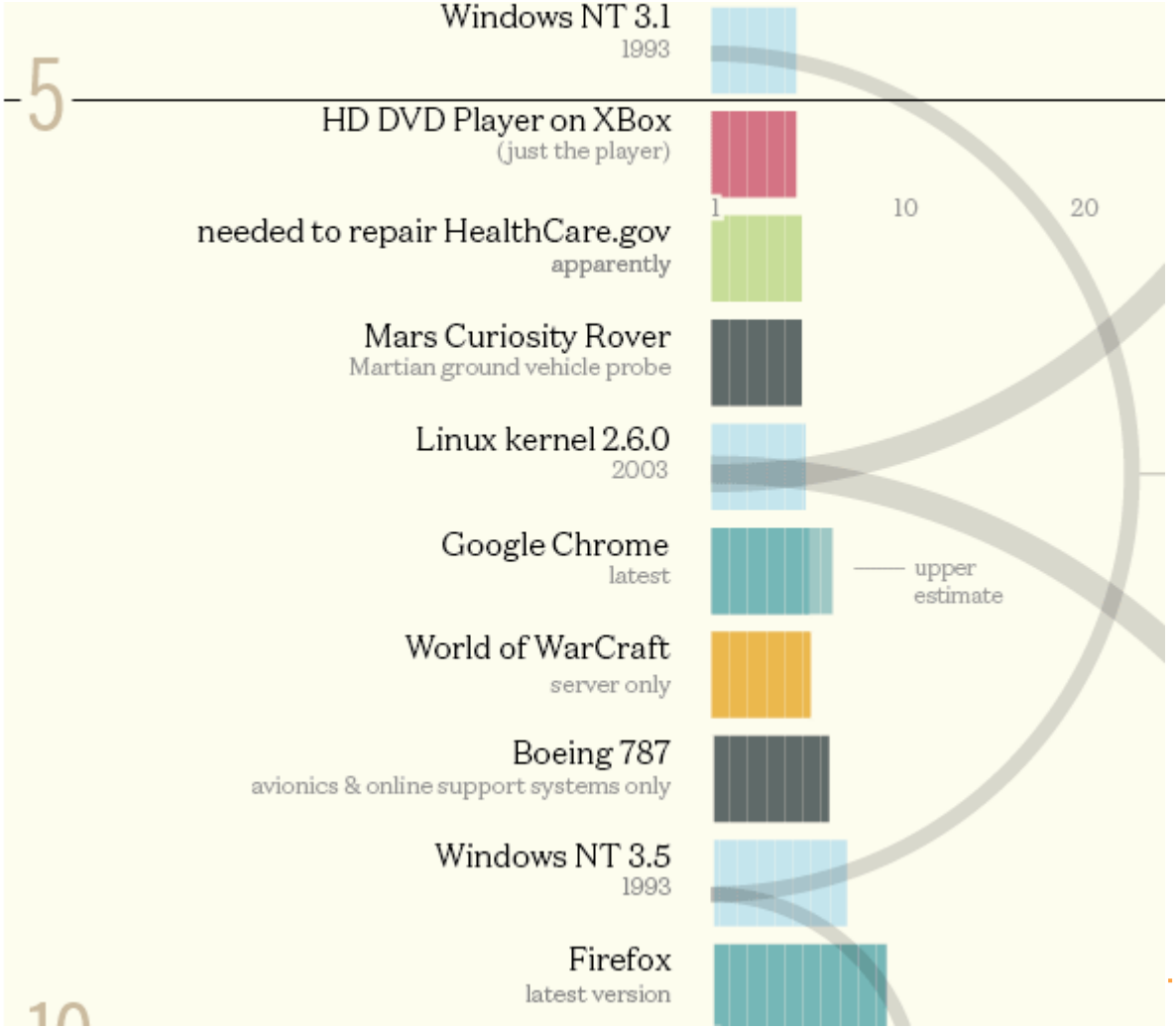
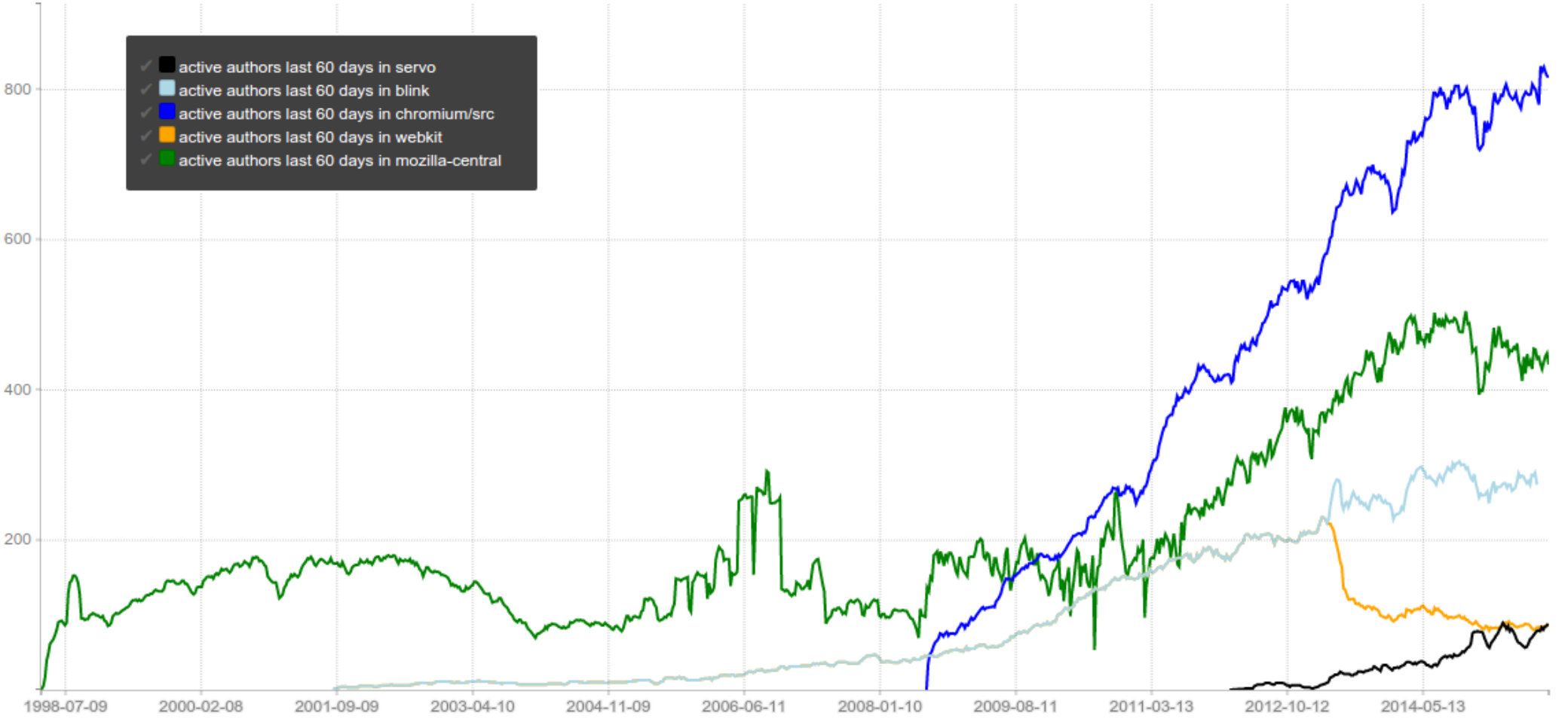
Browser Exploitation (Firefox Rant)

Browser security

Browser code size



Developer Count (2015)



Browser Security

Browsers:

Similar size like an OS

Support a shitload of file formats (PDF, GIF/PNG/JPEG, SVG, ...)

Can “upload” your own code (Javascript) to be executed!

Firefox Rant

Firefox Rant

Rant: Firefox (2016)

Good:

- Full ASLR
- (Except on OSX for 3 years… and nobody noticed)

Bad:

- No Sandbox (yet)
- No 64 bit (yet)
- No process-per-tab (yet)
- No (professional) source code auditing / SDL
- No (professional) fuzzing
- Lots of untrusted, unaudited 3rd party addons, extensions etc.

Firefox Rant

Rant: Firefox (2017)

Good:

- Full ASLR
- (Except on OSX for 3 years… and nobody noticed)

Bad:

- No Sandbox (yet) -> “will be released soon” (since 3 years)
- No 64 bit (yet) -> 64 bit exists, but default is 32 bit
- No process-per-tab (yet) -> “will be released soon”
- No (professional) source code auditing / SDL
- No (professional) fuzzing -> More fuzzing is being done.
- Lots of untrusted, unaudited 3rd party addons, extensions etc.

But: The Firefox rendering engine (Gecko) will be replaced by Servo, written in Rust!

Firefox Rant

Rant: Firefox (2019)

Good:

- Full ASLR
- (Except on OSX for 3 years… and nobody noticed)

Bad:

- No Sandbox (yet) -> **is there?**
- No 64 bit (yet) -> **64 bit default**
- No process-per-tab (yet) -> “will be released soon”
- No (professional) source code auditing / SDL
- No (professional) fuzzing -> More fuzzing is being done.
- Lots of untrusted, unaudited 3rd party addons, extensions etc.

But: The Firefox rendering engine (Gecko) will be replaced by Servo, written in Rust!

Firefox Rant

Rant: Firefox (2022)

Good:

- Full ASLR
- Sandbox is there
- 64 bit default
- Process-per-tab

Bad ?:

- No (professional) source code auditing / SDL
- No (professional) fuzzing -> More fuzzing is being done.
- Lots of untrusted, unaudited 3rd party addons, extensions etc.
- Anti-ROP (CFI, Shadow Stack)?

“Secure” Browser

The history of “secure browsers”

- Waterfox, brave, iridium, pale moon, epic, avg secure browser…
- Some “secure browsers” completely disabled Same-origin-policy, ASLR, DEP etc.
- Making them possibly the most **insecure** browsers

My professional opinion:

- Most secure: Chrome, Edge
- Close: IE11 (?)

- Don’t use: Firefox (sorry), or any other browsers (Safari, IE8/9)
- Really don’t use: Torbrowser
  - Based on Firefox ESR (Long term support)
  - Every Torbrowser version therefore contains dozens, if not hundreds of publicly known exploits
  - Monocolture…

What Is The Most Secure & Private Web Browser For 2019?

Best Secure Browsers that Protect Your Privacy

FEBRUARY 25, 2019 *By* SVEN TAYLOR — 67 COMMENTS

Ranked: Security and privacy for the most popular web browsers in 2019

internet privacy internet security • 15 min read

-> Privacy. Is. Not. Security. <-

Firefox Rant

2014: George Hotz (geohot, wrote first PlayStation 3 and iOS/iPhone Exploits) wrote the first Chromebook Exploit for pwnium. And:

"Before pwnium, I had a few days extra, so I figured, why not try Firefox. Firefox, at least ca 2013, was about on par with a hard CTF problem. It took my 24 hours. 24 hours, full 0-day in Firefox.
A lot of people use this browser. Don't use it. Use Chrome."

USENIX Enigma 2016 - Timeless Debugging

- https://youtu.be/eGl6kpSajag?t=178

Firefox Rant

Even the FBI has Firefox Exploits…

As Ars has reported before, to breach the security normally afforded by Tor, the FBI deployed a "network investigative technique" (NIT). In a related case prosecuted out of New York, an FBI search warrant affidavit described both the pornography available to Playpen's 150,000 members and the NIT's capabilities. As a way to ensnare users, the FBI took control of Playpen and ran it for 13 days in 2015 before shutting it down. During that period, with many users' Tor-enabled digital shields down—revealing their true IP addresses—the government was able to identify and arrest the 135 child porn suspects.

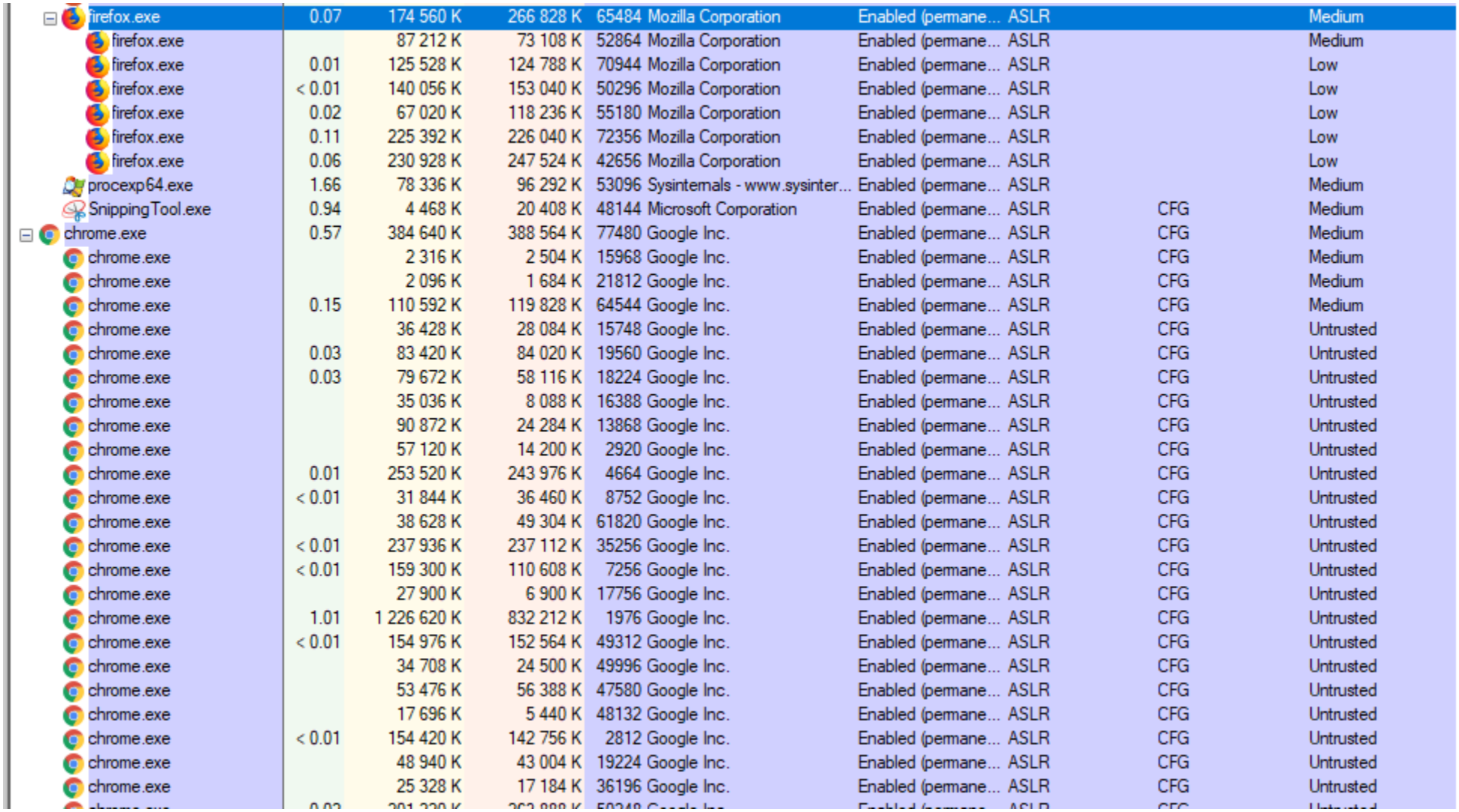
Joshua Yabut, another researcher who also analyzed the code, told Ars it exploits a so-called use-after-free bug that requires JavaScript to be enabled on the vulnerable computer. Yabut went on to say the code is "100% effective for remote code execution on Windows systems." The exploit code, the researcher added, adjusts the memory location of the payload based on the version of Firefox being exploited. The versions span from 41 to 50, with version 45 ESR being the version used by the latest version of the Tor browser. The adjustments are an indication that the people who developed the attack tested it extensively to ensure it worked on multiple releases of Firefox. The exploit makes direct calls to kernel32.dll, a core part of the Windows operating system.

Firefox Rant

Web-browser / Mitigation	MS Internet Explorer 11	Microsoft Edge	Google Chrome	Mozilla Firefox
Sandbox	AppContainer (EPM)	AppContainer	AppContainer	
DEP	X	X	X	X
HEASLR, force relocate	XX	XX	X	ASLR
Dynamic code prohibited		X		
Strict handle checks	X	X	X	
Win32k system calls disabled			X	
Extension points disabled				
Control Flow Guard enabled	X	X		
Signatures restricted		X		
Non-system fonts disabled				
Loading of remote and low IL images disabled		X	X	

Table 9. Comparison of mitigations in web browsers.

Per Origin Tab or not? (2019)

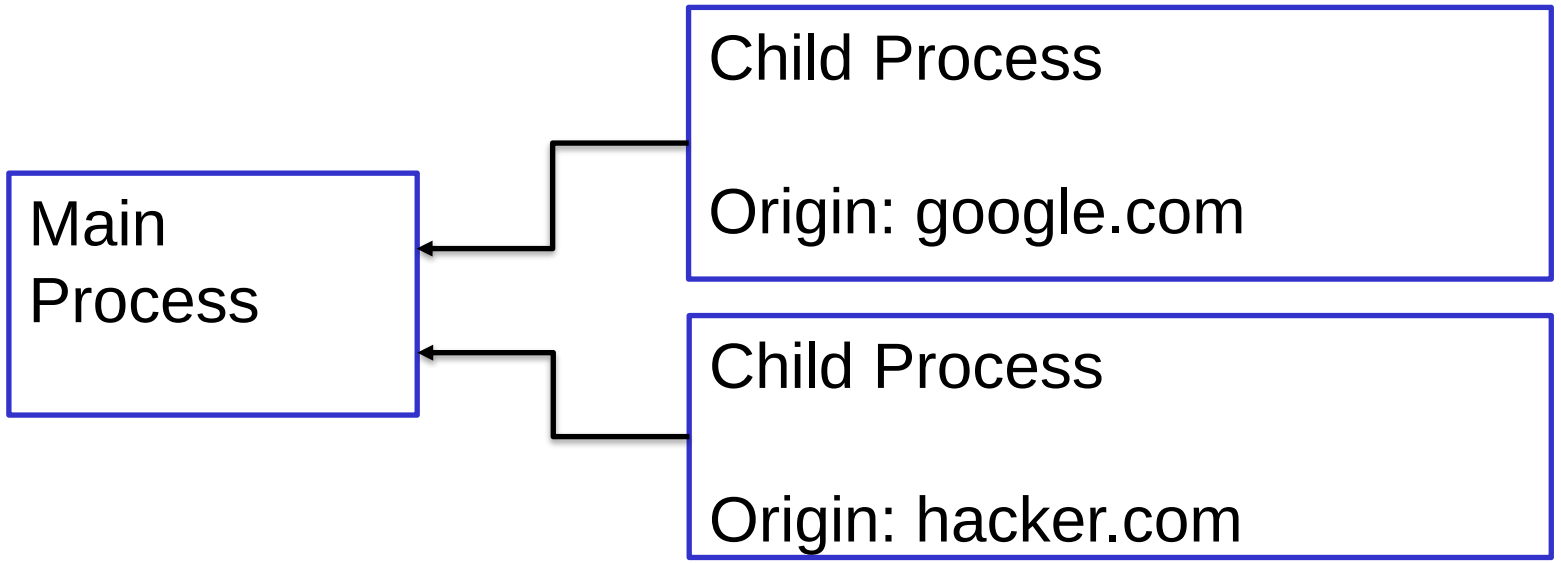


firefox.exe	0.07	174 560 K	266 828 K	65484	Mozilla Corporation	Enabled (permane...	ASLR	Medium
firefox.exe		87 212 K	73 108 K	52864	Mozilla Corporation	Enabled (permane...	ASLR	Medium
firefox.exe	0.01	125 528 K	124 788 K	70944	Mozilla Corporation	Enabled (permane...	ASLR	Low
firefox.exe	< 0.01	140 056 K	153 040 K	50296	Mozilla Corporation	Enabled (permane...	ASLR	Low
firefox.exe	0.02	67 020 K	118 236 K	55180	Mozilla Corporation	Enabled (permane...	ASLR	Low
firefox.exe	0.11	225 392 K	226 040 K	72356	Mozilla Corporation	Enabled (permane...	ASLR	Low
firefox.exe	0.06	230 928 K	247 524 K	42656	Mozilla Corporation	Enabled (permane...	ASLR	Low
procexp64.exe	1.66	78 336 K	96 292 K	53096	Sysinternals - www.sysinter...	Enabled (permane...	ASLR	Medium
SnippingTool.exe	0.94	4 468 K	20 408 K	48144	Microsoft Corporation	Enabled (permane...	ASLR	CFG	Medium
chrome.exe	0.57	384 640 K	388 564 K	77480	Google Inc.	Enabled (permane...	ASLR	CFG	Medium
chrome.exe		2 316 K	2 504 K	15968	Google Inc.	Enabled (permane...	ASLR	CFG	Medium
chrome.exe		2 096 K	1 684 K	21812	Google Inc.	Enabled (permane...	ASLR	CFG	Medium
chrome.exe	0.15	110 592 K	119 828 K	64544	Google Inc.	Enabled (permane...	ASLR	CFG	Medium
chrome.exe		36 428 K	28 084 K	15748	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	0.03	83 420 K	84 020 K	19560	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	0.03	79 672 K	58 116 K	18224	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		35 036 K	8 088 K	16388	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		90 872 K	24 284 K	13868	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		57 120 K	14 200 K	2920	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	0.01	253 520 K	243 976 K	4664	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	< 0.01	31 844 K	36 460 K	8752	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		38 628 K	49 304 K	61820	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	< 0.01	237 936 K	237 112 K	35256	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	< 0.01	159 300 K	110 608 K	7256	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		27 900 K	6 900 K	17756	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	1.01	1 226 620 K	832 212 K	1976	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	< 0.01	154 976 K	152 564 K	49312	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		34 708 K	24 500 K	49996	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		53 476 K	56 388 K	47580	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		17 696 K	5 440 K	48132	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe	< 0.01	154 420 K	142 756 K	2812	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		48 940 K	43 004 K	19224	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted
chrome.exe		25 328 K	17 184 K	36196	Google Inc.	Enabled (permane...	ASLR	CFG	Untrusted

Sandbox

Browser Sandbox?

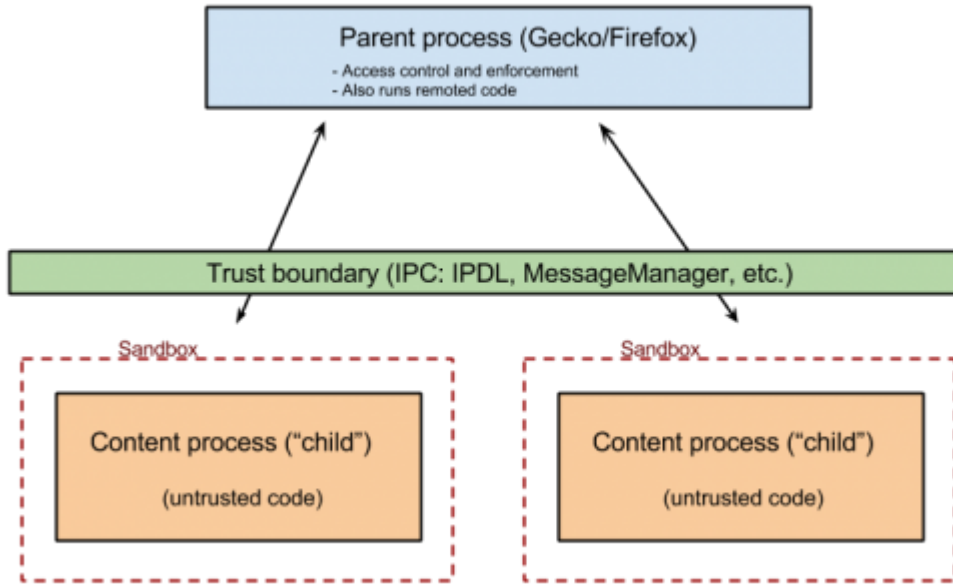
- Isolate "dangerous" code in a separate process, low integrity level
  - Sandbox2, gvisor, nsjail, ...
- Communicate with Main Parent Process (Network, FS, Graphics, ...)
- Child code cannot access filesystem, create processes
  - RCE doesnt give access to anything important



Sandbox?

Current Status

Sandbox	Trunk	Beta		Release	
	Level	Level	Version	Level	Version
Windows (content)	Level 5	Level 5	Fx60	Level 5	Fx60
Windows (compositor)	Level 0 [1]				
Windows (GMP)	enabled	enabled		enabled	
Windows 64bit (NPAPI Plugin)	enabled	enabled		enabled	
OSX (content)	Level 3	Level 3	Fx56	Level 3	Fx56
OSX (GMP)	enabled	enabled		enabled	
OSX (Flash NPAPI)	disabled	disabled		disabled	
Linux (content)	Level 3	Level 3	Fx57	Level 3	Fx57
Linux (GMP)	enabled	enabled		enabled	



	Level 3	Level 4	Level 5
Job Level	JOB_RESTRICTED	JOB_LOCKDOWN	JOB_LOCKDOWN
Access Token Level	USER_LIMITED	USER_LIMITED	USER_LIMITED
Alternate Desktop	no	YES	YES
Alternate Windows Station	no	no	no
Initial Integrity Level	INTEGRITY_LEVEL_LOW	INTEGRITY_LEVEL_LOW	INTEGRITY_LEVEL_LOW
Delayed Integrity Level	INTEGRITY_LEVEL_LOW	INTEGRITY_LEVEL_LOW	INTEGRITY_LEVEL_LOW
Mitigations	MITIGATION_BOTTOM_UP_ASLR MITIGATION_HEAP_TERMINATE MITIGATION_SEHOP MITIGATION_DEP_NO_ATL_THUNK MITIGATION_DEP MITIGATION_EXTENSION_POINT_DISABLE	MITIGATION_BOTTOM_UP_ASLR MITIGATION_HEAP_TERMINATE MITIGATION_SEHOP MITIGATION_DEP_NO_ATL_THUNK MITIGATION_DEP MITIGATION_EXTENSION_POINT_DISABLE MITIGATION_IMAGE_LOAD_NO_REMOTE MITIGATION_IMAGE_LOAD_NO_LOW_LABEL	MITIGATION_BOTTOM_UP_ASLR MITIGATION_HEAP_TERMINATE MITIGATION_SEHOP MITIGATION_DEP_NO_ATL_THUNK MITIGATION_DEP MITIGATION_EXTENSION_POINT_DISABLE MITIGATION_IMAGE_LOAD_NO_REMOTE MITIGATION_IMAGE_LOAD_NO_LOW_LABEL MITIGATION_IMAGE_LOAD_PREFER_SYS32
Delayed Mitigations	MITIGATION_STRICT_HANDLE_CHECKS MITIGATION_DLL_SEARCH_ORDER	MITIGATION_STRICT_HANDLE_CHECKS MITIGATION_DLL_SEARCH_ORDER	

Sandbox?

https://wiki.mozilla.org/Security/Sandbox

Sandbox	Trunk	Beta		Release	
	Level	Level	Version	Level	Version
Windows (content)	Level 6	Level 6	Fx76	Level 6	Fx76
Windows (compositor)	Level 0 [1]				
Windows (GMP)	enabled	enabled		enabled	
Windows (Socket)	Level 1	Level 1	Fx75	Level 1	Fx75
Windows 64bit (NPAPI Plugin)	enabled	enabled		enabled	
OSX (content)	Level 3	Level 3	Fx56	Level 3	Fx56
OSX (GMP)	enabled	enabled		enabled	
OSX (RDD)	enabled	enabled		enabled	
OSX (Socket)	enabled	disabled		disabled	
OSX (Flash NPAPI)	Level 1	Level 1		Level 1	
Linux (content)	Level 4	Level 4	Fx60	Level 4	Fx60
Linux (GMP)	enabled	enabled		enabled	

Chrome / Edge

Chrome, Edge

- CFG: Control flow guard
- ACG: Code cannot be dynamically generated or modified
- CIG: only allow properly signed images to load
- No-child
- Arbitrary code guard: no X pages
- EAF: Export Address Filtering
- IAF: Import Address Filtering
- Force randomization (for ASLR)

https://learn.microsoft.com/en-us/microsoft-365/security/defender-endpoint/exploit-protection-reference
https://blogs.windows.com/msedgedev/2017/02/23/mitigating-arbitrary-native-code-execution/

References

Look Mom, I don’t use Shellcode

- Browser Exploitation Case Study for IE11
- Moritz Jodeit
- EKO12 (Ekoparty Security Conference)
- https://www.youtube.com/watch?v=PbIpd89efX8&index=14&list=PLdgOScViw-omMZQymL2SWKh5BLfMhDijB