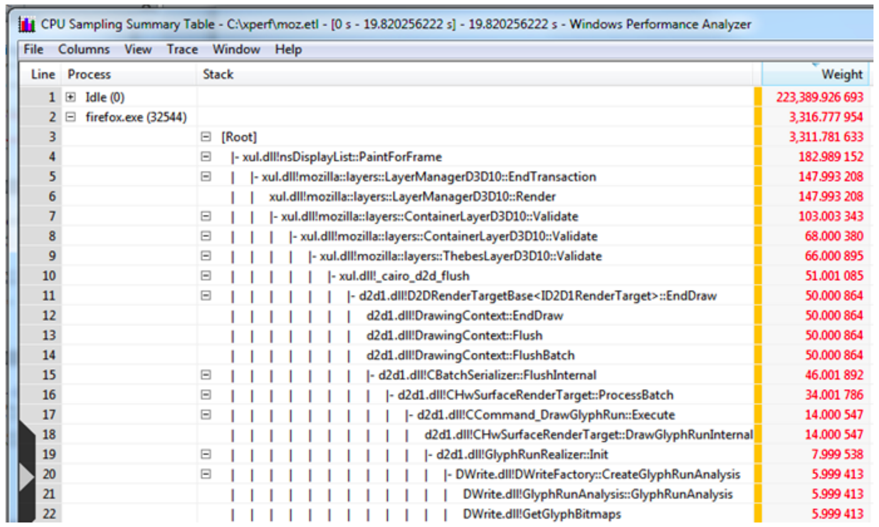
https://msdl.microsoft.com/download/symbols

http://symbols.mozilla.org/firefox

https://chromium-browser-symsrv.commondatastorage.googleapis.com/


CPU Sampling Summary Table - C:\xperf\foo.etl - [1.512499185 s - 3.032676031 s] - 1.520176846 s - Windows Performance Analyzer
File Columns View Trace Window Help

```
Line  Process               Stack                                                                              Weight
   1  ⊞ Idle (0)                                                                                          14,723.751 199
   2  ⊟ iexplore.exe (15716)                                                                               1,757.963 644
   3                        ⊟ [Root]                                                                       1,746.964 721
   4                        ⊟  |- ntdll.dll!_RtlUserThreadStart                                            1,450.969 689
   5                           |  ntdll.dll!__RtlUserThreadStart                                           1,450.969 689
   6                           |  kernel32.dll!BaseThreadInitThunk                                         1,450.969 689
   7                        ⊟  |  |- IEFRAME.DLL!Detour_DefWindowProcA                                     1,292.986 077
   8                        ⊟  |  |  |- IeRtUtil.dll!CIsoScope::RegisterThread                             1,017.006 326
   9                           |  |  |  IEFRAME.DLL!LCIETab_ThreadProc                                     1,017.006 326
  10                           |  |  |  IEFRAME.DLL!CTabWindow::_TabWindowThreadProc                       1,017.006 326
  11                        ⊟  |  |  |  |- user32.dll!DispatchMessageW                                       999.009 359
  12                        ⊟  |  |  |  |  |- user32.dll!DispatchMessageWorker                               898.008 691
  13                           |  |  |  |  |  user32.dll!UserCallWinProcCheckWow                             898.008 691
  14                           |  |  |  |  |  user32.dll!InternalCallWinProc                                 898.008 691
  15                        ⊟  |  |  |  |  |  |- MSHTML.DLL!GlobalWndProc                                    734.010 341
  16                           |  |  |  |  |  |  MSHTML.DLL!GlobalWndOnMethodCall                            734.010 341
  17                        ⊟  |  |  |  |  |  |  |- MSHTML.DLL!CView::EnsureViewCallback                     315.005 625
  18                        ⊞  |  |  |  |  |  |  |  |- MSHTML.DLL!CView::EnsureView                         314.005 404
  19                           |  |  |  |  |  |  |  |- MSHTML.DLL!CTreeNode::IsDisplayNone                     1.000 221
  20                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CDwnChan::OnMethodCall                        209.002 886
  21                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CPaintBeat::OnVSyncMethodCall                 117.001 658
  22                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CProgSink::OnMethodCall                        41.000 463
  23                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CXMLHttpRequest::DeferredFire_onreadystatechange 18.000 795
  24                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CMarkup::AnchorVisitedCheckCallback             9.000 081
  25                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CScriptElement::FireOnReadyStateChange          7.998 579
  26                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CDoc::OnUrlImgCtxDeferredDownload              5.999 732
  27                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CMarkup::ProcessPeerTasks                       5.000 150
  28                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CDoc::FilterCallback                           3.000 346
  29                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CMarkup::SetInteractiveInternal                 1.000 221
  30                        ⊞  |  |  |  |  |  |  |- MSHTML.DLL!CTimerCtx::OnMethodCall                         0.999 903
  31                           |  |  |  |  |  |  |- ntdll.dll!RtlEnterCriticalSection                          0.999 902
```


CPU Sampling Summary Table - C:\xperf\moz.etl - [0 s - 19.820256222 s] - 19.820256222 s - Windows Performance Analyzer
File Columns View Trace Window Help

```
Line  Process              Stack                                                                                      Weight
   1  ⊞ Idle (0)                                                                                                 223,389.926 693
   2  ⊟ firefox.exe (32544)                                                                                        3,316.777 954
   3                       ⊟ [Root]                                                                                3,311.781 633
   4                       ⊟  |- xul.dll!nsDisplayList::PaintForFrame                                                182.989 152
   5                       ⊟  |  |- xul.dll!mozilla::layers::LayerManagerD3D10::EndTransaction                       147.993 208
   6                          |  |  xul.dll!mozilla::layers::LayerManagerD3D10::Render                               147.993 208
   7                       ⊟  |  |  |- xul.dll!mozilla::layers::ContainerLayerD3D10::Validate                        103.003 343
   8                       ⊟  |  |  |  |- xul.dll!mozilla::layers::ContainerLayerD3D10::Validate                      68.000 380
   9                       ⊟  |  |  |  |  |- xul.dll!mozilla::layers::ThebesLayerD3D10::Validate                      66.000 895
  10                       ⊟  |  |  |  |  |  |- xul.dll!_cairo_d2d_flush                                              51.001 085
  11                       ⊟  |  |  |  |  |  |  |- d2d1.dll!D2DRenderTargetBase<ID2D1RenderTarget>::EndDraw           50.000 864
  12                          |  |  |  |  |  |  |  d2d1.dll!DrawingContext::EndDraw                                  50.000 864
  13                          |  |  |  |  |  |  |  d2d1.dll!DrawingContext::Flush                                    50.000 864
  14                          |  |  |  |  |  |  |  d2d1.dll!DrawingContext::FlushBatch                               50.000 864
  15                       ⊟  |  |  |  |  |  |  |  |- d2d1.dll!CBatchSerializer::FlushInternal                       46.001 892
  16                       ⊟  |  |  |  |  |  |  |  |  |- d2d1.dll!CHwSurfaceRenderTarget::ProcessBatch               34.001 786
  17                       ⊟  |  |  |  |  |  |  |  |  |  |- d2d1.dll!CCommand_DrawGlyphRun::Execute                 14.000 547
  18                          |  |  |  |  |  |  |  |  |  |  d2d1.dll!CHwSurfaceRenderTarget::DrawGlyphRunInternal  14.000 547
  19                       ⊟  |  |  |  |  |  |  |  |  |  |  |- d2d1.dll!GlyphRunRealizer::Init                       7.999 538
  20                       ⊟  |  |  |  |  |  |  |  |  |  |  |  |- DWrite.dll!DWriteFactory::CreateGlyphRunAnalysis   5.999 413
  21                          |  |  |  |  |  |  |  |  |  |  |  |  DWrite.dll!GlyphRunAnalysis::GlyphRunAnalysis       5.999 413
  22                          |  |  |  |  |  |  |  |  |  |  |  |  DWrite.dll!GetGlyphBitmaps                          5.999 413
```

ETW - MORE HELP

More great tutorials on ETW, UIForETW, and xperf are available at: randomascii.wordpress.com

via Bruce Dawson @BruceDawson0xB

ETW - USES

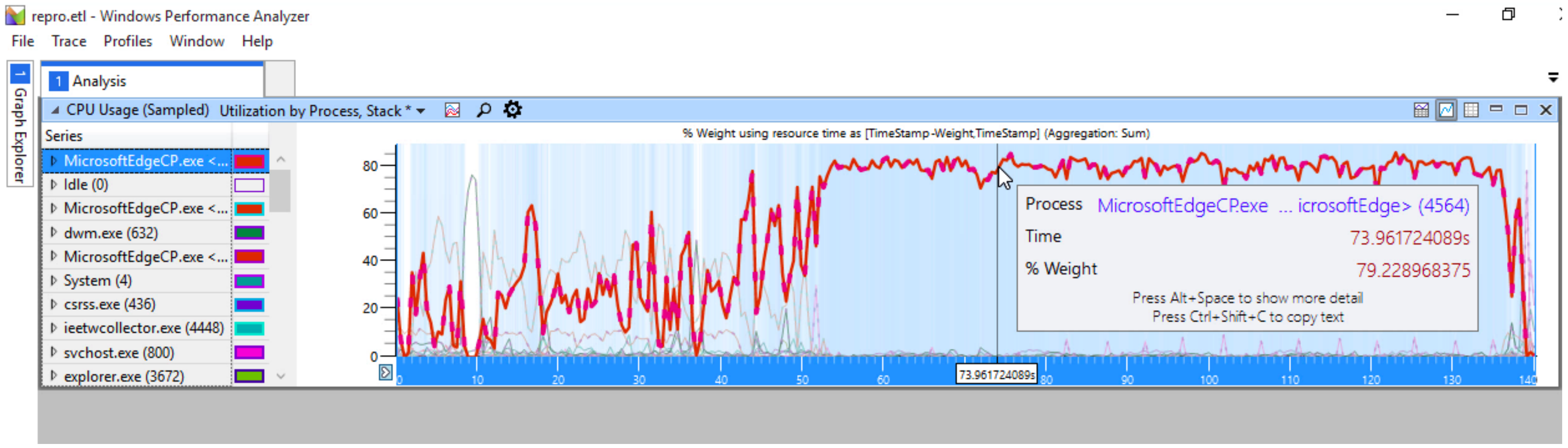
- Slow page load performance? Take a trace!
- See page load from a system-wide perspective
- Isolate page load from interference due to other CPU/disk/network activity
- Compare browser page load times and resource usage
- Examine browser CPU usage hot-spots from sampled profile stacks
- Automated page load regression testing of browsers via command-line tools
- Integrate page load time / cpu usage metrics into your build system

THE REPRO

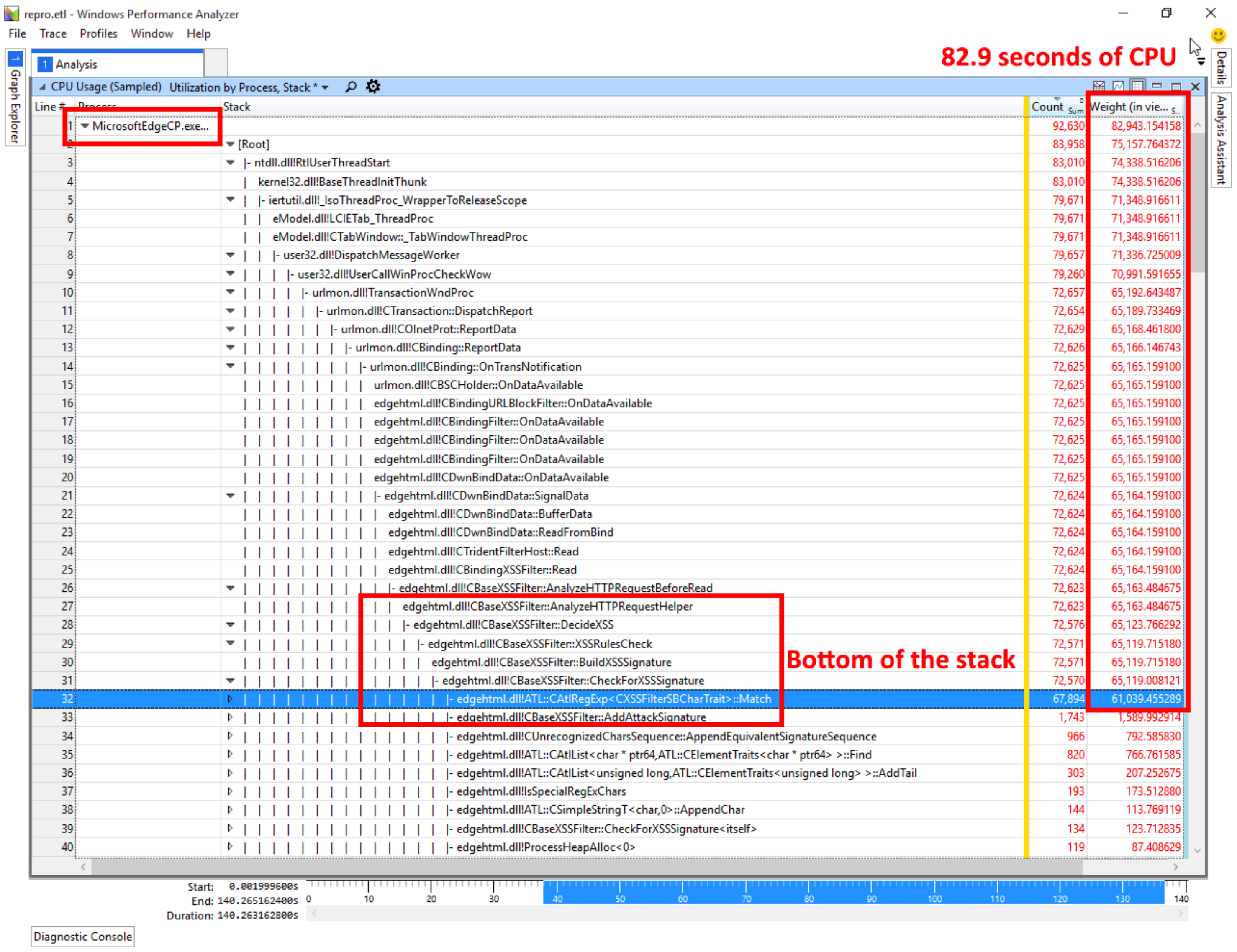
1. Using Windows 10 (in a VirtualBox VM?)
2. Open Edge
3. `xperf -on latency -stackwalk profile`
4. Head to www.customer.com
5. We immediately see the browser go to *(Not Responding)*
6. `xperf -d repro.etl`

WPA - CPU SAMPLING

The trace shows Edge spending nearly 100% CPU for over 70 seconds:


repro.etl - Windows Performance Analyzer
File Trace Profiles Window Help
Graph Explorer
1 Analysis
CPU Usage (Sampled) Utilization by Process, Stack *
Series
MicrosoftEdgeCP.exe <...
Idle (0)
MicrosoftEdgeCP.exe <...
dwm.exe (632)
MicrosoftEdgeCP.exe <...
System (4)
csrss.exe (436)
ieetwcollector.exe (4448)
svchost.exe (800)
explorer.exe (3672)
% Weight using resource time as [TimeStamp-Weight,TimeStamp] (Aggregation: Sum)
Process MicrosoftEdgeCP.exe ... icrosoftEdge> (4564)
Time 73.961724089s
% Weight 79.228968375
Press Alt+Space to show more detail
Press Ctrl+Shift+C to copy text
73.961724089s

CPU SAMPLING STACKS



```
repro.etl - Windows Performance Analyzer
File  Trace  Profiles  Window  Help
Graph Explorer   1 Analysis                                                   Details   Analysis Assistant
CPU Usage (Sampled)  Utilization by Process, Stack *

Line # Process              Stack                                                                                   Count   Weight (in vie...
 1     MicrosoftEdgeCP.exe...                                                                                      92,630  82,943.154158
 2                          [Root]                                                                                 83,958  75,157.764372
 3                          |- ntdll.dll!RtlUserThreadStart                                                        83,010  74,338.516206
 4                          |   kernel32.dll!BaseThreadInitThunk                                                   83,010  74,338.516206
 5                          |  |- iertutil.dll!_IsoThreadProc_WrapperToReleaseScope                               79,671  71,348.916611
 6                          |  |   eModel.dll!LCIETab_ThreadProc                                                  79,671  71,348.916611
 7                          |  |   eModel.dll!CTabWindow::_TabWindowThreadProc                                    79,671  71,348.916611
 8                          |  |  |- user32.dll!DispatchMessageWorker                                             79,657  71,336.725009
 9                          |  |  |  |- user32.dll!UserCallWinProcCheckWow                                       79,260  70,991.591655
10                          |  |  |  |  |- urlmon.dll!TransactionWndProc                                         72,657  65,192.643487
11                          |  |  |  |  |  |- urlmon.dll!CTransaction::DispatchReport                            72,654  65,189.733469
12                          |  |  |  |  |  |  |- urlmon.dll!COInetProt::ReportData                              72,629  65,168.461800
13                          |  |  |  |  |  |  |  |- urlmon.dll!CBinding::ReportData                            72,626  65,166.146743
14                          |  |  |  |  |  |  |  |  |- urlmon.dll!CBinding::OnTransNotification                72,625  65,165.159100
15                          |  |  |  |  |  |  |  |  |   urlmon.dll!CBSCHolder::OnDataAvailable                72,625  65,165.159100
16                          |  |  |  |  |  |  |  |  |   edgehtml.dll!CBindingURLBlockFilter::OnDataAvailable  72,625  65,165.159100
17                          |  |  |  |  |  |  |  |  |   edgehtml.dll!CBindingFilter::OnDataAvailable          72,625  65,165.159100
18                          |  |  |  |  |  |  |  |  |   edgehtml.dll!CBindingFilter::OnDataAvailable          72,625  65,165.159100
19                          |  |  |  |  |  |  |  |  |   edgehtml.dll!CBindingFilter::OnDataAvailable          72,625  65,165.159100
20                          |  |  |  |  |  |  |  |  |   edgehtml.dll!CDwnBindData::OnDataAvailable            72,625  65,165.159100
21                          |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CDwnBindData::SignalData              72,624  65,164.159100
22                          |  |  |  |  |  |  |  |  |  |   edgehtml.dll!CDwnBindData::BufferData              72,624  65,164.159100
23                          |  |  |  |  |  |  |  |  |  |   edgehtml.dll!CDwnBindData::ReadFromBind            72,624  65,164.159100
24                          |  |  |  |  |  |  |  |  |  |   edgehtml.dll!CTridentFilterHost::Read              72,624  65,164.159100
25                          |  |  |  |  |  |  |  |  |  |   edgehtml.dll!CBindingXSSFilter::Read               72,624  65,164.159100
26                          |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CBaseXSSFilter::AnalyzeHTTPRequestBeforeRead  72,623  65,163.484675
27                          |  |  |  |  |  |  |  |  |  |  |   edgehtml.dll!CBaseXSSFilter::AnalyzeHTTPRequestHelper     72,623  65,163.484675
28                          |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CBaseXSSFilter::DecideXSS               72,576  65,123.766292
29                          |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CBaseXSSFilter::XSSRulesCheck       72,571  65,119.715180
30                          |  |  |  |  |  |  |  |  |  |  |  |  |   edgehtml.dll!CBaseXSSFilter::BuildXSSSignature  72,571  65,119.715180
31                          |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CBaseXSSFilter::CheckForXSSSignature  72,570  65,119.008121
32                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!ATL::CAtlRegExp<CXSSFilterSBCharTrait>::Match  67,894  61,039.455289
33                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CBaseXSSFilter::AddAttackSignature  1,743  1,589.992914
34                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CUnrecognizedCharsSequence::AppendEquivalentSignatureSequence  966  792.585830
35                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!ATL::CAtlList<char * ptr64,ATL::CElementTraits<char * ptr64> >::Find  820  766.761585
36                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!ATL::CAtlList<unsigned long,ATL::CElementTraits<unsigned long> >::AddTail  303  207.252675
37                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!IsSpecialRegExChars  193  173.512880
38                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!ATL::CSimpleStringT<char,0>::AppendChar  144  113.769119
39                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!CBaseXSSFilter::CheckForXSSSignature<itself>  134  123.712835
40                          |  |  |  |  |  |  |  |  |  |  |  |  |  |  |- edgehtml.dll!ProcessHeapAlloc<0>  119  87.408629

   Start:    0.0019996000s
     End:  140.2651624000s
Duration:  140.2631628000s

Diagnostic Console
```

82.9 seconds of CPU

Bottom of the stack

DIVE DEPEER

- With the repro, after a lot of digging around, we found that the way we were sending large beacons, via a hidden `FORM` submission, was triggering this Edge hang
- But *only* if our server was returning either a:
  - `200 OK` response, or
  - `204 No Content` response that was *missing* a `Content-Length: 0` header.

VALIDATION

We were able to test different fixes across our test matrix (IE 6 - Edge, Chrome, Firefox, Safari, Mobile Safari, Android, Lynx, etc) using Fiddler

CONCLUSION

- When you really need to look at a problem wholistically, system-level tracing is the only way to go
- ETW (or things like DTrace on Mac/Linux) can give you a different perspective, and show you CPU, disk, network, and other system activity occuring during your scenario

LINKS

- mPulse: mpulse.soasta.com
- WebPageTest: webpagetest.org
- tcpdump: tcpdump.org
- Wireshark: wireshark.org
- CloudShark: cloudshark.org

LINKS

- Chrome Trace: chromium.org/developers/how-tos/trace-event-profiling-tool
- Fiddler: telerik.com/fiddler
- Windows Performance Analyzer: go.microsoft.com/fwlink/p/?LinkID=293840
- VirtualBox: virtualbox.org
- TamperMonkey: tampermonkey.net
- NodeJS: nodejs.org
- UIForETW: github.com/google/UIforETW

THANKS!