“Shhh...be quiet!” Reducing the Unwanted Interruptions of Notification Permission Prompts on Chrome


Google LLC

August 11-13, 2021
USENIX Security
Web Push Notifications

Operating systems provide APIs that allow apps to display push notifications as native system notifications.

Chrome, like many other browsers, implements the web Notifications API, which allows websites to send push notifications to users.

* We use the terms “Chrome user” and “Chrome client” interchangeably throughout this presentation.
Best Practices for Web Push Notifications

Permission Requests

- User should show intent before the site asks for permission
- Notifications should be time-sensitive and useful
- Sites should have in-site management controls for notifications
Notifications Permission Prompts on Chrome

**Desktop** (Linux, Mac OS, Windows)
- Anchored bubble UI
- Users can continue browsing the website without having to interact with the prompt

**Mobile** (Android)
- Modal dialog UI
- Users need to interact with the prompt in order to continue browsing the website
Notifications Permission Prompts on Chrome
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Permission prompts

Notifications permission

74%
10% and 21% of all notifications permission prompts are granted on desktop and Android, respectively, over a 28-day period in March 2020.
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Unwanted Notifications Permission Prompts

Permission prompts

Notifications permission

"Unwanted" notification prompts

User is uninterested in receiving notifications from the site

User does not want to be interrupted in general when browsing

Sites that send deceptive notifications (phishing, spam, social engineering, denial-of-service attacks)

10% and 21% of all notifications permission prompts are granted on desktop and Android, respectively, over a 28-day period in March 2020.
This Work

Goal
Reduce unwanted notification permission prompts for the majority of users without significantly impacting those who want to receive them

Contributions
2 large-scale studies of notifications prompt usage in-the-wild
Defined proxy measures of unwanted notification prompts
Designed new “quiet” permission prompt UI
Introduced adaptive activation mechanisms for new UI

Main Result
Significant reduction of unwanted notification prompts (decrease by 31%)
Minimal impact on wanted notification prompts (decrease by < 5%)
Notifications permission prompts in-the-wild
First Experiment

Study goal
Understand how Chrome users interact with the default (or legacy) notifications permission prompts in-the-wild

Dataset
Actions (allow, block, dismiss or ignore) on notification permission prompts from a random sample of Chrome users who opted-in to sharing telemetry with Google

Study ethics
Before conducting any experiment with behavioral data, we obtained approval from key Google stakeholders (legal, UX, privacy, engineering and product)

1. At the time of the experiment, this sample included only users who had enabled the setting “Share usage reports and crash analytics with Google”, signed-in to their Google account in Chrome and enabled the browser “Sync” feature without a custom passphrase. Entries in this dataset are keyed by random Chrome client identifiers and are not associated with the users’ Google accounts. This random identifier can be reset at any time by the user by enabling and disabling the Sync feature.
Methodology and Metrics

Filtering

Limit impact of
- Test Chrome clients/accounts
- Websites with extremely low volume of prompts

Experiment dataset

Metrics

Action rates
- Allow (or grant) rate
- Block (or deny) rate
- Ignore rate
- Dismiss rate

Aggregate metrics

Proxies

Unwanted notification prompts

Block or dismiss a permission prompt
Requires interaction and is explicit

Ignore a permission prompt
Implicit and does not require interaction

Sampled dataset, opted-in users
Results

<table>
<thead>
<tr>
<th>Period</th>
<th>Duration</th>
<th>Actions analysed</th>
<th>URL origins*</th>
<th>Chrome clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2020</td>
<td>10 days</td>
<td>&gt; 800 million</td>
<td>&gt; 70 thousand</td>
<td>&gt; 300 million</td>
</tr>
</tbody>
</table>

80% of desktop (and 70% of Android) clients in our sample never granted any prompts they saw.

Action rates by client percentile

* We use the terms “URL origin” and “site” or “website” interchangeably in this presentation.
Reducing the Interruptiveness of Unwanted Notification Permission Prompts
**Guiding principles**
Reduce number of prompts that users have to act upon
Provide more obvious “escape hatch” if users want to change their choice after they have made it

**Per-site activation mechanism**
Show only the quiet UI on websites that have a very low average grant rate

**Per-user activation mechanisms**
Users can choose to always see the quiet UI by enabling it in the Chrome settings
Adaptive activation heuristic: Enable quiet UI after 3 consecutive “Block” actions

- **Desktop**
  - (a) Variant 1: Animated icon.

- **Android**
  - (c) Variant 3: Info-bar.
Second Experiment - Quiet UIs

Study goal
Evaluate the impact of the quiet UIs on interaction metrics and its effectiveness in reducing unwanted interruptions

Methodology
A/B test where new UIs were disabled for the control groups and enabled for the experiment groups

Results

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<td>March 2020</td>
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<td>&gt; 100 million</td>
<td>&gt; 70 thousand</td>
<td>&gt; 40 million</td>
</tr>
</tbody>
</table>

Quiet UI has minimal impact on grant rates (< 5% lower average grant rate) while significantly reducing unwanted interruptions (31% lower average deny rate)
Conclusion
Conclusion

On Chrome, notification permission prompts represent 74% of all prompts but they are rarely granted
  - Standard prompt UI creates unwanted interruptions
  - → Need to rethink notification permission prompt UI

We conducted 2 large-scale studies
  - Unwanted prompts appear across all types of websites for most users
  - Designed new prompt UIs for the notifications permission in Chrome
    - The activation mechanisms depend on crowd-sourced data and the users’ own past interactions

Analysis showed that new UIs are successful in reducing unwanted interruptions while keeping utility for users who want notifications

Ongoing work
  - Improve the precision of activation mechanisms in cases where the user is unlikely to grant the permission
  - Extend the use of less interrupting UIs to other permission types (e.g., geolocation)
Thank You!

More information
Our paper
https://www.usenix.org/conference/usenixsecurity21/presentation/bilogrevic

Chromium blog post about quieter UIs
https://blog.chromium.org/2020/01/introducing-quieter-permission-ui-for.html

Chrome User Experience Report (action metrics)
https://developers.google.com/web/tools/chrome-user-experience-report

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