Google's Response to Working Paper #1:
The Nature of Competition in Mobile Browsers and Browser Engines

31 July 2024

Introduction & Summary

1. Google welcomes the opportunity to respond to the CMA's Working Paper on the nature of competition in the supply of mobile browsers and browser engines (**WP1**).

2. WP1 describes the range of browsers available to Android users, including Chrome, Samsung Internet, Firefox, Brave, DuckDuckGo, Edge, and Opera, and notes these browsers compete by offering differentiated features and services to users.[1] It cites evidence that Chrome is popular due to its differentiation, and recognises our efforts to continuously find new ways to differentiate.[2] And it acknowledges Chromium—which we develop and make available open source—as a "*common starting point for most browsers on Android.*"[3]

3. We welcome these findings, which demonstrate that Google supports vibrant competition in browsers on Android and other platforms. We are concerned, however, that WP1 overstates the barriers to entry and expansion for browsers on Android and underrates browsers' ability to compete on the merits on the Android platform.

4. That is hard to reconcile with the fact that there are approximately 23 different browsers that are frequently used by UK Android users. More fundamentally, it overlooks the myriad ways in which Android offers browser developers a high level of control, flexibility, autonomy, and opportunity. Many browser developers have built browsers on top of Blink/Chromium, which we make available free of charge, such as Edge, Brave, and Samsung Internet. Browser developers are free to use modified or 'forked' versions of Blink on Android and introduce or remove their own APIs and functionality if they wish to do so.[4] We do not dictate the use of any specific browser engine on Android. They can also use another browser engine,

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1 WP1, ¶2.31.

2 WP1, ¶2.33.

3 WP1, ¶2.7.

4 This choice enables browser developers on Android to differentiate themselves based on security, privacy, and performance, and introduce new innovations to their browsers. *See further* Google's response to Working Paper 2.

such as Gecko, as Firefox and Tor do. On Android, there are no artificial constraints on browsers' ability to differentiate themselves.

5. Likewise, browser developers can distribute and promote their browsers in several ways on the Android platform, through the Play Store, alternative app stores (like Samsung Galaxy), through sideloading, or by negotiating with OEMs and mobile carriers to obtain preinstallation. The Android ecosystem offers browser developers all the tools they need to compete effectively.[5]

6. In this response we focus on the following points:

   - **Section I** explains how we support vibrant competition in browsers, and that WP1's findings on barriers to entry and expansion and vertical integration (at least on Android) are contradicted by evidence.

   - **Section II** sets out how Chrome competes on the merits to increase user awareness and attract users.

   - **Section III** describes how we promote web compatibility, and explains why this is not a meaningful barrier to entry or expansion for browser vendors.

   - **Section IV** sets out our observations on WP1's proposed market definition.

7. Based on the above, we consider that WP1's identification and description of four structural characteristics of the market (those addressed in Sections I-III below) should be substantially revised in relation to Android, and should instead recognise that Android's characteristics promote effective browser competition. To assist the CMA, **Annex 1** to this response summarises our response to each of the structural characteristics of the browser market that WP1 identifies.

8. Our responses to Working Papers 2-5 contain our response to the CMA's emerging thinking on the WebKit restriction, access to functionality, in-app browsers and choice architecture respectively.

I. Google Supports Vibrant Competition in Browsers

9. WP1 fails to consider several features of the browser market that support, rather than hinder, competition. These features include: (i) our committed stewardship of the Blink and Chromium open source projects, which lower barriers to entry for browser developers; (ii) browsers' freedom to compete on Android based on all relevant competitive parameters; (iii) the myriad opportunities rival browsers have

[5] Similarly, we strongly promote competition in in-app browsers (**IABs**). On Android, we allow all browsers to build remote-tab IABs that native app developers can incorporate into their apps so that in-app browsing can use the user's default browser. At the same time, we enable developers to customise their apps' in-app browsing experiences so they can differentiate themselves and compete. We provide further details on IAB competition on Android in our response to Working Paper 4.

to distribute their browsers to UK users; and (iv) OEMs' and mobile carriers' control over the choice architecture of their Android devices. We explain these features in more detail below.

A. Google Supports Browser Development by Providing a Free, Open Source Browser and Browser Engine

10. **The free availability of Chromium and Blink lowers barriers to entry and expansion for browser developers**. Blink is the browser engine Google developed as part of its open source Chromium project. Chromium is an off-the-shelf open source browser that any developer in the world can use for free, with as much or as little modification as they want. WP1 recognises that Chromium is a "*common starting point for most browsers on Android*."[6] It does not, however, fully consider the extent to which the free availability of Chromium and Blink lowers barriers to entry and expansion for smaller browsers (such as Brave) and larger ones (such as Edge). In particular:

- Rather than needing to build a browser from scratch, browser developers on Android (and desktop)[7] can build on and customise Blink and Chromium to create their own browser.

- Developers can take Chromium and Blink and modify them, fork them, and/or build on top of them to suit their users' needs, differentiate, innovate, and compete.

11. Several browser developers (*e.g.*, Edge, Brave, Arc, Opera, Samsung Internet) have used Chromium/Blink to launch browsers with little upfront capital investment or considerably reduced cost. This compares to our investments [*confidential*] in Chrome R&D since its launch, a significant amount of which is reflected in Blink and Chromium, which are available for free to competing browser developers.

12. **There is vibrant browser competition on Android with a number of recent entrants**. In just the past year, a new UK-based browser named Chatloop, which is based on Chromium, launched after raising £2.1 million in seed funding.[8] Browsers are also attracting capital investment, signalling that investors view them as good opportunities. For example, Island, a browser focused on enterprise use cases,

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6 WP1, ¶2.7.

7 Chromium and Blink are not available on iOS or iPadOS due to Apple's WebKit restriction, covered in Working Paper 2.

8 *See* Tech EU, UK's Chatloop raises £2.1M and bags Apple default browser status (4 September 2023).

reportedly raised a total of $285 million between 2022 and 2023.[9] And Arc, focusing on AI features, has reportedly raised a total of $128 million since launching in 2019.[10]

13. **Google is a committed and responsible steward of Blink**. The CMA Board has acknowledged Google's role as a "*committed and responsible steward*" of Blink.[11] Indeed, we are constantly developing Blink in an effort to deliver the most functional browser engine possible, rolling out new innovations continuously. All new features and changes to Blink's APIs are designed and implemented publicly, and browser developers are free to use, modify, and innovate on top of them. This open, non-prescriptive approach means that on Android, browser developers are free to use whatever version of Blink, with or without modifications, or any other browser engine they wish, and are therefore able to differentiate their browsers in all possible respects.

14. **Browser developers on Android have multiple opportunities to contribute to Blink's development**. We use many sources to decide what to prioritise and where to invest in Chromium. For example:

    - We partnered with Mozilla and others in constructing a large survey of developers called the MDN Developer Needs Assessment,[12] and prioritised development work in relation to Blink based on the results.

    - We have worked with partners like Adobe to enable them to solve their most important problems on the web. For example, in May 2022 Adobe announced that they were bringing their flagship product Photoshop to the web as a result of our partnership with them.[13]

15. **We rely on third-party contributions when innovating Blink in an effort to deliver the most functional browser engine possible**. Browser developers can contribute to Blink through various mechanisms and channels. Google stewards these suggestions to ensure that engineering efforts are focused on features that will work and provide benefits to the web ecosystem. We aim to allocate engineering resources in the most efficient way possible, depending on the benefits that the feature may be able to deliver and how widely it can be distributed, as well as the length of time and cost it would take to introduce that feature.

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9 *See* Omdia, On the Radar: Island offers enterprise browser for security and productivity gains (9 February 2023).

10 TechCrunch, The Browser Company raises $50M at a $550M valuation (24 March 2024).

11 CMA Board, Advisory Steer, Mobile browsers and cloud gaming market investigation (22 November 2022), ¶11.

12 MDN Developer Needs Assessment.

13 Photoshop's journey to the web.

16. **Our commitment to open source initiatives is also closely linked to our commercial objective**. Our business is predominantly funded by online advertising.[14] We therefore have every incentive to make the open web ecosystem thrive and provide a great experience where people develop and consume content, use web apps, and see ads. This creates an opportunity for us to make a commercial return. Our investments in Chromium and Blink reflect this commercial incentive. As WP1 recognises, we stated publicly that we "*spur innovation and over time improve the health of the entire open web ecosystem.*"[15] Our commercial objective also incentivises us to keep barriers to entry low and prevent network effects that could "*weaken incentives for smaller vendors to develop or take up features which are not present on the major browsers.*"[16] WP1 contains no meaningful analysis of these incentives.

B. Android Browsers Can Compete on All Competitive Parameters

17. **Browsers on Android can use any browser engine**.[17] As WP1 recognises, browser engines "*play an important role in the user experience of mobile browsers*" given the bearing the browser engine has on a browser's functionality.[18] Like in a car, the engine is a significant component of the overall competitive browser product.

18. On Android, developers have freedom to use any browser engine they want. They can use a third-party alternative, such as Gecko (as Firefox and Tor do), or they can modify an existing browser engine (as Samsung Internet and Edge do). By providing the flexibility to use any browser engine, Android offers maximum scope for browser developers to customise their products.

19. **Android browsers can compete across all relevant competitive parameters**. Given the scope for differentiation Android offers, browsers on Android compete across all relevant parameters including speed, privacy, and functionalities and features.[19] For instance, as WP2 notes, Edge is able to offer features such as Image SuperResolution on Android, but not iOS.[20] Examples of competitive parameters that browsers on Android focus on include:

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14 *See* Alphabet Inc., Form 10-K for fiscal year ended 31 December 2023, p. 11.

15 WP1, ¶2.42.

16 WP1, ¶2.48(b).

17 *See further* Google's Response to Working Paper 2.

18 WP1, ¶2.8.

19 WP1, ¶2.43.

20 WP2, ¶3.20.

- ***Privacy***: Firefox and Brave compete on privacy and position their respective browsers as "*the browser that puts your privacy first*"[21] and "*the browser that puts you first*."[22] Privacy is an active area of innovation and differentiation, with different approaches taken by different browsers in designing privacy features.

- ***Performance***: Opera competes on performance and markets its "*unique technology that compress[es] data with no quality loss, giving users more content for less data usage*."[23]

- ***Speed***: Brave and Samsung Internet also promote the speed of their browsers. Brave claims to be "*the fastest Web browser for your device*"[24] and Samsung Internet is described as "*Simple, Fast and Reliable*."[25]

- ***Productivity***: Sidekick markets itself as "*a productivity browser for focused work*." It claims to speed up users' workflow and to protect them against "*attention killers*."[26]

- ***Enterprise***: Talon, Surf, and Island all promote themselves as enterprise browsers with an emphasis on tools designed for enterprise use such as device visibility and management.[27] In its promotional efforts, Island cites a Gartner report according to which "*[b]y 2030, enterprise browsers will be the core platform for delivering workforce productivity and security*."[28]

- ***AI features***: Edge, for example, markets itself as the "AI-Powered Browser" with multiple AI-powered features that make it "*easier and faster to learn, enjoy, create, and work on the web*."[29] Arc has also focused on its AI-powered features to enhance the user interface and boost productivity.[30]

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21 *See* Firefox, Firefox Browsers.

22 *See* Brave, The Browser that Puts You First.

23 BeHance, Opera.

24 *See* Brave, What's the fastest browser for surfing the Web?

25 *See* Samsung, Samsung Internet.

26 *See* SideKick, A productivity browser for focused work.

27 *See* Island, Designed from the inside out for the enterprise.

28 Gartner, Emerging Tech: Security — The Future of Enterprise Browsers.

29 *See* Microsoft Edge, Your AI-Powered Browser.

30 *See* Arc Max, Boost Your Browsing with AI. Arc is expected to become available on Android later this year.

20. At **Annex 2**, we list the range of innovative features these browsers have launched in recent years. [*Confidential*].

21. **Android's competitive environment leads to a diverse range of browsers competing for users**. It is unsurprising given the competitive environment on Android that UK users turn to a diverse range of browsers to access web content. WP1 does not, however, sufficiently acknowledge the many opportunities for browsers to differentiate on Android and the diversity of browser competition on the platform. Rather, it seems to equate Chrome's popularity with a lack of effective competition. This is not borne out by the evidence. According to our estimates:

- UK users regularly use around 23 different browsers on Android, compared with only 12 on iOS.[31]

- Non-Chrome, non-Safari browsers are used by around 15-20 million UK Android users, vs. only c. 2-3 million iOS users.[32] [*Confidential*].[33]

22. A key weakness in WP1 is therefore its assumption that the competitive conditions and therefore outcomes on both Android and iOS are more or less the same. They are not.

C. Android Developers Have Several Different Opportunities to Distribute and Promote Their Browsers

23. WP1 states that Apple and Google's *"control and use of choice architecture practices (particularly pre-installation and default settings) may increase barriers to entry and expansion, by restricting the ability of rival browsers to compete effectively*."[34] As we explain further in response to WP5, evidence contradicts this position with respect to Android. In summary:

24. **Browsers on Android can be downloaded via app stores or directly from the web**. Android offers multiple app stores (*e.g.*, Samsung's Galaxy Store and Google Play), and users regularly download browsers in this way. In addition, browsers can be downloaded directly from the internet (sideloaded). On Android, third-party browsers have been downloaded 21 million times in the UK since 2017. This negates any suggestion that users do not make an active choice of their browser.

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31 Browsers with positive Weekly Active Users (WAU) over 2023-2024Q1, data.ai.

32 Based on WAU and MAU 2023 data for non-Chrome, non-Safari browsers from data.ai. Figures do not exclude double counting of users (*e.g.*, if the same user accessed Firefox and Brave in the same week, they would be counted as two individual WAUs of third-party browsers).

33 *See also* WP1, ¶2.42, which explains that iOS and Android "*each power roughly half of active smartphones in the UK*."

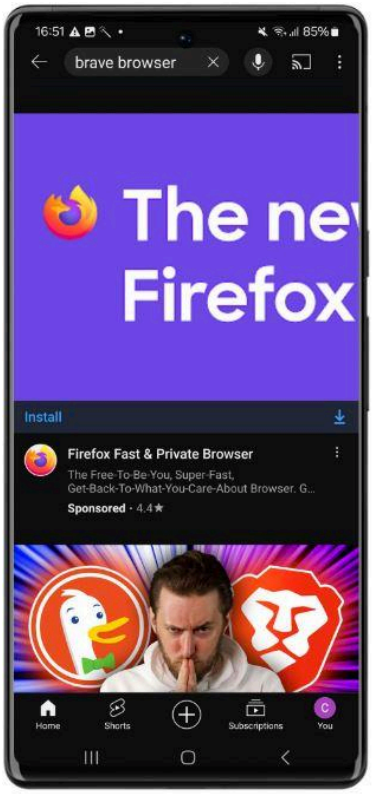
34 WP1, ¶2.58(d).

25. **Android developers have several options to promote their browsers to expand brand awareness, downloads, and reach**. For example, browsers on Android can:

- Be preinstalled and set as default out of the box. This includes both OEMs' browsers (e.g., Samsung Internet, which is preinstalled and set as default on over half of UK Android mobile devices) and other browsers that can enter into agreements with OEMs and mobile carriers to take advantage of those opportunities. For example, [*confidential*].[35] WP1 states that "*mobile devices using the Android operating system generally come with Google's Chrome pre-installed and set as the default*."[36] That is wrong. Over 50% of UK Android devices in fact come with more than one browser preinstalled, and have a browser other than Chrome set as default out of the box.

- Promote themselves to users via marketing channels like app store search results, online search ads, and in popular apps like Facebook, Instagram, YouTube, and Reddit.

Firefox Advertisement on YouTube, in Response to Query for Brave



- Market themselves to users outside the mobile environment using standard media channels, to enhance their brand awareness in the UK. This includes the likes of billboard, TV, and radio advertising. Browsers like DuckDuckGo

35 [*confidential*].

36 WP1, ¶2.59(a); and also WP5, ¶5.3.

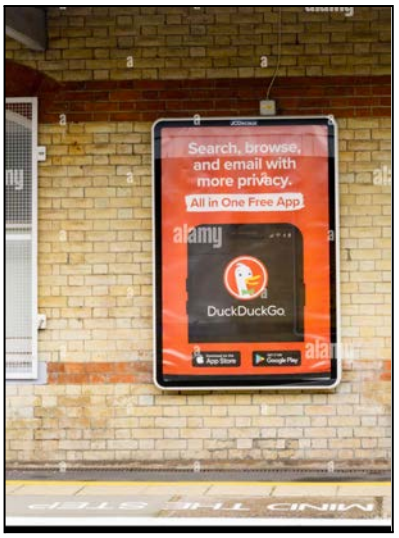
have expanded their brand awareness in this way. Despite its popularity, Chrome continues to compete fiercely with rival browsers and has therefore launched similar marketing efforts (*e.g.*, the 'No place like Chrome' campaign, [*confidential*]).

DuckDuckGo, Ecosia, and Chrome Have Targeted UK Users Using Traditional Media Advertising, Including BillBoards, TV Adverts, and the London Underground

Source: CargoCreative.co.uk

Source: YouTube

Source: JCDecaux

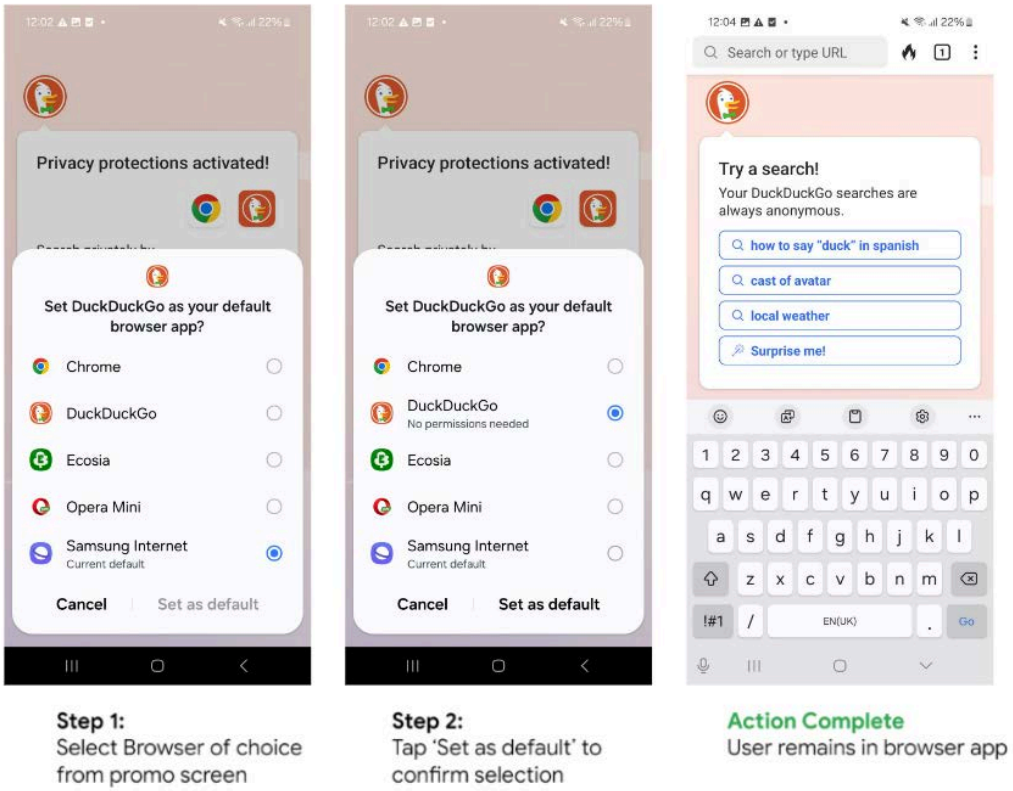


Source: alamy

Source: [livingword]

26. **Once downloaded, on Android browsers can prompt users to easily switch defaults.** Android browsers can use prompts, including the Android default switching API, to encourage users to set them as default. This tool allows users to switch default browsers without leaving the app they are in, as the below screenshots demonstrate.

Android Allows Browsers to Prompt Users to Switch Defaults Easily



27. Users are aware of these prompts to switch browsers and their options when browsing the web. Summarising the result of the Verian research, WP1 recognises

that "*respondents felt that there is adequate choice of browsers available to them*."[37] The research finds this to be the case "*even if this choice has not been presented to [respondents] at any point*."[38] But as the evidence above shows, Android developers have—and in fact use—several different opportunities to distribute and promote their browsers.

28. In addition, Android users in the UK are shown a browser choice screen the first time they use Play, prompting them to download alternative browsers if they wish to do so. This choice screen was introduced following an agreement reached with the European Commission after their *Android* decision. The Working Papers ignore this fact.

D. OEMs and Mobile Carriers Retain Control Over Android's Choice Architecture

29. WP1 states that "*Apple and Google are similarly active across all layers of the supply chain*."[39] It finds, as a result, a "*risk that Apple and Google may give preferential access to their own products*."[40]

30. This does not reflect reality for Google, and overlooks the important ways in which the Android ecosystem operates. As explained above, OEMs and mobile carriers retain control over preinstallation and default settings for browsers and other apps on their Android devices. Google has to compete for Chrome to be preinstalled and/or prominently promoted by OEMs and mobile carriers. Samsung, for example, preinstalls Samsung Internet on all of its Android devices, which represent 60% of UK Android device shipments. Android OEMs similarly retain full control over the implementation of default settings on their devices and how users may switch default browsers.

II. Chrome Competes on the Merits to Attract Users

31. WP1 suggests that Chrome's rivals may be held back by barriers to entry and indirect network effects. This concern seems to be based, in large part, on the fact that Chrome is popular with users. But the concern is misplaced: users choose Chrome because they see it as the best browser, not because they have insufficient options or are not able to exercise effective choices. The CMA's own customer research supports this. Moreover, as explained above, there are no meaningful barriers to entry or indirect network effects on Android.

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37 WP1, ¶2.16(f).

38 WP1, ¶2.16(f).

39 WP1, ¶2.34.

40 WP1, ¶2.57.

32. **Chrome continually invests in innovative new features**. We continuously work hard to be successful with users. [*Confidential*]. This investment results in new user-facing and security features that make Chrome a more attractive browser across platforms. Accordingly, WP1 comments that "*we have seen evidence … that [Google] considers Chrome to have achieved its leading market position through differentiation. We have also seen evidence that Google is looking to increase differentiation.*"[41] Recent examples of such features include the following (*see* **Annex 2** for more examples):

- ***Improved "suggested translation" feature***, which allows users to translate a webpage. In June 2022, Google improved this feature by launching an updated language identification model to determine the language of the webpage and decide whether it needs translation to match user preference.[42]

- ***Chrome Actions*** converts commands in the search bar into clickable shortcuts and enables users to modify settings or use Chrome features. For example, typing "manage passwords" into the search bar can trigger a button that opens the passwords page in Settings.[43] This feature was launched in 2020.[44] Recent updates to Chrome Actions on mobile introduce place-related shortcuts to let users quickly do things like call a business, get direction, or read reviews.[45]

- ***Help me write*** is a Gemini-based feature that helps users write content online, launched in February 2024. For example, it can help users submit a restaurant review or inquire about a hotel reservation.[46]

- ***Updates to Password Checkup***, which allows users to find out if passwords in their Google Account may have been exposed, are weak, or are used in multiple accounts.[47] The feature was updated in June 2023.[48]

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41 WP1, ¶2.34.

42 *See* Google Blog, 5 new features for Chrome on iOS.

43 *See* Google Chrome Help, Use Chrome Actions to quickly complete tasks.

44 *See Google Chrome Help,* Introducing Chrome Actions, a new way to navigate and take action right from Chrome's address bar.

45 *See* Google Blog, 5 new Chrome features to help you search on mobile.

46 *See* Google Blog, Chrome's new AI feature can help you write on the web.

47 *See* Google Chrome Help, Change unsafe passwords in your Google Account.

48 *See* Google Blog, 5 new features to easily manage your passwords in Chrome.

- ***Safety Check***, which provides proactive notifications to alert users of any security-related information that needs their attention. This feature was updated in December 2023.[49]

- ***Tab Organizer*** is an AI-powered feature that can suggest and create tab groups based on your open tabs. This addresses the user pain point of tab management and was launched in February 2024.[50]

- ***Performance Controls*** enable users to optimise Chrome performance to their preferences. Memory Saver frees up memory from tabs that aren't active so the current tab runs more smoothly. Energy Saver maximises battery life by limiting background activity and visual effects. Both were released in December 2022.[51]

- ***Price tracking*** lets users opt in to receive a notification if there is a price drop for an item available for purchase online. This feature was announced for Chrome on desktop and Android in December 2022.[52]

33. **Chrome invests in improved speed and performance**. We continuously improve Chrome's speed and performance. The CMA has previously recognised that "*many browser vendors ranked Chrome as the fastest browser.*"[53] In 2023, for example, we made improvements to Chromium's efficiency that resulted in a "*10% increase in Apple's Speedometer 2.1 browser benchmark over the course of three months.*"[54] One of these improvements was also copied by Apple into WebKit, allowing users on iOS to benefit from it.[55] This showcases Google's goal to "*create a better web experience for all web users.*"[56]

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49 *See* Google Blog, A more personalized and proactive Safety Check.

50 *See* Google Blog, Chrome is getting 3 new generative AI features

51 *See* Google Blog, New Chrome features to save battery and make browsing smoother.

52 *See* Google Blog, New ways Chrome makes holiday shopping online easier.

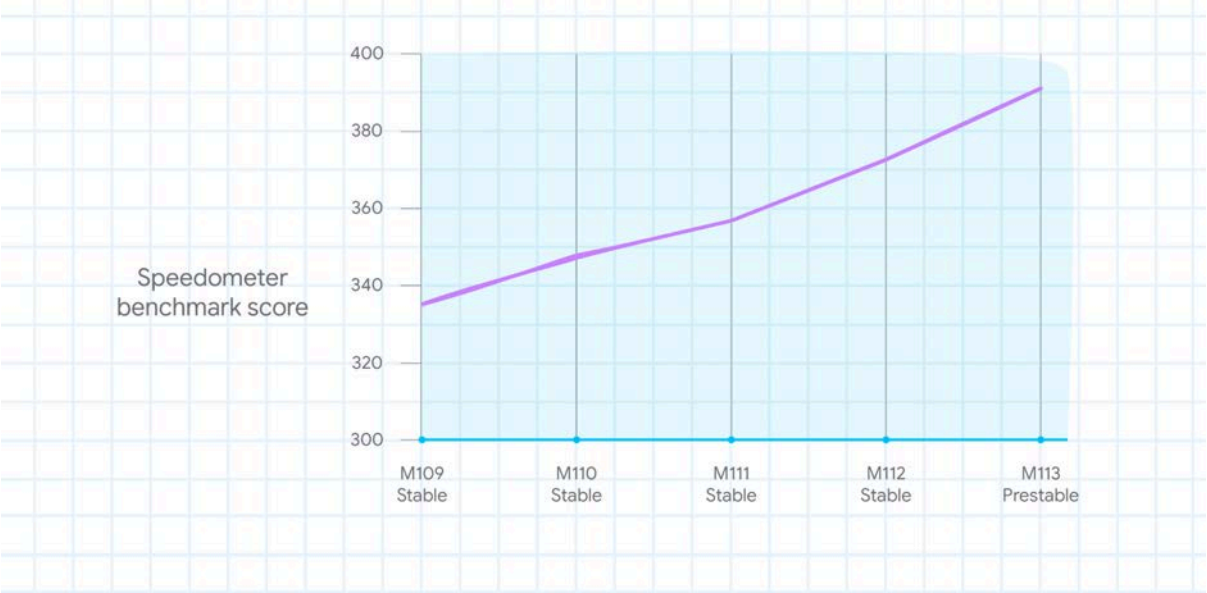
53 *See* the CMA's Mobile Ecosystems Final Report, ¶5.38.

54 *See* Chromium Blog, More ways we're making Chrome faster (13 April 2023).

55 *See* WebKit GitHub, Introduce fast path for innerHTML (11 February 2023).

56 *See* Chromium Blog, More ways we're making Chrome faster (13 April 2023).

Recent Improvements to Chromium's Speed, Increasing Speed By 10% Over Three Months



Source: Chromium Blog

34. **Chrome's superior performance, quality, and security is responsible for its success with UK users**. Contrary to the statement in WP1 (¶2.59(a)), Chrome is not generally set as default out-of-the-box on Android phones. The majority of Android devices in the UK come with another browser (*e.g.*, Samsung Internet) set as default. Instead, users choose to switch to Chrome due to its quality, ease of use, cross-platform compatibility, and features. [*Confidential*].[57] Chrome's superior performance, quality, and security as the main driver of its success with UK users is made evident when one looks at the outcome on Windows: despite Edge being the exclusively preinstalled and default browser on all Windows devices, Chrome has a 69% share on Windows.[58] [*Confidential*].

35. **The CMA's consumer research survey supports that Chrome attracts users based on superior quality**. For example:

- 63% of Chrome users on Android expressed a preference for Chrome, with only 5% saying they used it because they did not know there were other options.[59]

- 72% of Pixel users in the survey said they did not change default because the default (Chrome) was their preferred browser.

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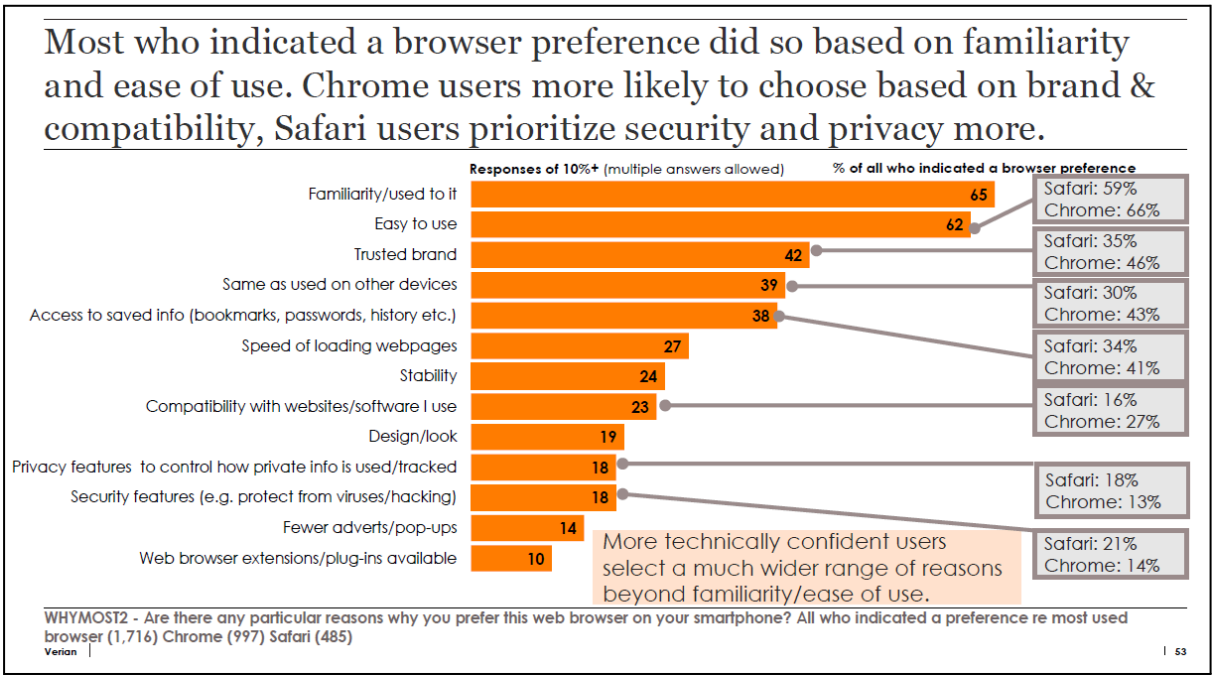
57 [*Confidential*].

58 Cloudflare Radar, Browser Market Share Report for 2024 Q1.

59 Verian Quantitative Consumer Research, slide 51.

- Over half of UK iOS users have installed Chrome on their devices.[60] Users that download Chrome are motivated by their familiarity with Chrome, ease of use, and their use of Chrome on another device.[61]

The CMA's Research Confirms That Users Choose Chrome Based on Familiarity and Ease of Use



Source: Verian Quantitative Consumer Research, slide 53.

36. This aligns with a survey commissioned by the Australian Competition and Consumer Commission ("**ACCC**") which found that most users who preferred Chrome did so based on factors such as ease of use, speed, and privacy features, rather than the fact that it was preinstalled on their devices.[62]

37. **The results of the CMA's consumer research survey show that Android users are aware of and actively engage with mobile browsers**. The evidence does not support the suggestion in WP1 that "*end users of mobile devices appear to have low levels of awareness and engagement with mobile browsers.*"[63] As we explain in further detail in our response to WP5, Android users can and do download alternative browsers when they want to use alternative browsers. Android users

60 WP5, ¶3.17; Verian Quantitative Consumer Research, slide 40.

61 WP1, ¶4.18.

62 Roy Morgan, Final Report: Consumer views and use of web browsers and search engines, prepared for the Australian Competition & Consumer Commission Digital Platform Services Inquiry Third Interim Report (September 2021), p. 44 (hereinafter "**ACCC Consumer Study**").

63 WP1, ¶2.59.

also understand that they can easily download alternative browsers to those that are preinstalled. The fact that many users have not chosen to download third-party browsers on Android does not indicate low user awareness or lack of engagement. Users actively choose Chrome based on its quality and superiority.

III. Google Promotes Compatibility Across the Web Ecosystem

38. **We are committed to and encourage web standards to ensure compatibility between browsers and browser engines**. WP1 expresses concerns that web compatibility issues give rise to indirect network effects, which "*give[s] large incumbent players an advantage*" by raising "*intrinsic*" barriers to entry.[64] While acknowledging that web standards bring benefits, WP1 considers that "*they are voluntary and may not fully solve compatibility issues.*"[65] Evidence, however, demonstrates our commitment to strong compatibility across the web ecosystem, which results in low barriers to entry and competition on Android, including for smaller browser vendors. The importance we place on web compatibility is also recognised in our internal documents.[66] According to WP1, they demonstrate our "*attempts at helping [...] web compatibility*."[67] In particular:

- ***Blink is open source with a vibrant developer community.*** Blink is an open source browser engine, which means that its development is operated according to publicly-available participation guidelines. That also means any developer in the world can use our open source browser engine and our off-the-shelf browser, Chromium, for free. They can modify these tools as much or as little as they want. Or they can use completely different tools instead. The choice is theirs. In practice, when other browsers use these tools, they contribute improvements, which make the tools better for everyone. Broad compatibility is at the core of this process.

- ***Blink maintains an open and transparent process for incorporating new features and functionalities***. We are transparent about the bar for deploying new features and how developed these need to be before they can be shipped.[68] We welcome contributions to Blink from across the ecosystem. This includes channels through which participants can contribute to ongoing discussions, technical discussion groups dedicated to the discussion of specific areas of the codebase, and the Blink channel on Chromium.slack.com, which facilitates quick, informal discussions. Issues can be reported via the public issues tracker at crbug.org, and Blink follows

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64 WP1, ¶¶2.48 and 2.58(a).

65 WP1, ¶2.53.

66 WP1, ¶2.50.

67 WP1, ¶2.50.

68 The Chromium Projects, Launching Features.

all standard Chromium practices, including those on contributing code and becoming a contributor.

- ***We have made significant investments in other browser engines***. Via Igalia, we have made significant investments to improve the compatibility of browsers based on Gecko and WebKit. Google spent [*confidential*] in 2022 and [*confidential*] in 2023 [*confidential*] on compatibility projects for browsers based on Gecko and WebKit.

- ***We contribute to web standards and interoperability initiatives***. Google manages contributions to Blink in a way that ensures minimum standards for contributors for the benefit of the integrity and quality of Blink for all. Broad support across engines is often the most important determinant for adoption of a new web platform feature, so we are heavily incentivised to work with standards development organisations and other browser engines on common standards. It is therefore in our interests to be, as one developer describes us, "*cooperative and willing to give and receive feedback on standards*."[69]

  While Google is an active contributor to the web community, we are committed to evaluating our own products against objective benchmarks and web standards. Chrome on Android, for example, is evaluated based on the Open Web Application Security Project's (**OWASP**) Mobile Application Security Verification Standard.[70] This provides a set of baseline security criteria for developers. Along with their published set of testing criteria, the Mobile Application Security Testing Guide, OWASP offers an objective means for developers to have their apps evaluated against a common minimum standard.

39. **Blink is the most compatible browser engine**. As a result of these efforts, Blink consistently outperforms other browser engines on compatibility. Chromium has, by far, the fewest number of engine-specific web platform test failures (as the wpt.fyi data cited in WP2 confirms). In addition, Microsoft's recently published tracker of "top developer needs" shows that the most important new features that developers need to build great web experiences are broadly interoperable on Blink-based Chrome and Edge.[71] Independent browser comparisons[72] further demonstrate that Blink is the browser engine consistently supporting the widest

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69 WP1, ¶2.53(e).

70 OWASP, Mobile Application Security Verification Standard.

71 Microsoft Edge - 2024 web platform top developer needs.

72 CanIUse, Browser Comparison.

range and greatest number of features.[73] This includes new features in which developers have expressed broad interest, such as "View Transitions" as well as old features essential to some specialised types of web applications like "Web Bluetooth. "

40. **There is broad compatibility across the mobile web ecosystem, with the exception of WebKit**. WebKit on iOS is the major outlier to compatibility in the mobile web ecosystem. As the Working Papers find, "*WebKit has performed worse in terms of compatibility with [the Web Platforms Tests Project's] tests than Blink and Gecko. "*[74] This is borne out by the following evidence:

    - Microsoft recently published a tracker of "top developer needs" across the web ecosystem, which analyses the availability of various new features that web developers are interested in using across browsers in 2024.[75] While Blink offers far more functionality than WebKit, the tracker also shows that the most important features that developers need to build great web experiences are broadly interoperable on Blink-based Chrome and Edge, but not on WebKit-based Safari.[76] WP2 therefore recognises that Safari has the "*lowest level of support for features identified by Microsoft as being important to web developers.*"[77]

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73 Features that Chrome does not support are generally inconsequential to browser functionality because they cover, for instance, the way punctuation is displayed, or are unnecessary in light of a more advanced solution on Android (*e.g.*, "offline web applications" is not available on Chrome for Android because Chrome for Android has no need for this feature given it supports Progressive Web Apps).

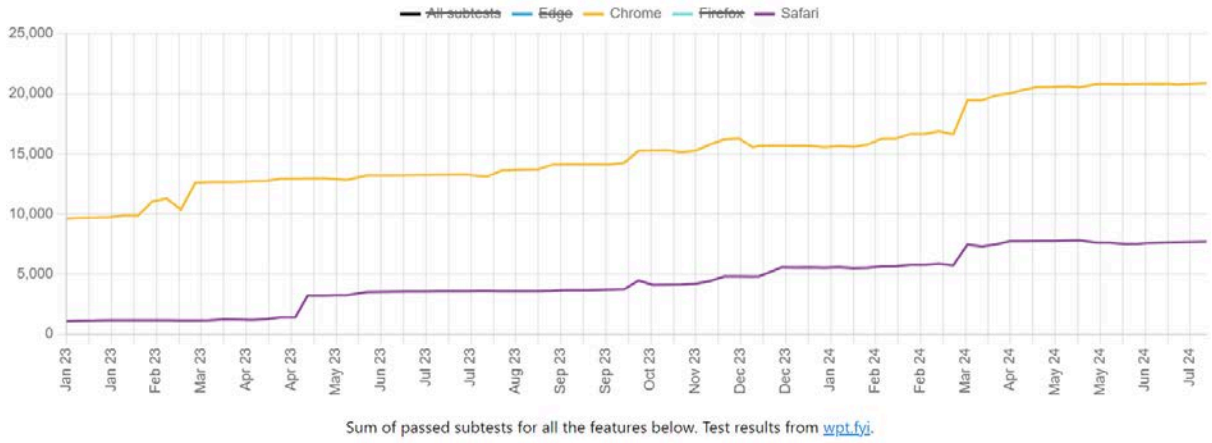
74 WP2, Appendix, ¶1.8.

75 Windows Blog, Introducing the Edge 2024 web platform top developer needs dashboard.

76 Microsoft Edge - 2024 web platform top developer needs.

77 WP2, Appendix, page 5, ¶6.

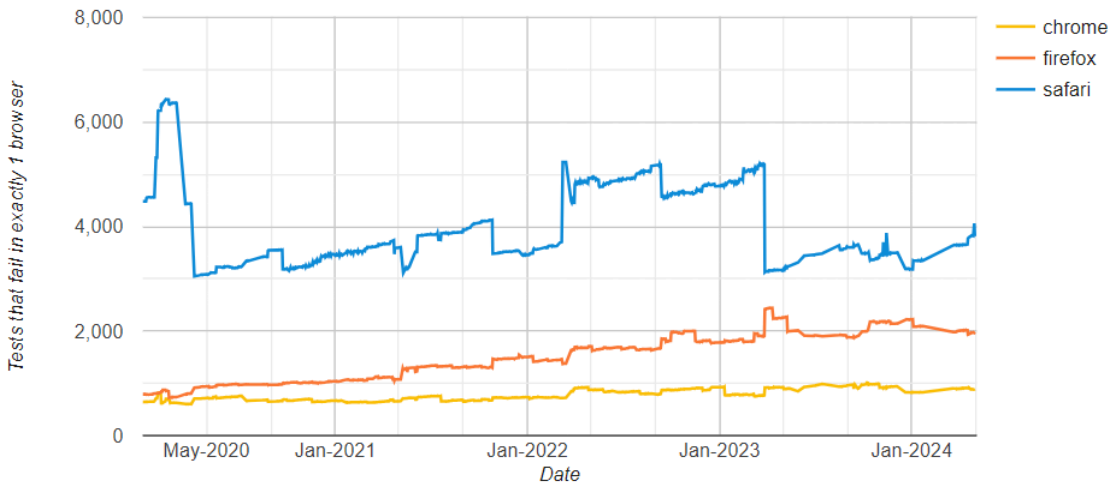
Microsoft 2024 Web Platform Top Developer Needs Dashboard



Source: Microsoft

- Apple itself acknowledges incompatibilities arising from features that are available in Blink but not supported in WebKit.[78]

Compatibility Failures By Browser (Web Platforms Tests)



Source: Web Platform Tests Dashboard

41. **Incompatibilities due to the WebKit Requirement increase web developers' costs.** Third parties confirmed to the CMA that WebKit's incompatibilities increase web developers' costs of cross-platform development.[79] We expand on the impact of Apple's WebKit's incompatibilities in response to Working Paper 2.

78 WP1, ¶2.53(c).

79 WP2, ¶4.23.

42. **On Android, browsers can compete based on developer-facing features**. On Android (and any platform that allows browser engine competition), browser developers can compete by modifying the underlying browser engine. For example:

- Samsung launched an API in Samsung Internet used to access virtual reality devices before Chrome supported the feature.[80]
- When Microsoft launched its Text Prediction feature in Edge, it also provided a non-standard "text prediction" API to control its behaviour before a standardised equivalent was available.
- Microsoft regularly delays applying Chromium changes which may have an adverse impact on web compatibility.[81]
- A Storage Access API was approved and launched in Blink to enable Microsoft's Edge browser to support this feature popularised by Safari, even though Chrome had no plans to support it (though has since adopted it).[82]
- Conversely, Chromium-based browsers routinely "turn off" certain features by default that other Chromium-based browsers do support. For example, Brave disables several Blink APIs including Web Bluetooth and Web NFC API.[83] Microsoft turned off a "scroll-to-text" feature in Edge until Microsoft decided it wanted to launch the feature.

43. **Web developers are accustomed to developing across multiple browsers that support different features**. Developers have access to extensive online resources explaining which browsers support particular features,[84] can easily test their websites against multiple browsers using tools like BrowserStack,[85] and regularly include features in their websites and display them only on supporting browsers.[86]

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80 *See* Can I Use, WebVR API. This API has been replaced with the WebXR Device API. *See further* Ada Rose Cannon, Samsung Developers, Virtual Reality, WebXR, and Samsung Internet (27 April 2020).

81 Microsoft, Site compatibility-impacting changes coming to Microsoft Edge.

82 *See further* Microsoft, Introducing the Storage Access API (8 July 2020).

83 *See* Brave Deviations from Chromium.

84 *See, e.g.*, Can I Use.

85 *See* BrowserStack, Live ("*Millions of QA testers & developers use Live to instantly access 3000+ real browsers & devices and deliver great user experiences.*").

86 *See* MDN Web Docs, Implementing feature detection.

IV. WP1's Proposed Market Definition Understates Competition Across Platforms

44. WP1 provisionally concludes that there are separate markets for: (i) browsers vs browser engines; (ii) mobile vs desktop browsers; (iii) mobile browsers on iOS and mobile browsers on Android; (iv) mobile browsers and mobile app stores; (v) mobile browsers and mobile search apps; and (vi) mobile browsers and native apps incorporating an in-app browser.[87]

45. WP1 places insufficient weight on the fact that browsers compete on a cross-platform basis, including Android and iOS devices, but also on desktop. At the very least, for the following reasons, the CMA should acknowledge that there are strong competitive constraints that apply across platforms:

- **Browsers are typically developed as cross-platform products**. Browser vendors develop and market their products as web browsers, rather than distinguishing them between "mobile" and "desktop" browsers. Indeed, WP1 finds that "*[a]lmost all browser vendors develop both desktop and mobile browsers*" and "*the primary motivation for providing a browser on both desktops and mobile devices is to provide a cross-platform experience*."[88] As far as practicable, Chrome features and innovations are rolled out on all platforms. On the supply side, evidence submitted to the CMA confirms that major browsers have shared codebases across mobile and desktop (with the exception of iOS).[89]

- **Users' choice of browser is influenced by their experience on other platforms**. Consistency in browsing experience (including through browsing history, bookmarks, login details, *etc.*) across platforms is important to users. [*Confidential*]. The CMA's consumer research survey supports this conclusion, finding that 39% of those users who indicated a browser preference did so because they had been using that preferred browser on other devices.[90]

- **Browsers compete across platforms, including iOS and Android**. Browser competition does not occur in silos. Rather, browsers seek to differentiate their offerings against rivals operating on various different platforms. [*Confidential*]. Conversely, WP1 finds that there is "*evidence in Apple's internal documents that it benchmarks Safari against Chrome and Firefox*."[91]

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87 WP1, ¶3.68

88 WP2, ¶4.35.

89 WP1, ¶3.36.

90 Verian Quantitative Consumer Research, slide 53.

91 WP2, ¶2.32.

Conclusion

46. The choice and openness at the heart of the Android ecosystem has had an undeniable and enduring positive impact on users, developers, and device manufacturers in the UK. On Android, browser developers retain a high level of control, flexibility, and autonomy. They can choose whatever browser engine they like. Blink/Chromium provides them with all the necessary tools to enter the market. Many browser developers then build on top of Blink/Chromium, and introduce their own APIs and functionality.

47. Browser developers on Android innovate and differentiate according to their competing business models and product offerings, and consumers choose the browser that best suits their needs. Chrome only remains competitive for as long as we continue to invest heavily to build an innovative, high-quality browser that works across platforms. The increasing browser competition we face keeps us focused and working hard to innovate and earn user choice and loyalty.

48. In the circumstances as described above, WP1 is wrong to attribute Chrome's popularity to a lack of effective competition on Android. A proper assessment of all relevant evidence makes clear that browser competition is thriving on Android.

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Annex 1: Overview of Structural Issues Identified in WP1

Paragraph in WP1	Summary of Position/Evidence in WP1	Google's Response
¶2.48	Indirect network effects resulting from web compatibility give large incumbent browsers an advantage and make it more difficult for smaller browser engines to compete effectively and for new ones to enter the market.	Evidence demonstrates our commitment to compatibility across the web ecosystem, which results in low barriers to entry and competition on Android, including for smaller browser vendors. This is in line with our commercial objective of promoting a thriving web ecosystem. Details are explained at ¶¶38 to 43 of our response to WP1.
¶2.53(a)	Google dominates standards bodies, allowing it to push its preferred specifications which must then be implemented by its competitors.	We encourage web standards to ensure compatibility between browsers and browser engines, including through our work with the web development community. Details are explained at ¶38 of our response to WP1.
¶2.57	Vertical integration, in particular the control that Apple and Google have in relation to the iOS and Android operating systems over the software and functionality available to competing providers of other products offered on their platforms (including browsers), creates a risk that Apple and Google may give preferential access to their own products.	This overlooks the important ways in which the Android ecosystem operates. Android offers browser developers a high level of control, flexibility, autonomy, and opportunity. Many browser developers have built browsers on top of Blink/Chromium, which we make available free of charge. Details are explained in our response to WP2.
¶2.58(b)	The extent to which rival browsers have limited access to certain functionalities may impact on the ability of other browsers to differentiate themselves from Safari and/or Chrome.	On Android, browser developers have access to all the necessary tools and functionality to compete effectively. Details are explained in our response to WP3.
¶2.58(c)	Apple's and Google's restrictions on in-app browsing and potential favouring of their own in-app browsers may create barriers to entry and expansion for rivals.	We promote competition in in-app browsers. On Android, we allow all browsers to build remote-tab IABs that native app developers can incorporate

Paragraph in WP1	Summary of Position/Evidence in WP1	Google's Response
		into their apps so that in-app browsing can use the user's default browser. Details are explained in our response to WP4.
¶2.58(d)	Apple's and Google's control and use of choice architecture practices (particularly pre-installation and default settings) may increase barriers to entry and expansion, by restricting the ability of rival browsers to compete effectively.	This does not apply to Android because it is OEMs and mobile carriers that retain control over preinstallation and default settings for browsers and other apps on their Android devices. Details are explained in our response to WP5.
¶2.59	End users of mobile devices appear to have low levels of awareness and engagement with mobile browsers	The results of the CMA's consumer research survey show that Android users are aware and actively engage with mobile browsers. Details are explained at ¶37 of our response to WP1, and in our response to WP5.

Annex 2: Recent Innovations By Several Example Android Browsers

Google Chrome

Date launched	What is the feature?	Description of the feature
July 2024	Prompts in Encrypted Archive	Enables a user to supply a download with a file password to be deep scanned in Enhanced Protection, users in Standard Protection will receive a trigger prompt to enter the file's password.
July 2024	Automatic Deep Scans of Downloads	Provides automatic deep scans for Enhanced Protection users' downloads.
July 2024	Context and consistency to download warnings	Provides a user with more context about the nature of the danger when they are protected from a malicious file.
June 2024	Sports Cards in Discover Feed	Shows automatic updates to users on sports teams that have followed or expressed interest in.
June 2024	New shortcut suggestions	Provides a user with a shortcut suggestion based on their normal route to the site.
June 2024	Increased Chrome Actions	Provides shortcut buttons in search results.
February 2024	Poor connection capabilities	Provides improved on-device capabilities to assist a user to give more search suggestions even with poor connection.
February 2024	Increased images in suggested searches	Provides images for search suggestions in the address bar, beyond which that match a specific product searched.
February 2024	Suggested Searches based on other users	Provides search suggestions based on a user's previous searches based on similar things others are looking for.
December 2023	Saved tab groups	Enables a user to save tab groups for access on other desktop devices or to more easily pick projects back up.
December 2023	Smarter performance controls	Provides more details about a user's tabs' memory usage when it is hovered over in memory saver mode.
December 2023	Proactive Safety Check	Enables Safety Check to run automatically in the background and revokes sites permissions if they haven't been visited in a long time.
October 2023	Customisable Address Bar	Enables a user to customise the position of their address bar.
October 2023	Improved visual layout	Provides an easier to read and more responsive address bar.
October 2023	Suggestions for popular sites	Suggests popular websites, even if a user has not visited them before.
October 2023	Search within Bookmark Folders	Allows users to search bookmark folders within the address bar.
October 2023	Automatic Typo Corrections in Address Bar	Detects typos and immediately shows suggestions in the address bar based on previously visited websites.

Date launched	What is the feature?	Description of the feature
October 2023	Smarter Autocompletion in Address Bar	Enables autocompletion based on any word previously used to search a website, not just URLs.
October 2023	Faster address bar searches	Detects typos and displays suggested websites when using the address bar.
October 2023	Customisable Assistant Routines	Enables a user to configure their home screen with custom shortcuts and configurations.
October 2023	Wheelchair-accessible information	When a user searches for a place in Google Maps and selects it, a wheelchair icon will appear if the destination has a step-free entrance.
October 2023	Accessible walking routes	Builds on the wheelchair-accessible transit in Maps and allows users to see walking routes.
October 2023	Screen reader capabilities in Maps	Provides auditory feedback of places around a user with information like the name or category of a place and its distance from the user.
September 2023	Enhanced Protections	Provides an upgraded standard protection mode of Safe Browsing.
September 2023	Chrome Web Store Extensions	Introduces a new interface, extension categories and more personalised recommendations for extensions.
September 2023	Material You	Enables greater personalisation of Chrome on desktop with increased legibility, new colour palettes, and better integration of operating systems so Chrome preferences can easily adapt to OS-level settings.
August 2023	Increased suggestions on search	Delivers 10 suggestions to guide a user's search, instead of the previous 6.
August 2023	Related Searches on Touch to Search	Enables related searches on Touch to Search.
August 2023	Trending Google Searches	Shows users what searches are trending in the Google search bar.
August 2023	Relevant search suggestions	Provides users, on certain eligible sites, with relevant search suggestions related to the page they are browsing.
June 2023	Google Lens search with pictures	Enables users to use Google Lens to search with new and existing pictures in their camera roll.
June 2023	Seamless Calendar Events	Allows users to create Google Calendar events directly in Chrome without having to switch apps or copy information over manually.
June 2023	Addresses on Webpages	Enables users to view addresses on webpages, without being redirected to Google Maps.
June 2023	Location of reused and weak passwords	Flags weak and reused passwords to users.
June 2023	Import passwords	Allows users to upload their passwords from other password managers as a .csv file directly into Chrome.

Date launched	What is the feature?	Description of the feature
June 2023	Add notes to credentials	Enables users to add notes to the credentials saved in Google Password Manager, so all login details can be in one place.
June 2023	Biometric information	Enables users to use biometric information, supported by a computer's operating system, before Chrome autofills a password.
June 2023	Dedicated home for Password Manager	Brings a dedicated space for Password Manager.
May 2023	Customisation of Chrome	Enables users to customise their settings (colours, themes) in real-time.
December 2022	Check-out Autofill	Enables Chrome to automatically fill out previously saved information from Google Pay.
December 2022	Google Lens price check	Gives immediate results for price checks.
December 2022	Memory Saver	Frees up memory tabs not currently in use by a user.
December 2022	@ shortcuts	Enables users to search for the tab, bookmark, or history search by using "@" in the address bar before the relevant term.
October 2022	Widgets	Enables a user to place Chrome widgets on the Home Screen and Lock Screen.
June 2022	Touch-to-fill	Allows users to log in to sites directly from the overlay at the bottom of their screen.
June 2022	Password Checkup	Checks passwords in bulk, not just when they are entered into a site.
June 2022	Simplified Password Manager	Rolls out a simplified and unified password manager that is the same in both Chrome and Android settings.
June 2022	Chrome Actions	Expands what a user can do in the address bar; by typing "edit passwords" or "delete history" a user is able to take an action.
June 2022	Return to recent tab	Enables users to find their recent tabs.
June 2022	Google Password Manager	Enables Google Password Manager to be set up as a user's Autofill Provider on iOS.
June 2022	Enhanced Safe Browsing	Enables Chrome to proactively check whether pages and downloads are dangerous by sending information about them to Google Safe Browsing.
June 2021	Predicted permission prompts	Enables Chrome to predict when permission prompts are unlikely to be granted based on how the user has previously interacted with similar permission prompts, and silences these undesired prompts.
July 2021	Improved Site Isolation	Expands Site Isolation across a broader range of sites and extensions.
July 2021	Safety checks from the address bar	Enables a user to action safety checks by typing "safety checks" into the address bar.

Date launched	What is the feature?	Description of the feature
July 2021	Per-site permissions	Rolls out an updated panel to enable a user to see and change permissions granted to sites.
July 2021	New Emojis	Enables the use of new emojis.
May 2021	Fix passwords	Enables a user, whenever Chrome detects a breach of a password, to change passwords automatically.
April 2021	Tab freezing for collapsed groups	Allows “collapsed group” tabs to use less memory and CPU, making a computer quicker.
April 2021	Enhanced battery life	Prioritises active tabs, resulting in a reduction in CPU usage and more hours of battery life.
April 2021	Mute notifications when presenting	Mutes all notifications when presenting or sharing Chrome Windows.
April 2021	PDF reader	Introduces a new sidebar to browse thumbnails and jump to specific pages, presentation mode, document properties, two-page view and an updated toolbar.
April 2021	Link to highlighted text	Enables a hyperlink to open highlighted text in a webpage.
April 2021	WebXR collection	Enables users to experience AR and VR on the web.
March 2021	Live Caption	Enables users to automatically generate real-time captions for media with audio.
March 2021	Profiles Experience	Makes it easier to create, customise or switch users’ personal spaces on Chrome.
January 2021	BeyondCorp Enterprise	Delivers enhanced malware and phishing prevention, sensitive data protection across the web, and greater visibility and insights into potential risks or suspicious behaviour.
December 2020	Extension’s “privacy practices”	Publicly displays every extension’s “privacy practices”, exposing the data that extensions collect and use, and limits what developers can do with the data they collect.
December 2020	Permissions over extensions access	Enables a user to grant or deny an extension permission to access a website’s data.
November 2020	Cards in Chrome	Allows a user to “jump back in” to recently-visited and related content on the web.
November 2020	Chrome Actions	Expands what a user can do in the address bar; by typing “edit passwords” or “delete history” a user is able to take an action.
November 2020	Tab Search	Lets users see a list of, and search within, their open tabs.
May 2020	Secure DNS	Uses DND-over-HTTPS to encrypt the “DND (Domain Name System) lookup” step when accessing a website, helping to prevent attackers from sending phishing websites or observing which sites users visit.

Date launched	What is the feature?	Description of the feature
May 2020	Enhanced Safe Browsing	Enables Chrome to proactively check whether pages and downloads are dangerous by sending information about them to Google Safe Browsing.
May 2020	Puzzle Icon for Extensions	Introduces a puzzle icon to house extensions on the toolbar, which gives users more control over which data extensions can access visited sites.
May 2020	New Safety Check	Shows which passwords a user has asked Chrome to remember have been compromised and how to fix them, will flag if safe browsing has been turned off, show if the version of Chrome is up to date, and if malicious extensions are installed, it will show a user how and where to remove them.
May 2020	Sync Controls	Allows a user (under "You and Google") to control what data is shared with Google and stored in the user's Google account.
May 2020	Reorganisation of Site Settings	Separates controls into two distinct sections to make it easier to find the most sensitive website permissions: access to location, camera, microphone and notifications.
May 2020	Cookie Controls	Allows a user to choose if and how cookies are used by websites, with options to block cookies.
May 2020	Tab Groups	Enables a user to group tabs together and label them with a custom name and colour.
January 2020	Media Controls	Allows a user to control audio and video through the introduction of an icon in the top-right corner of Chrome on desktop, without the need to identify which tab the audio or video is playing from.

Firefox

Date launched	What is the feature?	Description of the feature
July 2024	Language capabilities	Makes Firefox available in Saraiki (skr).
July 2024	Microphone capture capabilities	Through getUserMedia, supports system-provided voice processing when applicable, improving audio quality.
July 2024	Privacy Preserving Attribution API	Supports the experimental Privacy Preserving Attribution API, which provides an alternative to user tracking for ad attribution.
July 2024	Playback of protected content	Supports playback of protected content from streaming sites like Netflix while in Private Browsing mode.

Date launched	What is the feature?	Description of the feature
July 2024	Unified dialog for clearing user data	Provides insights into the site data size corresponding to the selected time range.
July 2024	Translation of text selections and hyperlinked text	Means that Firefox can translate selections of text and hyperlinked text to other languages from the context menu.
June 2024	Device sign-in for stored passwords	Introduces a device sign in when accessing or filing stored passwords in the Firefox Password Manager.
June 2024	"Close duplicate tabs" command	Enables users to close all duplicate tabs in a window with the "Close duplicate tabs" command available from the List all tabs widget in the tab bar or a tab context menu.
May 2024	NVIDIA RTX Video HDR	Adds NVIDIA RTX Video HDR to Firefox. RTX Video HDR automatically converts SDR video to vibrant HDR10 in real time, improving video clarity on a user's HDR10 panel.
May 2024	Increased translation capabilities	Brings Catalan to Firefox Translations.
May 2024	Remove parameters from nested URLs	Supports the Copy Without Site Tracking option to remove parameters from nested URLs. It also includes expanded support for blocking over 300 tracking parameters from copied links, including those from major shopping websites.
April 2024	Web Proxy Auto-Discovery	Provides the option to users to enable Web Proxy Auto-Discovery while configured to use system proxy settings.
April 2024	Search tab-specific Container add-ons	Allows users of tab-specific Container add-ons to search in the Address Bar for tabs that are open in different containers.
April 2024	URL Paste Suggestion	Provides a way for users to visit URLs copied to the clipboard in the address bar of Firefox. When the clipboard contains a URL and the URL bar is focused, an autocomplete result appears automatically. Activating the clipboard suggestion will navigate the user to the URL with one click.
April 2024	Proactive blocking of downloads	Enables Firefox to proactively block downloads from URLs that are considered to be potentially untrustworthy.
April 2024	Display pinned tabs in Open tabs	Provides Firefox with the ability to display pinned tabs in the Open tabs section. Indicators were also added for bookmarks, tabs with notifications, and other unnamed features.
April 2024	Text highlighting in PDF view	Supports text highlighting in PDF viewer.
April 2024	AV1 codec for Encrypted Media Extensions	Supports AV1 codec for Encrypted Media Extensions, enabling higher-quality playback from video streaming providers.
March 2024	Ability to sort open tabs	Allows a feature to sort open tabs by recent activity or tab order in Firefox View (the

Date launched	What is the feature?	Description of the feature
		function that enables users to enjoy a fluid transition between devices).
February 2024	Compatibility Reporting Tool	Enables users to report web compatibility issues with a website that is not working on Firefox, but is working as expected on another browser.
February 2024	Ability to search through tabs	Integrates search into Firefox View, enabling users to search through all of the tabs on each of the sections.
January 2024	Passkeys	Supports creating and using passkeys stored in the iCloud Keychain on macOS.
January 2024	Images for suggested searches	Enables Firefox to display images and descriptions for search suggestions when provided by the search engine.

Brave

Date launched	What is the feature?	Description of the feature
February 2024	Bitcoin Support	Allows Brave Wallet to support Bitcoin transactions fully.
January 2024	Brave News Revamp	Brave updated Brave News with a personalised "For You" section, content filters and a news preview section.
December 2023	EIP-6963	Makes it easier for Brave users to connect multiple different wallets.
June 2023	Localhost Resource Permission	New features in Brave Version 1.54 gave users greater control over which websites accessed local network resources and for how long.
May 2023	Vertical Tabs	Maximises screen space by stacking their tabs vertically on the left hand side of the window rather than horizontally at the top.
May 2023	Request OTR	Allows users to hide their browsing data from others who have access to their phone or computer.
May 2023	Token Gating	Enhances user authentication for Brave Talk by allowing hosts to use NFTs and POAPs as access passes to live events.
March 2023	Google Sign-In Permission	Gives users more control over when sites use a Google sign-in and send third-party cookies to Google.
February 2023	"Open In App" Blockers	Provides more advanced ad blockers and new protections against trackers.
February 2023	HTTPS by Default	Improves security by upgrading all sites to HTTPS, reverting to HTTP only when the site does not support HTTPS.
December 2022	Brave News Improvements	Allows users to personalise content while maintaining privacy.

Date launched	What is the feature?	Description of the feature
October 2022	Brave Translate	Brave expanded its web translation tool from 15 to 108 supported languages.
October 2022	Cookie Banner Blocker	Allows the blocking of cookie consent notifications.
August 2022	iOS 1.39 Release	Enhances privacy protections and aligns them more closely with Brave's Android and desktop browsers.
May 2022	Solana Integration	Brave partnered with blockchain platform Solana to integrate it more closely into the browser.
May 2022	Privacy Hub	The Privacy Hub gives more visibility on the types of material that Brave's privacy protections block.
March 2022	Unlinkable Bouncing	Provides more protection against bounce trackers.
November 2021	Brave Wallet	Consists of a cryptocurrency wallet built into the Brave browser.
September 2021	Brave Talk	Brave Talk is a privacy-focused video-conferencing tool built into the Brave browser.
July 2021	Version 1.25	Brave Version 1.25 added a variety of new features, including (i) giving users more control over how long sites can access geolocation sensors, webcams, and microphones and (ii) more advanced measures to block trackers.
January 2021	IPFS Integration	Brave integrated IPFS, a peer-to-peer hypermedia protocol, into its browser to increase content availability.
December 2020	Brave News	Brave introduced a personalised, customizable content stream on the new tab page.
August 2020	Redesigned Sync Functionality	Brave launched a redesigned functionality to sync browser data between desktops and across desktop and Android devices.
July 2020	Guardian Integration	Brave and Guardian partnered to integrate the Brave iOS Browser with Guardian Firewall + VPN.
May 2020	Fingerprinting Defenses 2.0	Brave redesigned its fingerprinting defences to build on the randomisation techniques introduced in March 2020.
April 2020	New Android App	Brave released a new version of its app for Android to enhance performance including battery savings and CPU and data savings.
April 2020	Binance Widget	Brave partnered with Binance, a global blockchain company, to bring a new widget to the new tab page for buying and trading cryptocurrency.
March 2020	Fingerprint randomization	Brave introduced a new form of browser fingerprinting protection using randomization techniques.

Date launched	What is the feature?	Description of the feature
February 2020	3P Cosmetic Filtering	Hides page elements related to third-party tracking and advertising.
February 2020	Sponsored Images	Branded background images will appear on the tab page alternating with Brave's regular background images. Users who opt into Brave Rewards receive 70% of the ad revenue from Sponsored Images (30% goes to Brave).

Microsoft Edge

Date launched	What is the feature?	Description of the feature
May 2024	Memory Usage Controls	Allows users to control how much RAM Edge can use.
April 2024	Text Editing Improvements	Improves the ways users can input text into web pages, including making the Compose feature available inline, support for writing with digital pens and improved text predictions.
March 2024	Ad Selection API	Allows advertisers and publishers to show relevant ads to users without relying on third-party cookies or other cross-site trackers.
February 2024	Wallet	Stores payment methods and passwords for more convenient and secure online shopping.
December 2023	New DevTools Interface	Edge redesigned the interface of its in-built web development tools to make it more user-friendly and customizable.
November 2023	Magnify / Read Aloud	Edge introduced accessibility features allowing users to zoom in on images and have web content read aloud.
November 2023	Shared Links	Collects and organises links shared in Outlook and Teams so that they are easily accessible in the Edge browser.
August 2023	Edge for Business	Enables separate work and personal browser windows within a single browser.
July 2023	Sidebar Extensions	Provides support to developers to build extensions to the sidebar.
February 2023	Adobe Acrobat Integration	Microsoft and Adobe collaborated to power the in-built PDF reader in Edge with Acrobat's PDF engine.
October 2022	Typo Protection	Protects users if they accidentally access fraudulent websites after misspelling a URL.
October 2022	Live Captions	Provides auto-generated captions for audio playing in the browser.
October 2022	Workspaces	Allows users to create shared sets of browser tabs so that all members of a project can access the relevant websites and working files in one place.

Date launched	What is the feature?	Description of the feature
September 2022	Window Controls Overlay	Improves support for web apps by enabling them to use the full surface area of the app window to display their own content.
September 2022	New Sidebar	Allows users to access various tools while browsing including search engines, Office, games and Outlook.
July 2022	Disk Caching	Edge automatically suppresses disk caches to improve performance and reduce disk footprint.
May 2022	Apps Hub	The Apps Hub, Apps Page and Apps Sync features make it easier to manage installed apps and sites and sync them across devices.
March 2022	Auto-Generated Image Labels	Helps people who are blind or have low vision experience the web by automatically generating alt text for images that do not include it.
November 2021	Citations	Automatically generates full and in-text citations in multiple citations styles.
June 2021	Automatic HTTPS	Automatically switches connections to websites from HTTP to HTTPS to make browsing more secure.
May 2021	Math Solver	Provides solutions to mathematical problems with step-by-step instructions.
February 2021	Adaptive Notification Requests	Uses data from accrued user choices to display either quiet or full prompt notifications.
December 2020	Sleeping Tabs	The option to set tabs to “sleep” during periods of inactivity improves memory usage and reduces battery life.
October 2020	My Feed	Adds a customizable feed in the Enterprise New Tab Page.
September 2020	Web APIs for Dual Screen / Foldable Devices	Assists web developers to effectively lay out content in a browser window for dual screen and foldable devices.
July 2020	Collections for Mobile	Extension of the Collections feature to mobile users allowing them to easily collect and organise content from the web.
July 2020	Storage Access API	Gives users greater control over sites requesting access for browser-based storage.
May 2020	Improved Spellcheck	Moves from open source proofing tools to Windows Spellcheck providing support for additional languages and a shared custom dictionary.
May 2020	Sidebar Search	Enables users to see a search results pane on the side of the page rather than opening a new tab.
April 2020	Profiles	Allows users to create multiple “profiles”, for example to keep browsing data separate for work and personal browsing.

Date launched	What is the feature?	Description of the feature
February 2020	Potentially Unwanted App Protections	Protects Edge users from potentially unwanted applications such as extra ads, cryptocurrency mining apps and apps with poor reputations.
February 2020	Performance Optimizations	Performance improvements which increase browser speeds by up to 13%.

Opera

Date launched	What is the feature?	Description of the feature
June 2024	Tab Emojis	Enhances users' tab management capabilities.
April 2024	Live Wallpaper	Allows users of Opera GX to create animated backgrounds for their Opera GX browser which they can also set as their desktop background.
March 2024	Reaktinator	Allows users to turn any YouTube video into a reaction meme.
February 2024	Crypto Browser	Enables users to make secure crypto transactions directly within the Opera browser.
December 2023	Panic Button	Allows users to protect their activities online from others.
June 2023	Tab Islands	Automatically groups related tabs together based on context, giving users greater flexibility in tab management.
April 2023	Free VPN to Opera for iOS	Extension of the free VPN coverage to Opera for iOS.
March 2023	Opera Pinboards	Allow users to access a digital bulletin board in their browser where they can collect, organise and rearrange content (images, notes, links, etc) in one simple place, then share it with others for feedback.
December 2022	Lucid Mode	Provides videos with brightness, sharpness, and clarity.
November 2022	Built-in TikTok	Integrates Tiktok into Opera's browser and allows users to access TikTok directly from the browser.

Samsung Internet

Date launched	What is the feature?	Description of the feature
June 2022	Text Capture	Allows users to select and copy text from images on websites.
June 2022	Smart Anti-Tracking	Protects against trackers that use 'CNAME' cloaking.

Date launched	What is the feature?	Description of the feature
June 2022	Rewriting http links to https by default	Makes browsing more safe and secure.
May 2022	Web Authentication	Enables strong authentication with public key cryptography, enabling passwordless authentication and secure multi-factor authentication without SMS texts.
November 2021	Focus Mode	The browser's address bar can be moved to the bottom of the screen.
November 2021	Labs feature	Support for https (secure) upgrades was launched as a Labs feature.
November 2021	Device Posture API	Supports foldable devices.
September 2021	Enhanced Search Experience	Provides a list of potential results while searching and reorders the results for easier recognition.
September 2021[92]	Smart Protect	Helps to mitigate against tracking networks building up profiles about users.
July 2021	Back-Forward Cache	Allows users to navigate pages more quickly.
July 2021	Improvement to Secret Mode	Once a user selects Secret Mode, Samsung Internet will launch in Secret Mode by default even if terminated.
May 2021	Permission control for individual sites	Allows users to customise individual site permission, they can activate or deactivate permissions by switching on/off at the sites list.
May 2021	Bookmark Bar	Provides a bookmark bar in the upper toolbar area.
May 2021	Continue Apps	Enables using Samsung Internet on a different Samsung device and automatically sync clipboards across devices for copying and pasting text and images.
May 2021	S Pen Air Action	Allows users a remote control on Samsung Internet.
May 2021	Tab bar GUI enhancement	This tab bar design creates better visibility and usability for users.
May 2021	Update popup for new password autofill	Allows users to choose whether to update the password or not when the entered password is different from the already saved one.
May 2021	Quick access page at fresh launch	Creates a new tab to display the quick access page when users run the internet app.
September 2020	Permission Request UI	Changes the settings for users to display a warning message if the website looks malicious, making it harder to trick or force users into allowing notifications, especially from those sites that like to mislead their users into accepting notifications.

[92] This was first released in December 2020.

Date launched	What is the feature?	Description of the feature
July 2020	Context Menu	Allows users to control tabs easily without needing to open up the tab switcher.
July 2020	WebXR device API	Provides support for Augmented Reality websites.