Latex Gloves:
Protecting Browser Extensions from Probing and Revelation Attacks

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Browser extensions

- Allows users to modify browser behaviour
  - Block advertisement & tracking scripts
  - Password managers

GHOSTERY

- Written in a combination of JavaScript, HTML and CSS
  - Content scripts
  - Background scripts

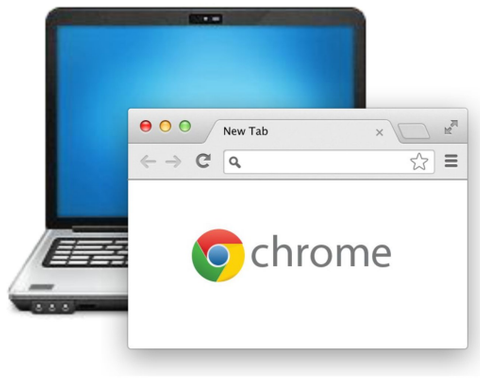
- User grants permissions

- Can inject content
  - One way through “web accessible resources”
  - `chrome-extension://` and `moz-extension://`

Google Cast example

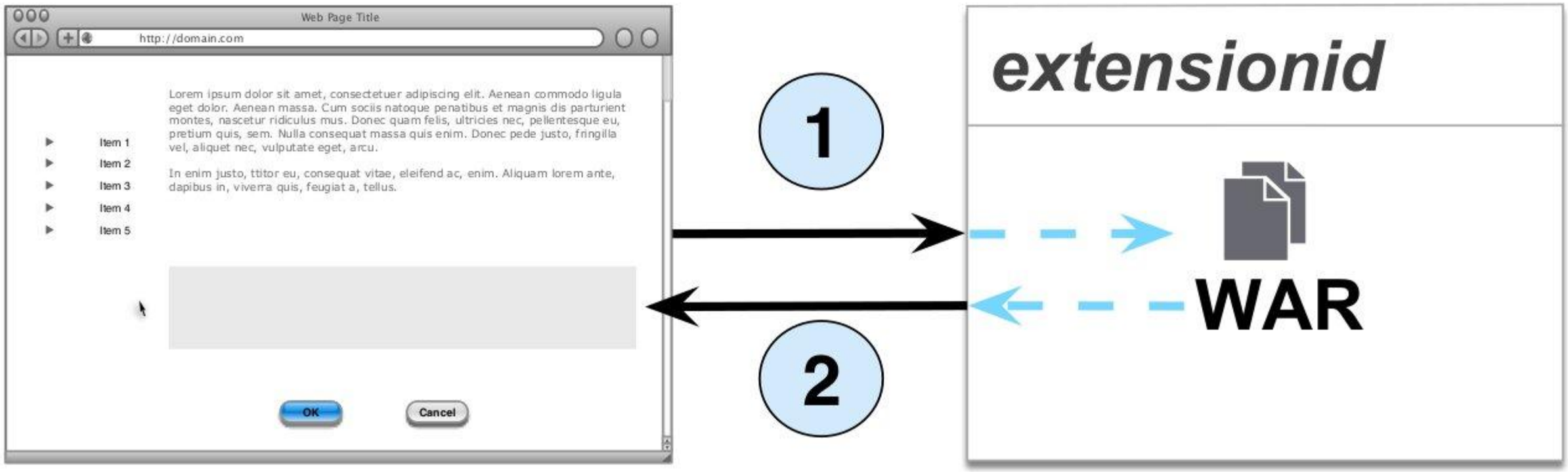
Detect google cast extension

`chrome-extension://boadgeojelhgndaghljhdicfkmllpafd/cast_sender.js`



Discover Chromecast on the network

Probing attack



1) Web page makes request to

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chrome-extension://boadgeojelhgndaghljhdicfkmllpafd/cast_sender.js
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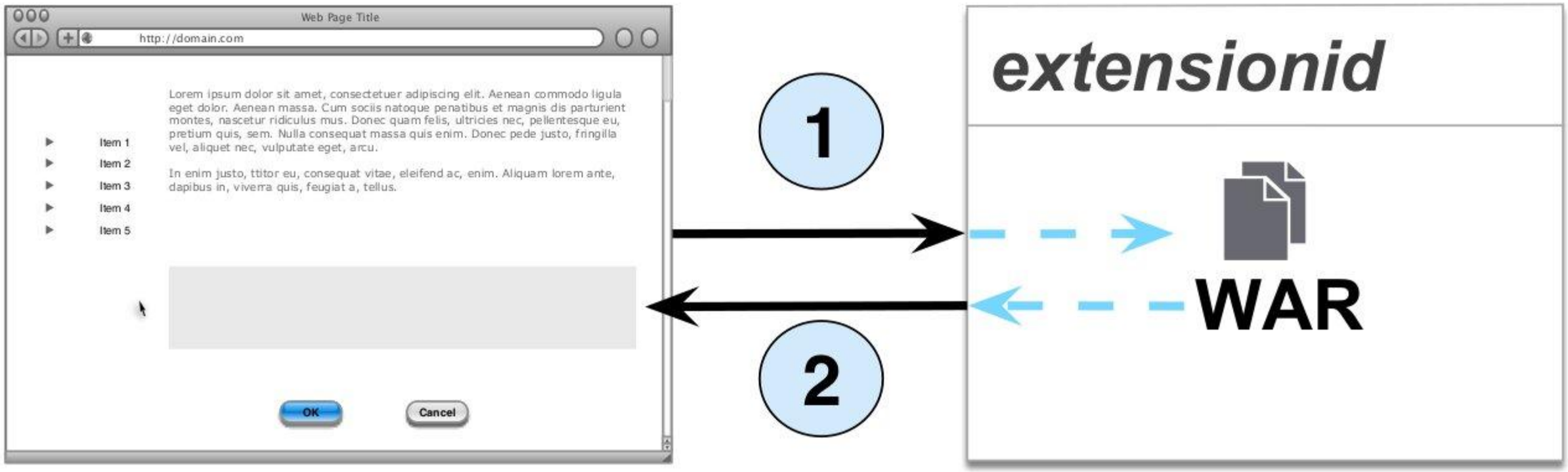
Sjösten et al., CODASPY 2017
Gulyás et al., WPES 2018 (demo web page: https://extensions.inrialpes.fr/)
Sanchez-Rola et al., USENIX 2017

Probing attack



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chrome-extension://boadgeojelhgndaghljhdicfkmllpafd/cast_sender.js
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2) If extension is installed, resource is returned.

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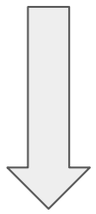
Mozilla’s solution

moz-extension://actual-extension-id/resource.js



Randomized

moz-extension://30bb95e6-4208-4633-ab7b-5623c0b09483/resource.js

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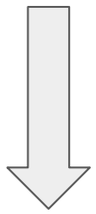

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“*It is randomly generated for every browser instance. This prevents websites from fingerprinting a browser by examining the extensions it has installed.*”

- Mozilla documentation

  https://developer.mozilla.org/en-US/docs/Mozilla/Add-ons/WebExtensions/manifest.json/web_accessible_resources

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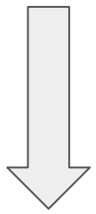

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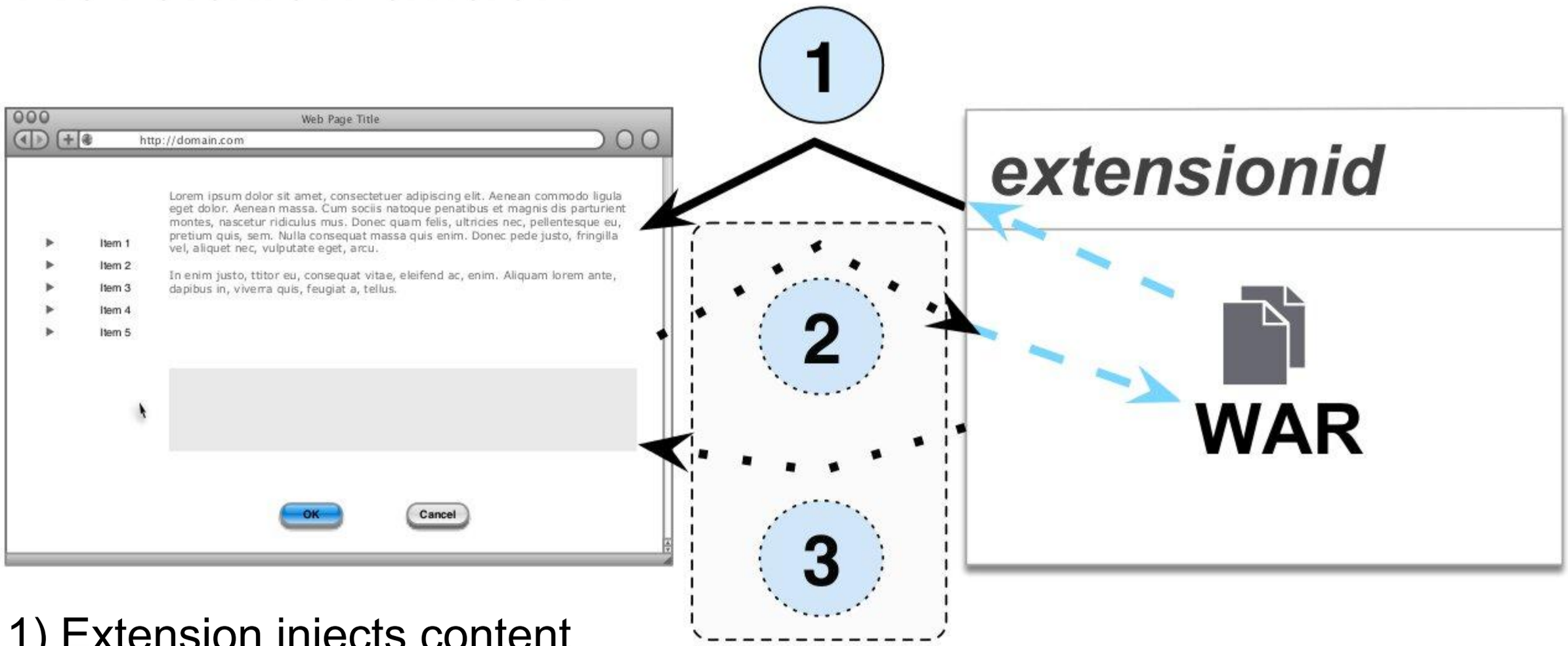
“*This is something we'd like to do when we have the opportunity to make a breaking change.*”

- Chrome developer forum

https://bugs.chromium.org/p/chromium/issues/detail?id=611420#c19

Revelation attack



1) Extension injects content

```
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```
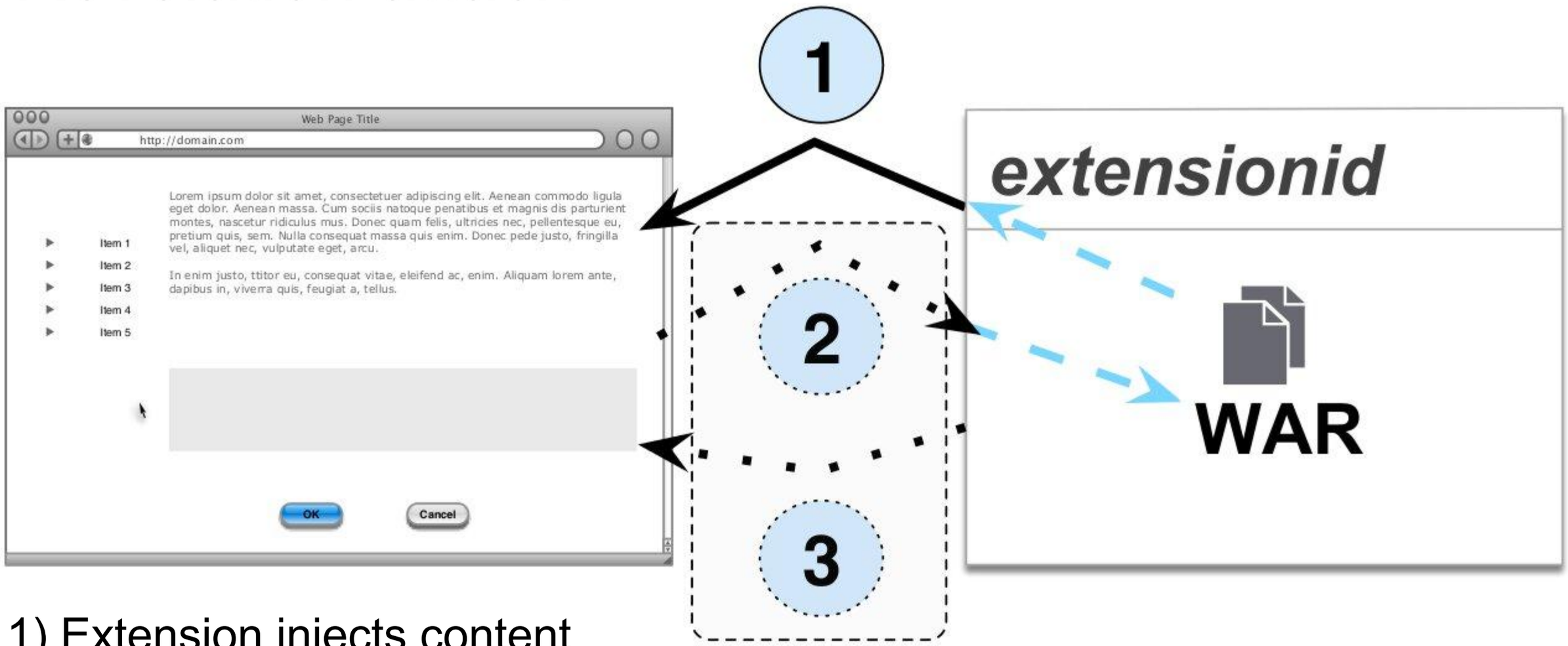

Revelation attack



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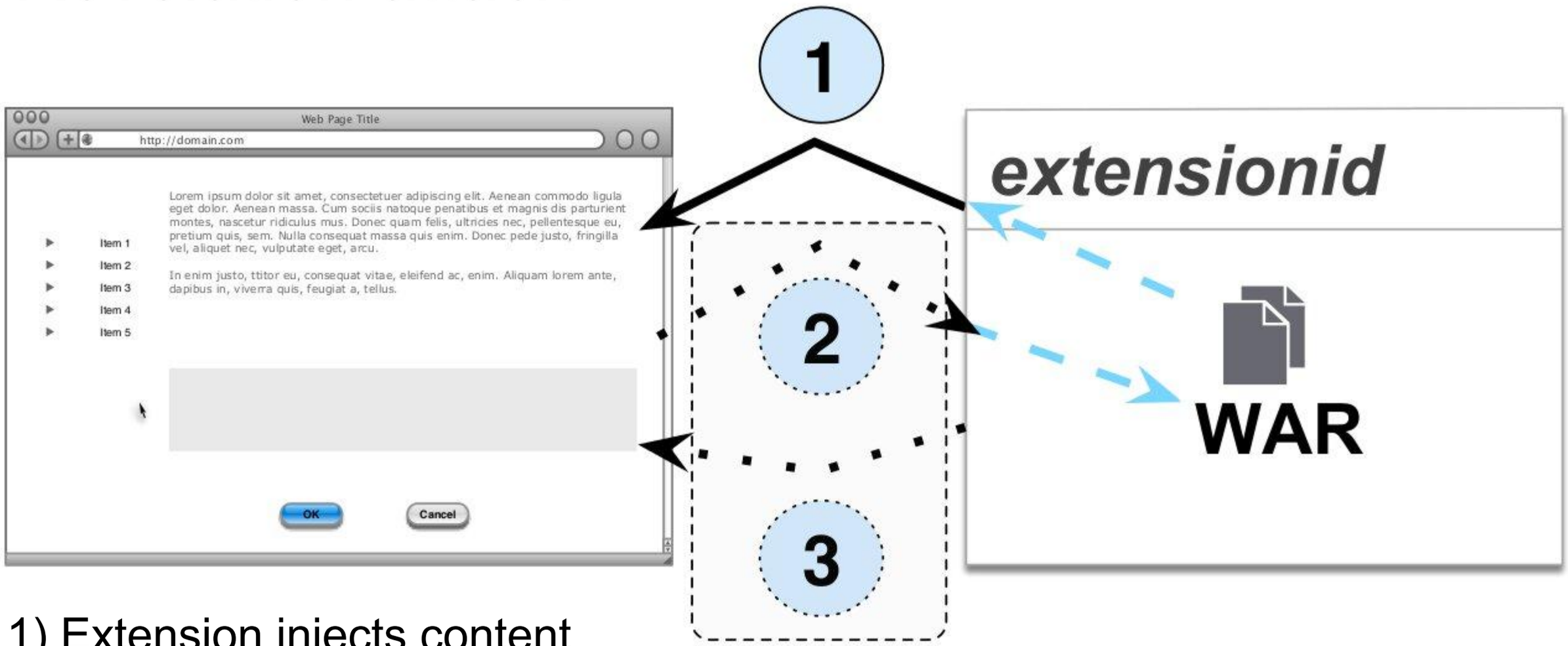
Revelation attack



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Extensions susceptible to revelation attack

- Filter extensions which might inject content
- Check if they have (at least) one unique path to a resource
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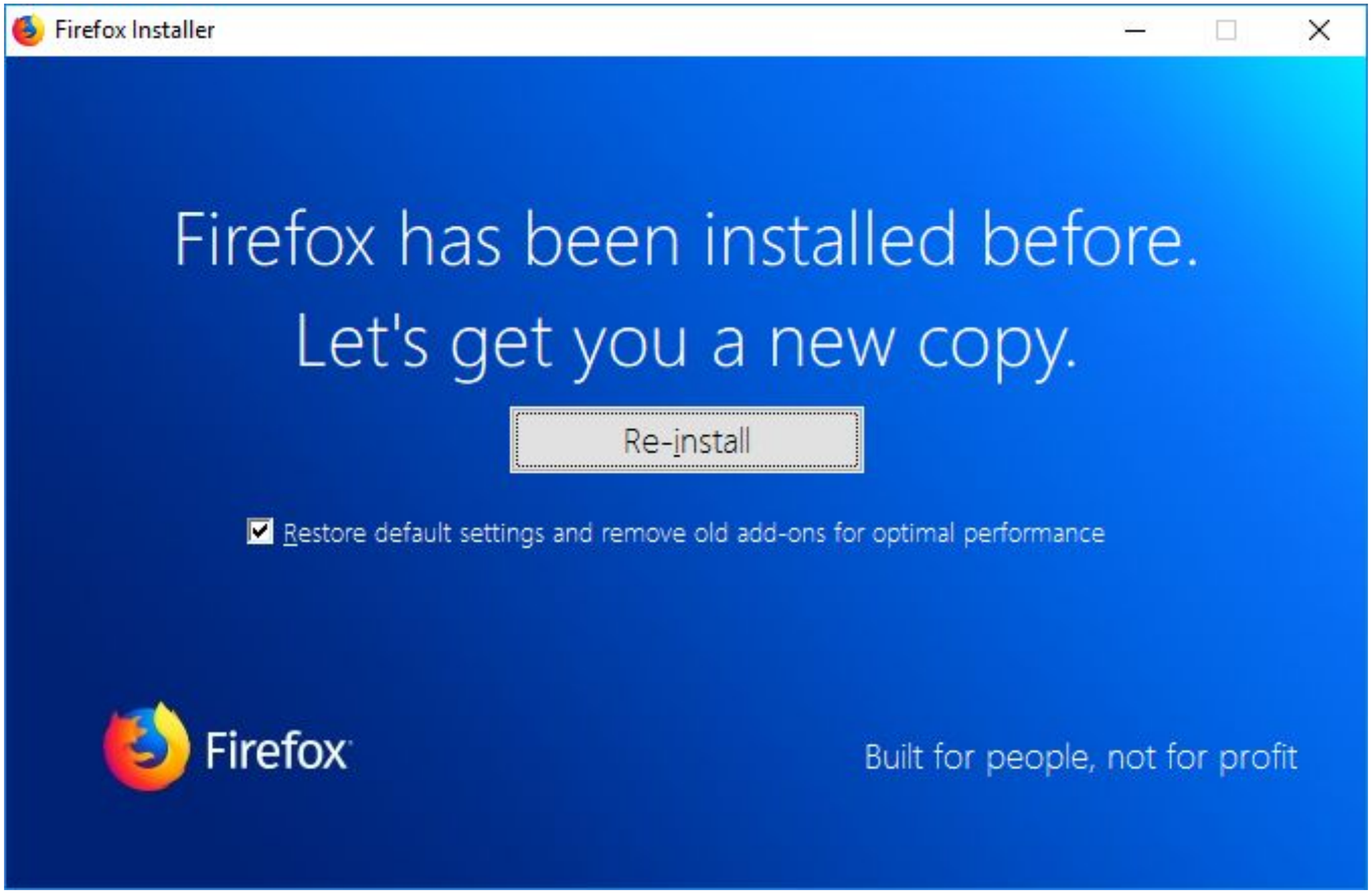
	Extensions total	Susceptible
Firefox	1,378	1,301 (94.41%)
Chrome	11,633	10,459 (89.91%)
Total	13,011	11,760 (90.39%)

How can one reset the random UUID?

		Linux	Mac OSX	Windows
Restarting browser		No		
Updating browser		No		
Re-installing browser		No		Yes
Updating extension		No		
Re-installing extension	w/ browser restart	Yes		
	w/o browser restart	No		
Incognito mode		No		
Clearing cache and cookies		No		
Clearing the profile		Yes		


Firefox Installer
Firefox has been installed before.
Let's get you a new copy.
Re-install
Restore default settings and remove old add-ons for optimal performance
Firefox
Built for people, not for profit

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How many extensions reveal themselves?

```
"exclude_matches": [ "*://*/_/chrome/newtab*" ],
"js": [ "dist/content_script_bundle.js" ],
"matches": [ "http://*/*", "https://*/*" ],
```

How many extensions reveal themselves?

- 3 sets of URLs
  - “real” URLs: derived from the `matches` attribute
  - “attackerhost” URLs: replace hostname with `attacker.invalid`
    `http://www.example.com/abc` ⇒ `http://www.attacker.invalid/abc`
  - “buydns” URLs: for more fine-grained regexps, e.g. `http://*.com/abc`
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- Extract the regular expressions
  - 24,398 unique regular expressions

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- Performed crawling using CommonCrawl database
  - Contains ~4.57 billion URLs
  - For each regular expression: consider only first 100 matching URLs
  - For each extension: take random set of max 1000 URLs

How many extensions reveal themselves?

	Content-dependent		Any content		Total	
Chromium	508	(5,908,381)	2,176	(31,903,741)	2,684	(37,812,122)
Firefox	68	(115,720)	154	(676,318)	222	(792,038)
Either browser	576	(6,024,101)	2,330	(32,580,059)	2,906	(38,604,160)

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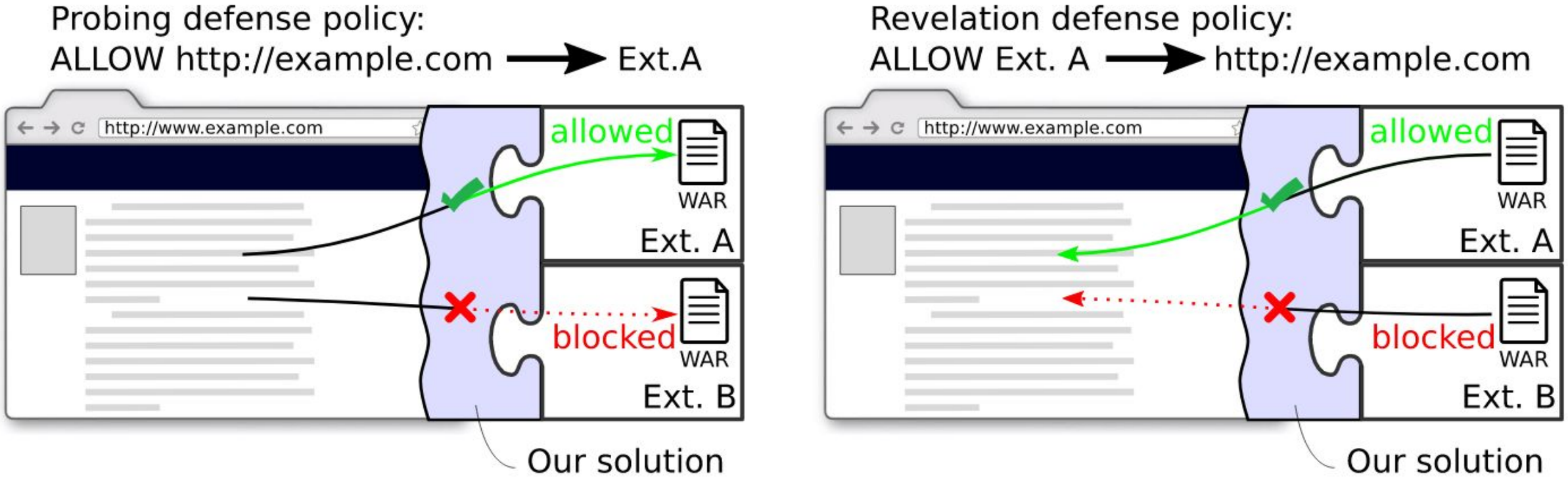
Each of the 792,038 Firefox users are uniquely identifiable

Revealed and susceptible to revelation attack?

	Revealed	Susceptible
Chromium	2,684	2,606 (97.09%)
Firefox	222	216 (97.30%)
Total	2,906	2,822 (97.11%)

Measures: Latex Gloves



(a) Probing defense

(b) Revelation defense

Measures: Latex Gloves

- Blacklists from browser vendors

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- Allow web pages to specify whitelists

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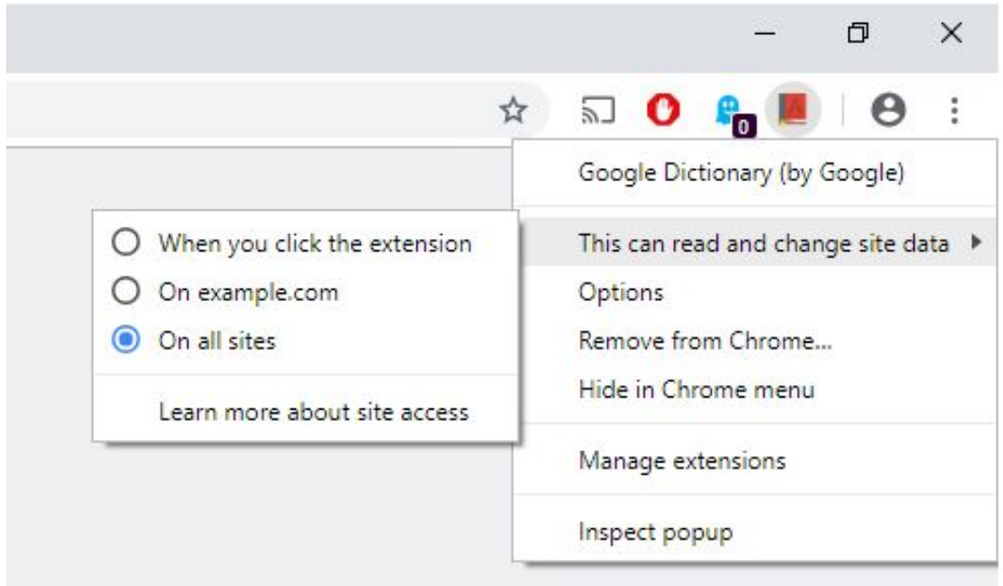
- Blacklists from browser vendors
- Allow web pages to specify whitelists
- Users classify web pages

Sensitive

Insensitive

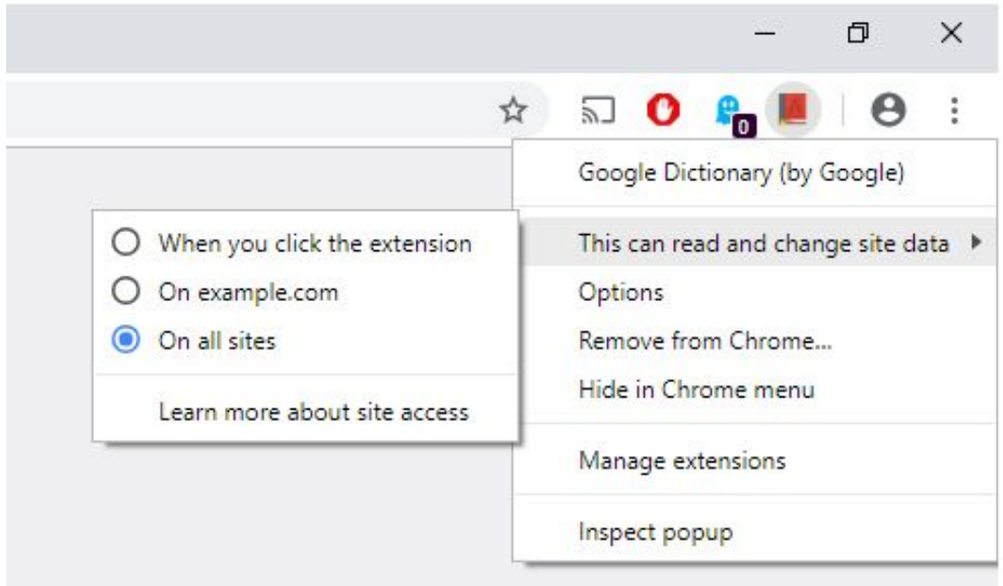
Countermeasures

- Long term
  - Latex Gloves



Countermeasures

- Long term
  - Latex Gloves
- Short term
  - Re-generate the random UUID more often
    - When starting the browser
  - Re-generate the random UUID when entering private browsing mode
  - Randomize the full URL, including the path
    - Helps, but is not perfect...
  - Use data URIs



Thank you!

Questions?