Trends and Lessons from Three Years Fighting Malicious Extensions

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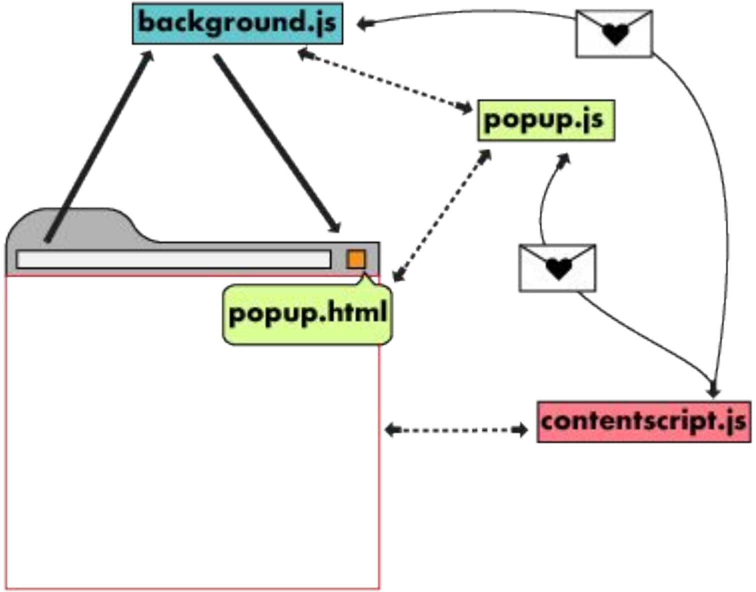
Motivation

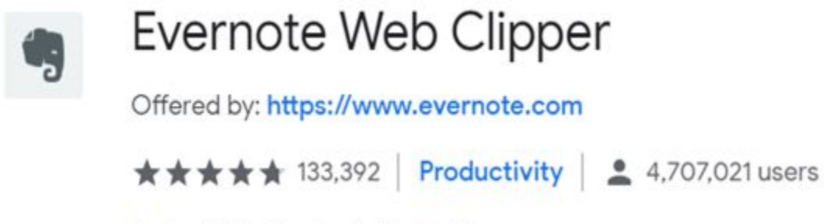
Chrome Extensions – What & Why?

- Small add-ons.
- Enhance browser experience.
- Chrome Extensions - Distributed by Chrome Web Store.



Source: https://developer.chrome.com/extensions/overview

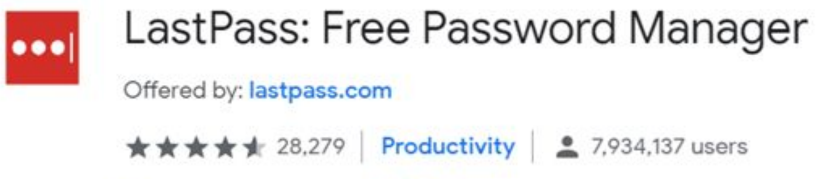
Extensions – Utility



Evernote Web Clipper

Offered by: https://www.evernote.com

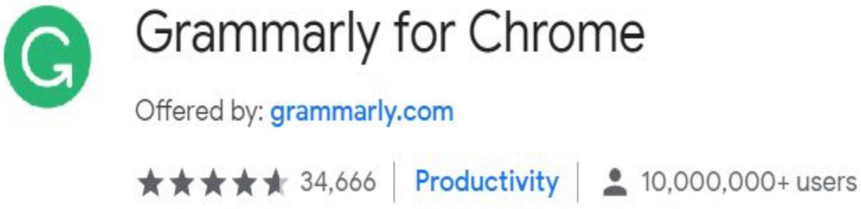
★★★★⯪ 133,392 | Productivity | 4,707,021 users



LastPass: Free Password Manager

Offered by: lastpass.com

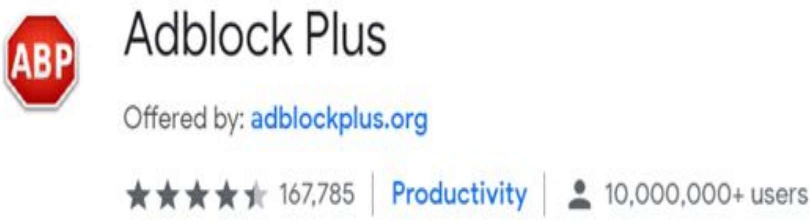
★★★★⯪ 28,279 | Productivity | 7,934,137 users



Grammarly for Chrome

Offered by: grammarly.com

★★★★⯪ 34,666 | Productivity | 10,000,000+ users

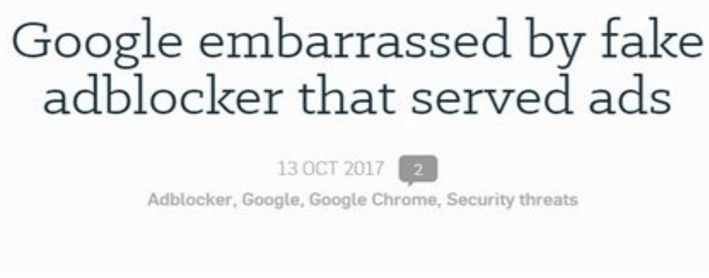


Adblock Plus

Offered by: adblockplus.org

★★★★⯪ 167,785 | Productivity | 10,000,000+ users

While at the same time…



Google embarrassed by fake adblocker that served ads

13 OCT 2017 2

Adblocker, Google, Google Chrome, Security threats

Source: https://nakedsecurity.sophos.com/2017/10/13/google-embarrassed-by-fake-adblocker-that-served-ads/

Goal

- ➢ Block newly submitted malicious extensions before publishing.
- ➢ Take down existing malicious extensions present in the store.

Topics Discussed in this Research Study

Study on roughly 100,000 extensions submitted to Chrome Web Store in between January, 2012 - 2015.

➢ Design & implementation of security framework - WebEval.

➢ Trends of malicious extension in the wild.

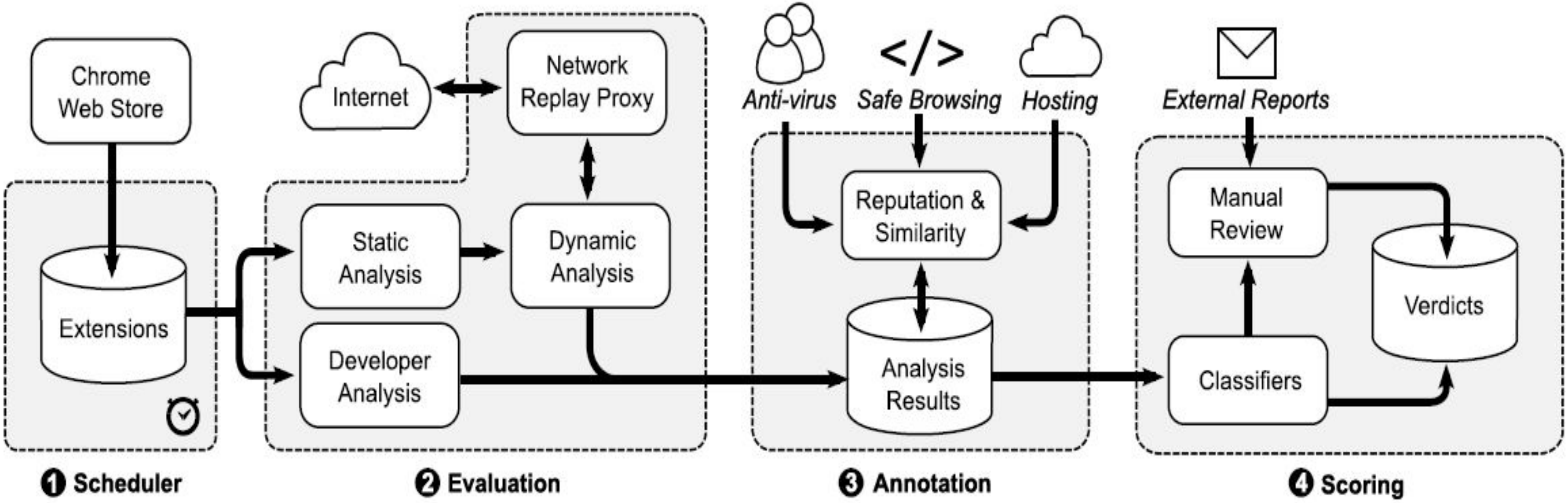
➢ Impact of undetected extensions

WebEval

Design Constraints

1. Minimum malware installs.
2. Simplified human verification.
3. Time – constrained.
4. Comprehensible, historical reports.
5. Tolerant to feature drift.

System Flow


Chrome Web Store
Extensions
Internet
Network Replay Proxy
Static Analysis
Dynamic Analysis
Developer Analysis
Anti-virus
Safe Browsing
Hosting
Reputation & Similarity
Analysis Results
External Reports
Manual Review
Verdicts
Classifiers
❶ Scheduler
❷ Evaluation
❸ Annotation
❹ Scoring

Evaluation - Extension Execution Framework

Static Analysis

- ➢ Permission & content script
- ➢ Code obfuscation
- ➢ Files & directory structure

Dynamic Analysis

- ➢ Behavioral Suites
- ➢ Network events
- ➢ Chrome & DOM API calls

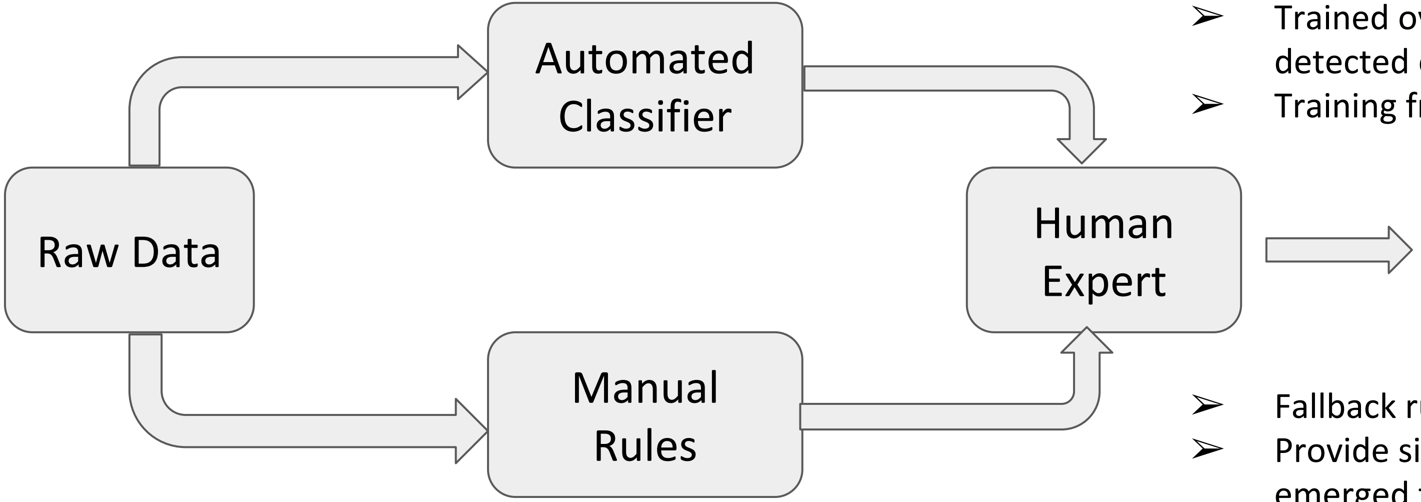
Developer Analysis

- ➢ Developer’s last login
- ➢ Developer’s registered email domain
- ➢ Developer’s age

Extension Analysis

- ➢ Total no. of installs
- ➢ Total no. of users rating the extension
- ➢ Average rating of extension

Scoring Extensions



- ➢ 20 million features
- ➢ Trained over all previously detected extension
- ➢ Training frequency - daily

- ➢ Fallback rules
- ➢ Provide signals for newly emerged threats

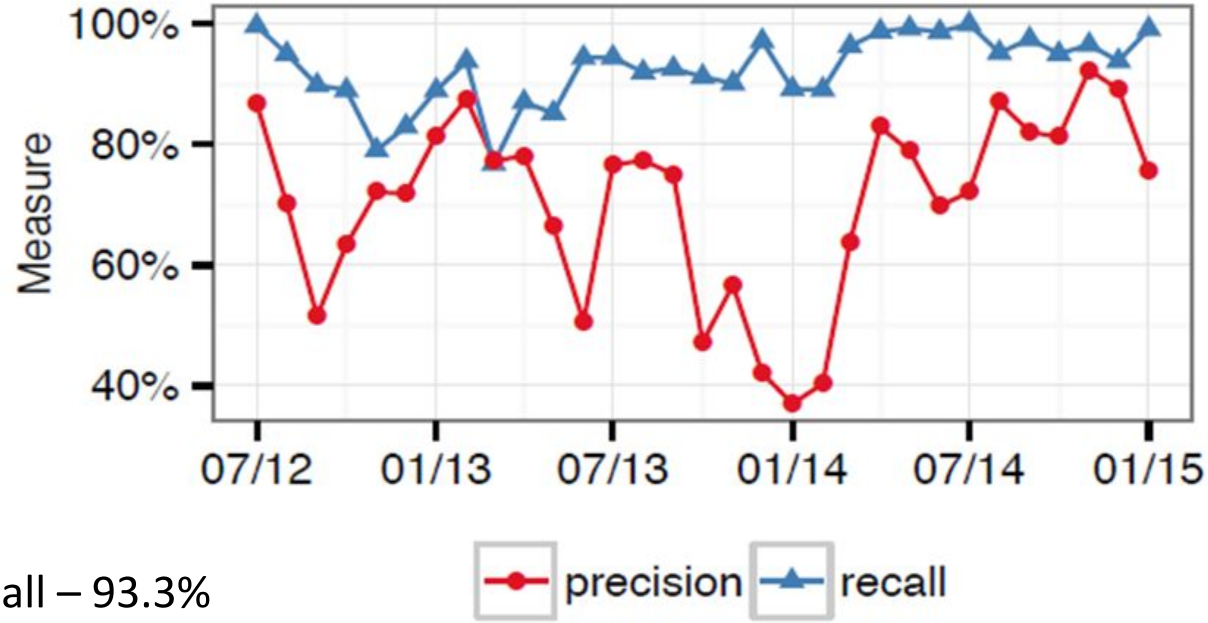
Decision = {Block, Take Down, Good to Go}

Evaluation Dataset

Evaluation Window	January, 2012 - 2015
Total Extensions Reviewed	99,818
Total Malicious Extension Found	9,523 (9.4% of all extensions)
Total Malicious Developers Found	2,339
Total Extensions Manually Reviewed	10,120
Extensions Scan Rate	19,000/day (Approx.)

Source:https://cdn.onlinewebfonts.com/svg/img_510380.png

Accuracy - Precision & Recall



Overall Recall – 93.3%

Overall Precision – 73.7%

Why Human Experts?

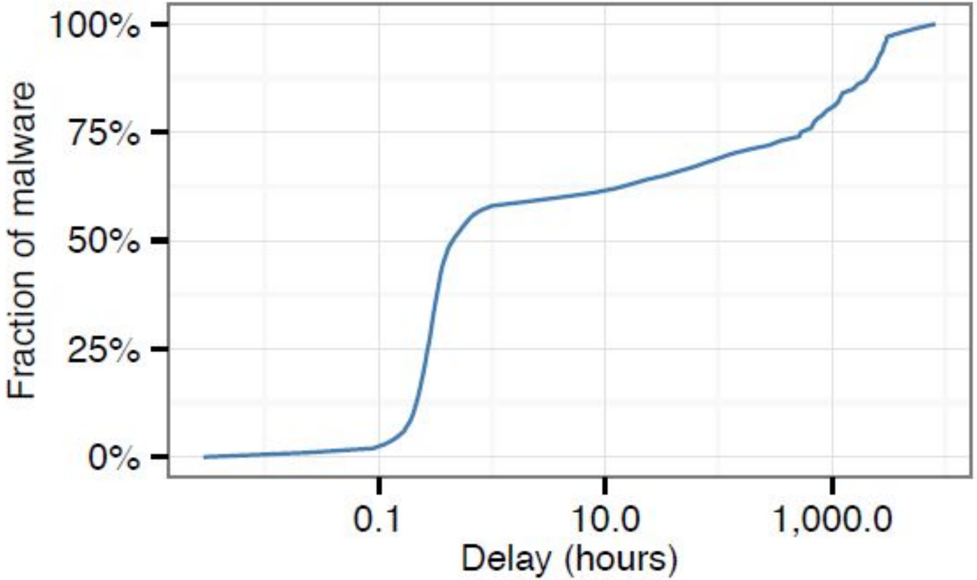
- ➢ Reduce false-positives & false negatives.
- ➢ Adaptation to new threats.
- ➢ Live deployment environment - requires additional check.
- ➢ Time taken to decide - 2.75 minutes per extension.

Key Indicators to Detect Malicious Extensions

- ➢ Modification of CSP headers.
- ➢ Uninstalling other extension.
- ➢ Preventing uninstall of extensions.
- ➢ Chrome & DOM API calls.

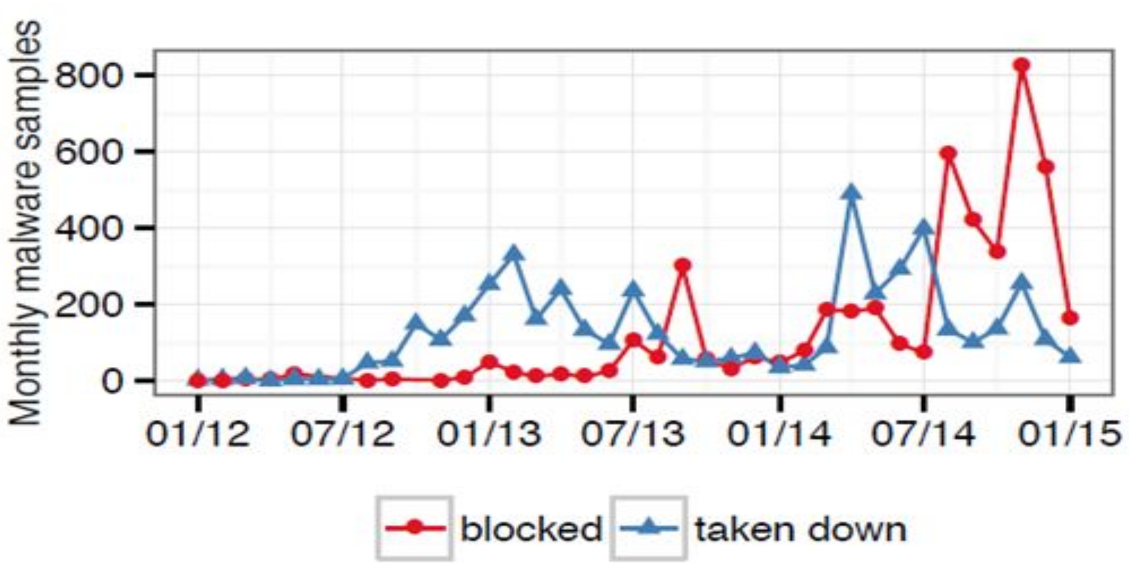
Permissions - not really.

Detection Latency



Median of Detection Frame: 25 Minutes

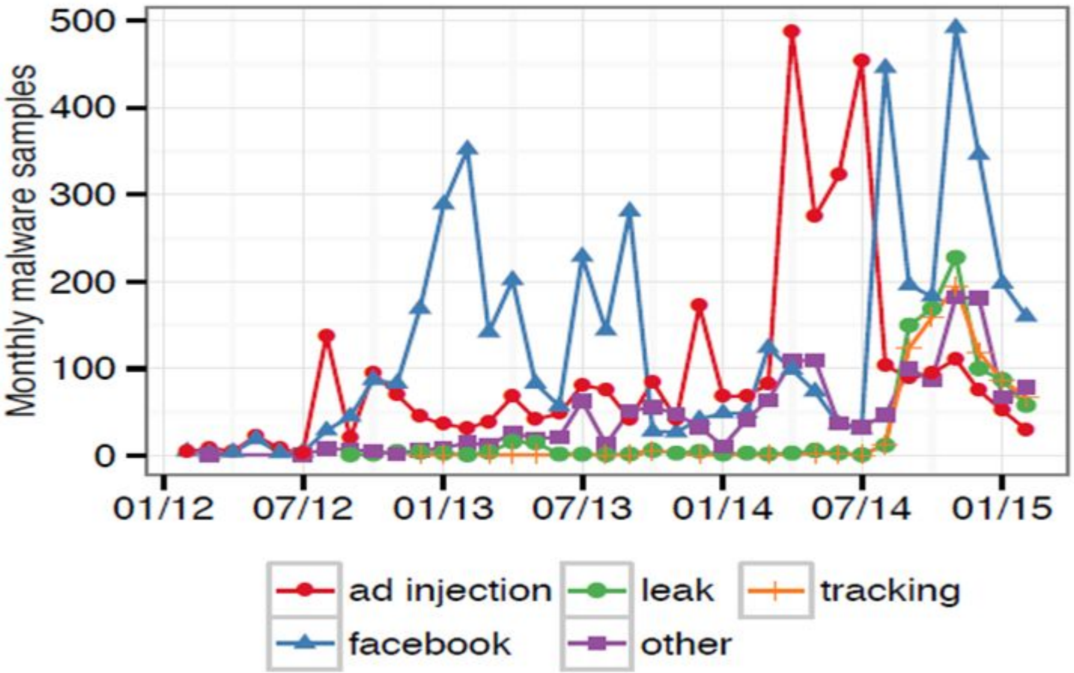
Moving Towards Proactive Approach



Overall Blocked/Taken Down Extensions

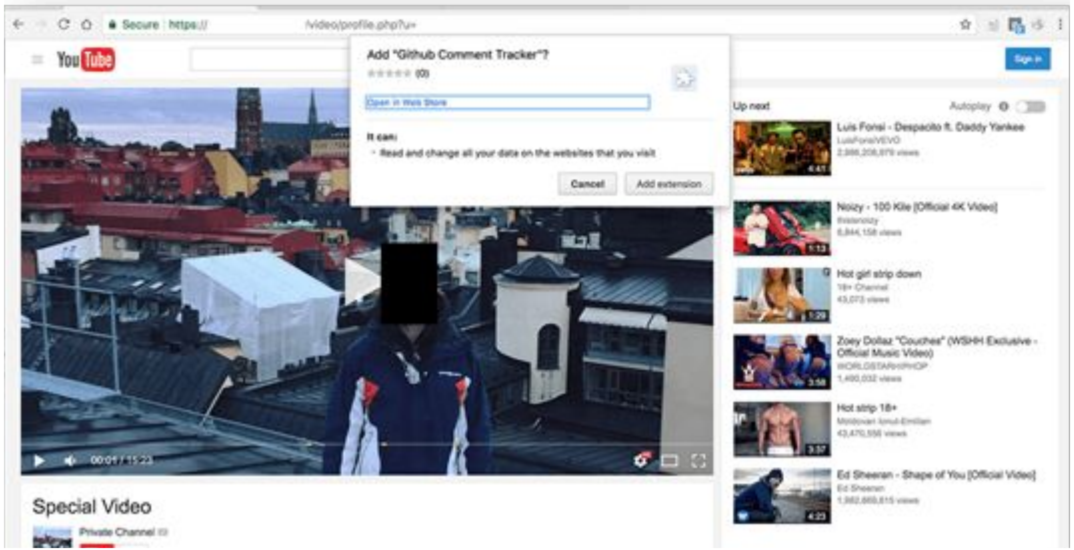
Trends of Extension Abuse

Different Malicious Extensions Detected in the Wild



Prominent Extension Abuses

Facebook session hijacking



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Add "Github Comment Tracker"?

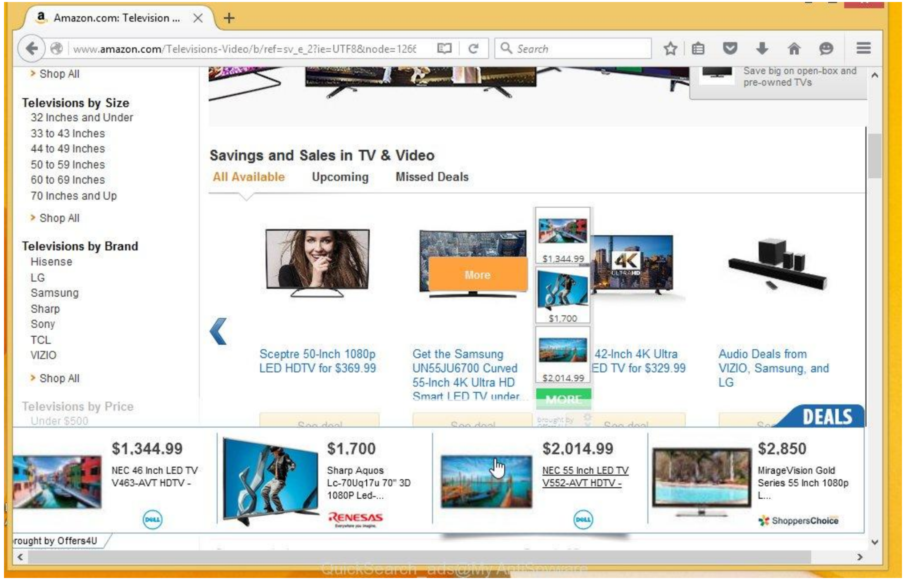
It can:

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

Source:https://media.kasperskycontenthub.com/wp-content/uploads/sites/43/2017/08/07171223/170831-facebook-malware-3.png

Prominent Extension Abuses

Ad injecting extensions


Amazon.com: Television ...
www.amazon.com/Televisions-Video/b/ref=sv_e_2?ie=UTF8&node=126
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Televisions by Size
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33 to 43 Inches
44 to 49 Inches
50 to 59 Inches
60 to 69 Inches
70 Inches and Up
Shop All
Televisions by Brand
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LG
Samsung
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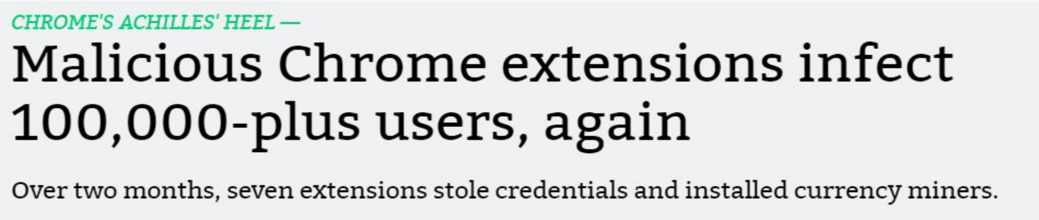
RENESAS
$2,014.99
NEC 55 Inch LED TV V552-AVT HDTV -
$2,850
MirageVision Gold Series 55 Inch 1080p L...
ShoppersChoice
rought by Offers4U
QuickSearch_ads@MyAntiSpyware

Source:http://www.myantispyware.com/wp-content/uploads/2016/02/QuickSearch_ads.jpg

Other Pertinent Threats

- Cryptocurrency miner.
- Banking thefts.
- Search leakage.
- User tracking.



CHROME'S ACHILLES' HEEL —

Malicious Chrome extensions infect 100,000-plus users, again

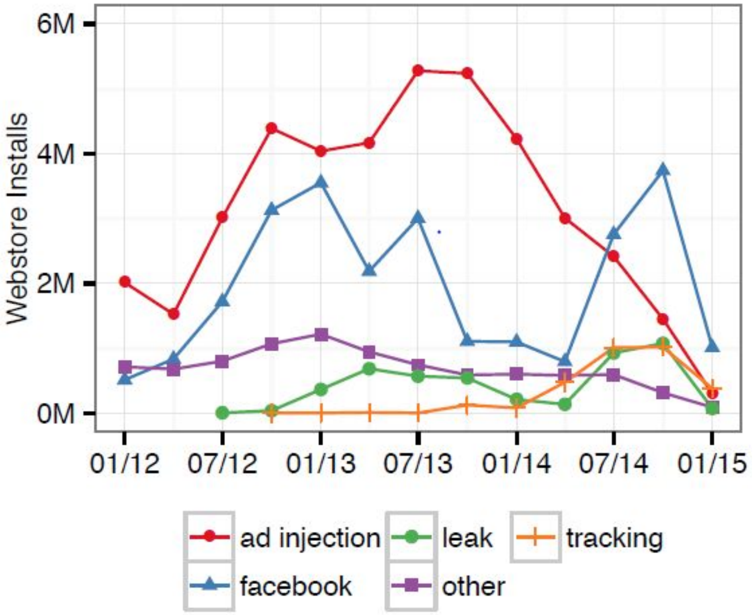
Over two months, seven extensions stole credentials and installed currency miners.

Source:
https://arstechnica.com/information-technology/2018/05/malicious-chrome-extensions-infect-more-than-100000-users-again/

Impact of Malicious Extensions

False - Negatives

- ➢ Approx. 100 extensions - affected 50 million users.
- ➢ Suggestion: Proactive approach.



Lessons Learned

- ➢ Extensive abuse different from malicious binaries.
- ➢ Monetization - driving force.
- ➢ Tools required to handle new, unforeseen threats.

Limitations

- ➢ Testing Extensions in Sandboxed Environment - not favorable.
- ➢ Chrome Lockdown Policy - way to bypass policy exists.
- ➢ Human resources - issue in scaling such systems.

Conclusion

- Identified & reported 96.5% – between January 2012 – 2015.
- 50% extensions – reported within 25 minutes.
- Human experts – integral to framework.
- False-negatives can have drastic impact.
- Evolutionary trends of extension abuse.
- Key challenges while detecting in live deployment environment.

Image Source:
http://www.iconarchive.com/download/i98233/dakirby309/simply-styled/Chrome-Web-Store.ico

Questions?