

EXHIBIT E

Chromium (web browser)

From Wikipedia, the free encyclopedia

Chromium is the open source web browser project from which Google Chrome draws its source code.^[2] The project's hourly Chromium snapshots appear essentially similar^[3] to the latest builds of Google Chrome aside from the omission of certain Google additions, most noticeable among them: Google's branding, auto-update mechanism, click-through licensing terms, usage-tracking, a built-in PDF viewer and bundling of the Adobe Flash Player. Chromium uses the WebKit layout engine.

The Chromium Project takes its name from the element chromium, the metal from which chrome is made.^[4] Google's intention, as expressed in the developer documentation, was that Chromium would be the name of the open source project and that the final product name would be Chrome.^[5] However other developers have taken the Chromium code and released versions under the Chromium name.

One of the major aims of the project is for Chrome to be a tabbed window manager, or shell for the web, as opposed to its being a traditional browser application. The idea is for the application to be minimalist in the same way Windows Explorer or Mac OS X's Finder are minimalist. The developers state that it "should feel lightweight (cognitively and physically) and fast".^[6]

Chromium



Chromium 13.0 displaying its Wikipedia article

Stable release	none (n/a) [+/-]
Preview release	14.0.792.0 (June 13, 2011) [+/-]
Written in	C++ and Assembly
Operating system	FreeBSD Linux Mac OS X (10.5 and later) Windows (XP SP2 and later)
Size	Approximately: 20.0 MB (FreeBSD i386) 28.0 MB (Linux X86-32) 30.8 MB (Linux x86-64) 27.7 MB (Mac OS X) 18.1 MB (Windows)
Type	Web browser
License	BSD license, MIT License, LGPL, MS-PL and MPL/GPL/LGPL tri-licensed code, plus unlicensed files. ^[1]

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Website	chromium.org
	dev.chromium.org

Differences from Google Chrome

Chromium is the name given to the open source project and the browser source code released and maintained by the Chromium Project.^[7] It is possible to download the source code and build it manually on many platforms. Google takes this source code and adds:

- an integrated Flash Player^[8]
- a built-in sandboxed PDF viewer^[9]
- the Google name and logo
- an auto-updater system called GoogleUpdate
- an opt-in option for users to send Google their usage statistics and crash reports
- RLZ tracking (see Google Chrome) when Chrome is downloaded as part of marketing promotions and distribution partnerships. This transmits information in encoded form to Google, for example, when and where from Chrome has been downloaded. In June 2010 Google confirmed that the RLZ tracking token is not present in versions of Chrome downloaded from the Google website directly or in any version of Chromium. The RLZ source code was also made open source at the same time so that developers can confirm what it is and how it works.^[10]

By default, Chromium only supports Vorbis, Theora and WebM codecs for the HTML5 audio and video tags, while Google Chrome supports these in addition to AAC and MP3. On 11 January 2011 the Chrome Product manager, Mike Jazayeri, announced that Chrome will no longer support the H.264 video format for its HTML 5 player, just as

Chromium does not.^[11] Certain Linux distributions may add support for other codecs to their customized versions of Chromium.^[12]

Licensing

The Google-authored portion of Chromium is released under the BSD license,^[13] with other parts being subject to a variety of different permissive open-source licenses, including the MIT License, the LGPL, the Ms-PL, and an MPL/GPL/LGPL tri-license.^[14] In addition to that, developers have noticed that some files were not freely licensed.^[1] As of March 2011, this issue was still unfixed.^[1]

History

Because Chromium is the open source project that results in releases of Google Chrome, the history of the two is intertwined. Chromium is a project, making all releases developmental, with Chrome being the official release.

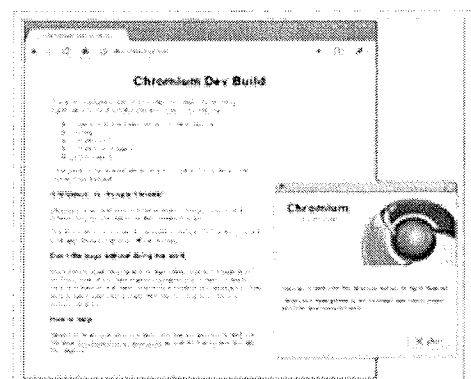
2008

Google Chrome was first introduced in September 2008 and along with its release the Chromium source code was also made available allowing builds to be constructed from it. The initial code release included builds for Windows and Mac OS X, as well as Linux, although the latter was at a very early stage of development and lacked complete functionality.

Chromium 1.0 was released in December 2008 and

with it Chrome was removed from beta status for Windows only.^{[15][16]}

Upon its first release in September 2008 Chromium was criticised for storing saved passwords in a manner so that any casual user of a computer can easily read them from the GUI. Users have filed many bug reports and feature requests asking for a master password option to access stored passwords, but Chromium developers have consistently insisted that this provides no real security against knowledgeable hackers. Users have argued that it would protect against co-workers or family members borrowing a computer and seeing the stored passwords in clear text. In December 2009 Chromium developer P. Kasting stated: "A master password was issue 1397. That issue is closed. We will not implement a master password. Not now, not ever. Arguing for it won't make it happen. "A bunch of people would like it" won't make it happen. Our design decisions are not



An early alpha build of Chromium 3.0 for Linux, which clarifies its separation from Google Chrome.

democratic. You cannot always have what you want."^{[17][18]}

2009

In January 2009 the first development versions of Chromium 2.0 were made available, featuring a bookmark manager and support for non-standard CSS features, including gradients, reflections and masks.^[19]

In May 2009 the first alpha Linux version of Chromium was made available. In reviewing that alpha version Ryan Paul said that it was "still missing features and [has] lots of rendering bugs, but it is clearly moving in the right direction." The first developer releases for Chrome on the Linux and Mac OS X platforms were made available in June 2009, although they were in a very early stage and lacked Adobe Flash, privacy settings, the ability to set the default search provider and even printing at that point. In July 2009 Chromium incorporated native theming for Linux, using the GTK+ toolkit to allow it fit into the GNOME desktop environment.^{[20][21][22][23]}

Chromium 3.0 was released on 28 May 2009 as version 3.0.182.2.^{[24][25]} Chrome 3.0 followed in September 2009 and introduced a much faster JavaScript engine, a system for user-selectable themes, improvements to the Omnibox and a redesigned *new tab* display page.^[26]

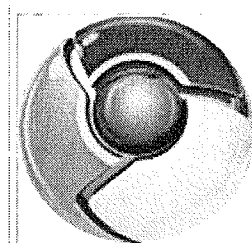
Chromium 4.0.212.0 was the first Chromium 4.0 version and appeared on 22 September 2009^{[24][27]} with Chrome 4.0 publicly released in December 2009. Both brought support for extensions, plus synchronization of bookmarks along with Chrome beta versions for Mac OS X and Linux. The all-platform market penetration of Chrome/Chromium 4.0 combined was at 6.73% by the end of April 2010.^{[28][29][30][31]}

2010

Chromium 5.0 was released on 26 January 2010 with 5.0.306.0 as the initial version.^[24]^[32] Google Chrome 5.0 followed on 25 May 2010 and provided stable (non-beta) releases for all platforms. At that time the web magazine, *OMG! Ubuntu!*, reported that Chrome/Chromium usage was at 36.53% for Linux browsers, compared to 55.52% for Firefox and 2.82% for Opera.^{[29][33][34][35]}

Chromium 6.0 was introduced in May 2010 with the first release version 6.0.397.0. In July 2010 Chromium 6 daily builds introduced new features focusing on user interface minimalism, including a unified single page and tools menu, no home button by default (although user configurable), no "go button", a combined "reload/stop" button, bookmark bar deactivated by default, an integral PDF

reader, WebM/VP8 support for use with HTML5 video, a smarter URL bar.^{[24][36][37]} Chrome 6 was released in both a stable and beta version on 2 September 2010 as version 6.0.472.53. The switch to 6.0 brought security fixes, a slightly updated user interface, improvements to form autofilling, synchronizing of both extensions and autofill data, along with increased speed and stability.^[38]



Original Chromium logo used from project inception until Chromium 11

Chromium 7.0 was released on 17 August 2010, with 7.0.497.0 as the first version made available. This version boosted HTML5 performance to double the speed of Chromium 6. It also added hardware acceleration, which speeds up the browser in complex graphics situations by a factor of 225 times, integration of instant search, UI Tabs which move all the remaining user interface windows into the browser tabs, including the "options" menu, and 3% faster JavaScript performance.^{[24][39][40][41]}

7 October 2010 marked the release of Chromium 8.0, seven and a half weeks after that of Chromium 7. The initial release in this series was version 8.0.549.0. The development of Chromium 8.0 focused on improved integration into the Google Chrome OS, and improved cloud features. These include background web applications, host remoting (allowing users centrally to control features and settings on other computers), and cloud printing.^{[24][41]} On 12 January 2011 versions of Chrome and Chromium prior to version 8.0.552.237 were identified by US-CERT as "contain[ing] multiple memory corruption vulnerabilities. These vulnerabilities include a stack corruption vulnerability in the PDF renderer component, two memory corruption vulnerabilities in the Vorbis decoder, and a video frame size error resulting in a bad memory access...By convincing a user to view a specially crafted HTML document, PDF file, or video file, an attacker can cause the application to crash or possibly execute arbitrary code." This vulnerability was publicized after Chrome version 8.0.552.237 was released fixing these problems, to alert users to upgrade versions as soon as possible.^[42]

Chromium 9.0 was released on 23 October 2010, just 16 days after Chromium 8.0, with 9.0.562.0 as the initial version. The new version introduced an infobar refresh feature with the aim of preventing website spoofing attacks. Reviewer Wolfgang Gruener noted that the first builds of Chrome 9 have now doubled in size between Chrome 3 and Chrome 9 to a compressed download of 28.2 MB, calling it "notably more bloated". Gruener also criticized the seemingly arbitrary numbering breaks between major versions, saying, "even by more progressive standards, the version numbering may be a bit excessive. By the end of this year, Google will have gone through seven or eight different browser versions. Some may doubt the benefit of that strategy."^{[24][43]} Chromium 9 introduced two new test features in November 2010 intended to load web pages more quickly, "pre-rendering" and "false start", plus sandboxing for Adobe Flash.

Stable releases of Chrome and Chromium were version 9.0.597.84 and included features such as *Instant Search* which allows the URL bar to act through Google Instant when Google is the default search. Other features included GPU/hardware acceleration, default 3D graphics through WebGL and access to the Chrome Web Store on the New Tab page. [44][45][46]

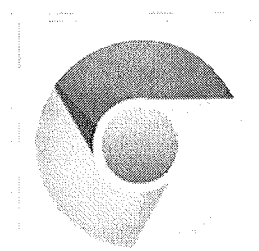
Chromium 10.0 was released on 3 December 2010, with 10.0.601.0 as the initial version. It introduced 18 new features, including "Instant Type" searching as well as "GPU accelerated compositing". Development of "Webpage pre-rendering" was reduced to an inactive while selectable "snap start" was introduced. [24][47]

2011

Chromium 11.0 was released on 28 January 2011, with 11.0.652.0 as the initial version. Development work in this version centered on cleaning up the *settings* menu, including the Sync menu and eliminating all checkboxes. Reviewer Wolfgang Gruener said "The Settings menu isn't quite as messy anymore and looks much more like what you would expect from a professionally designed software." Language and spell checking support was expanded to 100 languages. Chromium 11 used WebKit 534.18 and V8 3.1.1 which resulted in improved speed in JavaScript and other benchmark tests. In early testing Chromium 11 was faster than Firefox 4 in V8 and Kraken benchmarks, but was 12% slower than Internet Explorer 9 in Sunspider tests. [24][46]

In February 2011 Google's Jeff Chang announced to Chromium developers that there would be further large-scale interface changes. These may include eliminating the "Omnibox" URL bar and combining the current two line layout which has tabs on one line and navigation buttons, menu and URL bar on a second line into one single line, thus freeing up more screen space for content. Chang indicated that this would result in URLs not always being visible to the user, that navigation controls and menus may lose their context and that the resulting single line could be quite crowded. Other proposed changes include being able to log into multiple accounts in different windows and improved URL suggestions from the user's history. [48]

Chromium 12.0 was released on 11 March 2011, with 12.0.700.0 as the initial version. Initial changes in the first versions of Chromium 12 included `about:flags` updates of test features, incorporating an fps counter for hardware acceleration benchmarks, a P2P API interface that may indicate future platform data exchange features, an enhanced URL bar and small changes to the tabs. Chromium 12 incorporated WebKit 534.24 and V8 javascript engine version 3.2.1.1. It is anticipated that a URL bar web app launcher will be added during the development cycle. Chromium 12 also introduced a new simplified 2D logo that replaced the 3D style logo used from



Logo introduced with Chromium 12

the project since its inception. Early in the Chromium 12 cycle the *history quick provider* was introduced. This feature automatically searches the browser history for websites visited in the past 72 hours looking for matching page titles and URLs. It also searches through URLs that have been typed at least twice as well as URLs that have been visited at least four times ever. The first stable version of Chrome and Chromium 12 released was 12.0.742.91 which brought malware detection and support for hardware-accelerated 3D CSS transforms.^{[24][49][50][51]}

In March 2011 Google announced directions for the project for the year, including a plan for seven new major versions, planning to end the year with Chrome 17 out. Development priorities will focus on reducing the browser's size, integrating web applications and plug-ins, cloud capabilities and touch interface. The size is a concern to developers, who have noted that Chrome 1 was 9.0 MB in Windows download size, compared to Chrome 10 for Windows at 26.2 MB, as a result they have created a "bloat taskforce". Larger download sizes are a problem for a number of reasons, as Chrome Developer Ian Fette explained: "1. We do distribution deals with Chrome, where we bundle Chrome with other products. These get difficult when our binary grows. 2. We see increased download failures / install dropoffs as the binary grows, especially in countries with poor bandwidth like India. India also happens to be a very good market for Chrome (we have good market share there and growing), so that's also very problematic."^{[52][53]}

With the release of Chromium 12.0.742.0 on 19 April 2011 the interface incorporated some new changes, the most significant since Chromium 6 was released. A multi-profile button was introduced allowing users to log into multiple Google and other accounts in the same browser instance. The new tab page was also redesigned and separated into four horizontally-scrollable screens, providing access to *most visited pages*, *Google apps*, plus two identified pages. The page reload button was also redesigned along with minor changes to the URL bar.^[54]

Chromium 13.0 was released on 26 April 2011, with 13.0.748.0 as the initial version.^[24] Early versions of Chromium 13 included a menu button to enable users to switch between multiple Google profiles, multi-selection of tabs and an improved omnibox engine. This version also included several minor GUI changes, including a slightly lightened menu bar.^[55] By early May 2011 the results of Google's attempts to reduce the file size of Chromium were already being noted. Much of the early work in this area concentrated on shrinking the size of WebKit, by removing Wireless Markup Language (WML), the Image Resizer, datagrids and the Android build system. The largest Chromium nightly build was 35.3 MB on 15 April 2011, but this was reduced to 29.9 MB by 20 April 2011.^[56] Later builds of Chromium and Chrome in mid-May 2011 introduced the optional "compact navigation view", aimed at mobile device users. This view combined the tab and URL/menu bars into one bar, by making the URL bar hide when not in use, thus saving 30 pixels of vertical space.^{[57][58]}

Chromium 14.0 was released on 2 June 2011, with 14.0.783.0 as the initial version. This initial version included `about:flags` testing support for preload instant search, permitting the user to preload the default search engine used in *instant search* and GPU-acceleration on all pages. Default changes includes 2D-accelerated canvas and the task manager incorporated a *frames-per-second* counter. There was also support for the Page Visibility API.^{[24][59]}

System requirements

Main article: Google Chrome#System_requirements

Chromium can be built on Windows, Mac OS X (Intel only), Linux and ChromeOS.^[60]

64-bit builds

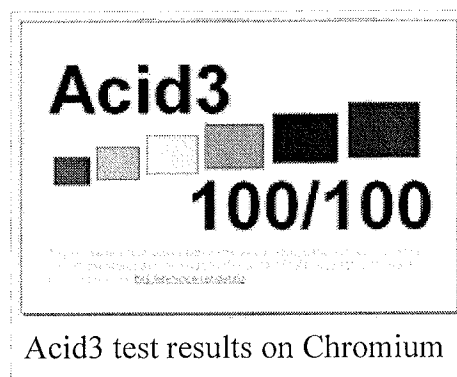
64-bit builds are possible on Linux, FreeBSD, Mac OS X but not Windows.^[61]

Community releases

Most Linux and BSD variants offer Chromium in their software repositories. It has also has been compiled by third party developers for use with Microsoft Windows and Mac OS X. These include:

Chromium - branded releases

- Arch Linux has a package in the official repository.^[62]
- Debian - Chromium is available.^[63]
- Fedora - unofficial repository.
- FreeBSD - packages have been available since late 2009, and a port has been available from the FreeBSD ports system since late 2010.^{[64][65]}
- Gentoo Linux has had a package in the official repository since March 2010.^[66]
- Lubuntu - Chromium is the default browser with new versions delivered as updates through the Ubuntu update manager system, keeping the Chromium version up to the latest stable release of Chrome.^[67]
- Nokia's Maemo 5 mobile operating system - A proof-of-concept version of Chromium with an unmodified user interface was released on April 11, 2010.^[68]
- MeeGo uses Chromium in its netbook version.^[69]



- openSUSE has Chromium available in its repositories.^[70]
- PartedMagic - offers Chromium as the default web browser.^[71]
- Puppy Linux - offers Chromium, starting with Chromium 5.0.342 on Lucid Puppy 5.0.0, based on the Ubuntu application repository.^[72]
- Ubuntu started offering Chromium through the Ubuntu Software Center with Ubuntu 10.04 LTS as part of the 'universe' repository. The initial version available in April 2010 was 5.0.342.9, with new versions delivered as updates, keeping the Chromium version up to the latest stable release of Chrome.^[73]

CrossOver Chromium

- CodeWeavers CrossOver Chromium is an unofficial bundle of a Wine derivative and Chromium Developer Build 21 for Linux and Mac OS X, first released on September 15, 2008 by CodeWeavers as part of their CrossOver project.^{[74][75]}

ChromePlus

- ChromePlus is a Chromium-based browser for Windows and Linux. It adds features such as mouse gestures, link dragging and IE tabs.^[76]

Comodo Dragon

- Comodo Dragon is a rebranded version of Chromium for 32-bit Windows 7, Vista and XP produced by the Comodo Group which includes improved security and privacy features.^[77]

Flock

- Flock was a browser that specialized in providing social networking and had Web 2.0 facilities built into its user interface. It was based on Chromium starting with version 3.0. Flock was discontinued in April 2011.^{[78][79]}

Iron

- SRWare Iron is a release of Chromium for Windows, Mac OS X and Linux. It disables some configurable Chromium features that could share information with third parties.^[80]

Rockmelt

- RockMelt is a release of Chromium for Windows and Mac OS X under a commercial proprietary licence. It integrates heavily with features from Facebook

and Twitter.^[81]

See also

- Google Chrome OS
- Chromium OS
- Google Chrome
- Comparison of web browsers

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External links

- Official website
- Latest Chromium snapshots

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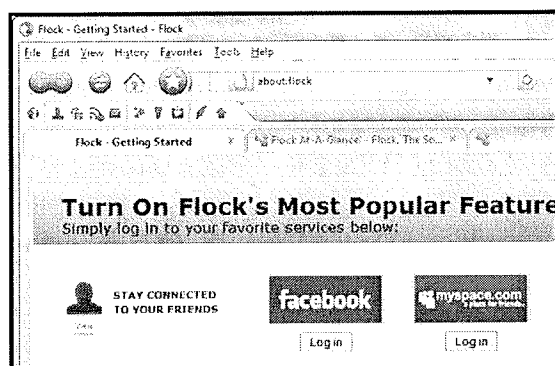


Home Product Guides Software Internet Browsers **Flock Jumps from Firefox to Chromium**

June 16, 2010 02:44pm EST 0 Comments

Flock Jumps from Firefox to Chromium

By Michael Muchmore 0 3 Share 5



The "social" Web browser Flock was originally built atop a Firefox foundation using Mozilla's XUL application framework. Today, though, its namesake Menlo Park [software](#) house announced in a blog post that it was switching to the open-source Chromium platform that underlies [Google's](#) Chrome browser.

Flock becomes the first non-Google browser to accomplish this. The motivation behind the move seemed to be Chrome's considerably faster JavaScript [performance](#), which the announcement calls "superfast" and which is indeed more than twice as fast as Firefox at certain tasks. The new Flock will also use Google as its default integrated Web search engine.

Flock includes features that let you view and organize interactions with Facebook, Twitter and YouTube, as well as RSS feeds. You can organize internet activities by people, topic, and content type using its "Channel Surfer." In addition to the new browser engine, the new version adds a feature called "What Friends Are Saying" that finds info across multiple social networks with real-time search results from bookmarks, RSS feeds, videos, friend status updates, and shared content.

"Our interactions with people online have changed everything about the way we discover, shop, work and play," said Shawn Hardin, chief executive of Flock. "The new Flock is designed to naturally complement the value we place in relationships and puts you at the center of your friends and their conversations while you browse the Web. Conventional browsers like Internet Explorer and Safari aren't built to bring together the conversations and content that matter to each user. Flock is the only browser with the best of the social Web built-in."

The new version, Flock 2.6, is available for [Microsoft Windows](#), with a Mac OS version planned for later this summer.

Originally posted to [AppScout](#).



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by Pallab De | Wednesday, 06th Oct 2010 | Comment | Print | Share / Save

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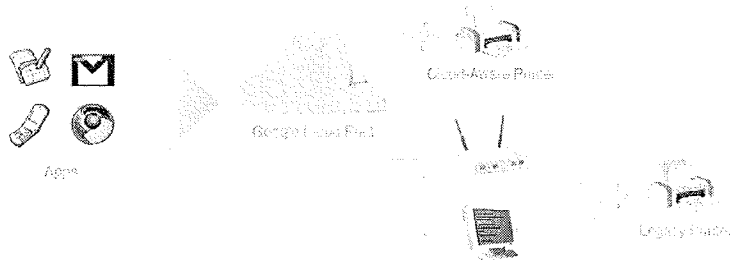
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Ads by Google

Back in August, Google added a Labs section to [Chromium](#) for showcasing the latest [crazy projects](#) from Google [engineers](#). The Chromium Labs [kicked off](#) with only a couple of new features, but has since been expanded to include a few more features.

The latest feature to [grace](#) Chromium Labs is Cloud Printing. [Cloud Print](#) is a feature that was announced earlier by Google for the Chrome OS. In Chrome OS all the apps are web apps. This makes leveraging system drivers to enable native printing support in apps more challenging. Google Cloud Print enables these web apps to submit and manage print jobs without relying on the print drivers.



Cloud Print can be enabled in the latest build of Chromium (7.0.547.0) by typing `about:labs` in the address bar to bring up the Labs section. Cloud Print compatible printers are under development. However, a proxy (a small piece of [software](#) that sits on a PC where the printer is installed) enables legacy printers to work with this new feature.

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Google adds PDF viewer to Chrome beta

Jack Clark ZDNet UK | November 5, 2010 6:23 AM PDT

Google has integrated a PDF viewer into the beta version of its browser Google Chrome. Previously, an integrated PDF viewer was available only in Chromium, the developer version of the browser.

The viewer, introduced on Thursday, makes it possible to view PDF documents within the browser as HTML web pages. It does this through the use of an open-source next-generation API, named Pepper. This means that when opening PDFs, the browser does not need to open a dedicated PDF viewer program such as Adobe Reader, according to Google.

Adobe's PDF software is regularly patched for security flaws to help protect individuals "from malware and security attacks that are targeted at PDF files" Google software engineer John Abd-El-Malek said in a blog post that Google has put a "sandbox" around the Chrome PDF viewer.

For more on this story, read [PDF viewer integrated into Google Chrome beta](#) on ZDNet UK.

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A sneak peek into Google's Chromium Operating System

Monday 23 November 2009 @ 12:39 am in [Operating System](#)

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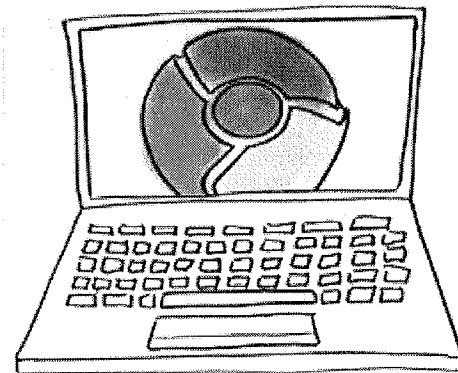
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Google CHROME OS

Have you seen or even tried the developer version of [Google's Chromium OS](#)?

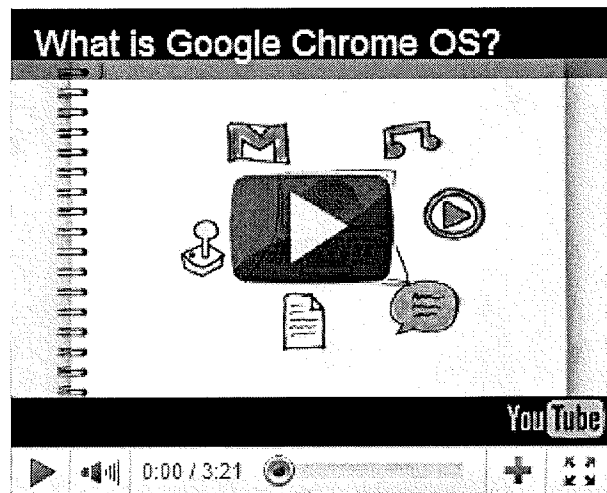
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When I read news about this new OS by Google being released and made available to download as an Image (.vmdk file), I couldn't wait to try it out.

All I know about the Chromium OS is it's supposed to start up very fast and allows us to gain access to our common applications such as email, web browsing, YouTube, google docs without much delay.

If you're like.. wait a minute, I've heard of the Google Chrome browser but what is Chrome OS? Is it supposed to be an OS which replaces our Windows or Mac OSX?

Check out this video below if you've just heard of Google Chrome OS:

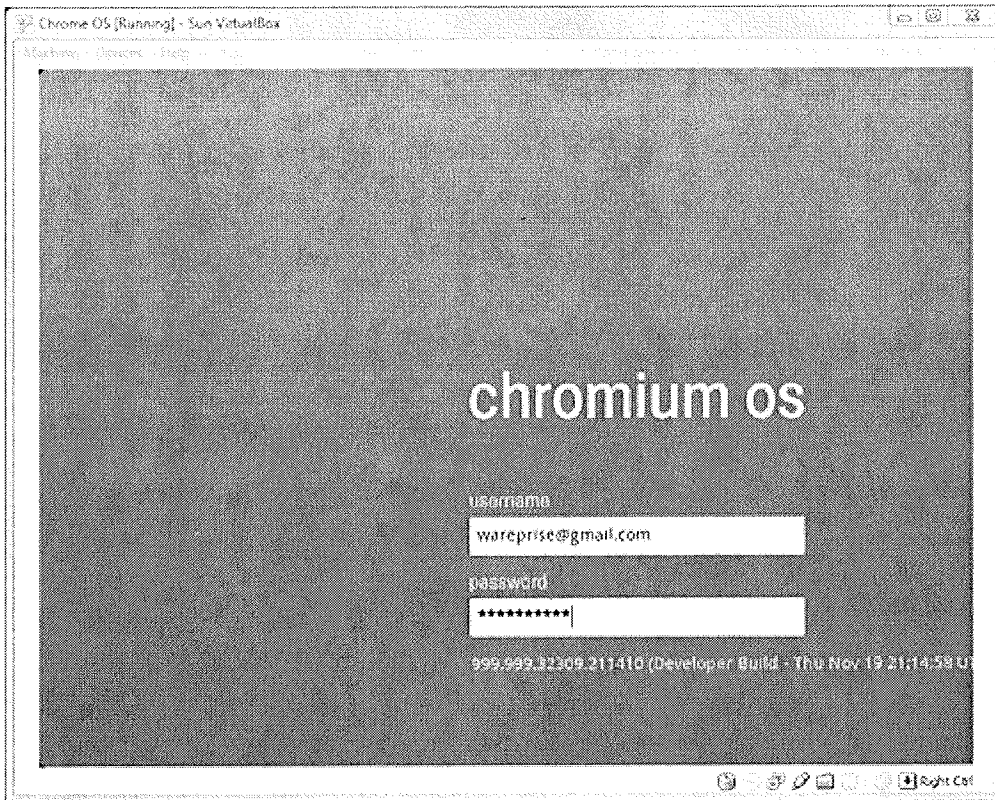


So now that the developer version is ready for us to try out, this is what I had to do in order to test the Google Chromium OS (Developer build):

1. Download the [Chrome OS Image](#)
2. Download and install Sun [VirtualBox](#)

Now with both VirtualBox installed and Chrome OS Image unzipped, it's time to load the image into VirtualBox. If you have trouble getting this to work, check out [TechCrunch's guide on installing the Chrome OS](#).

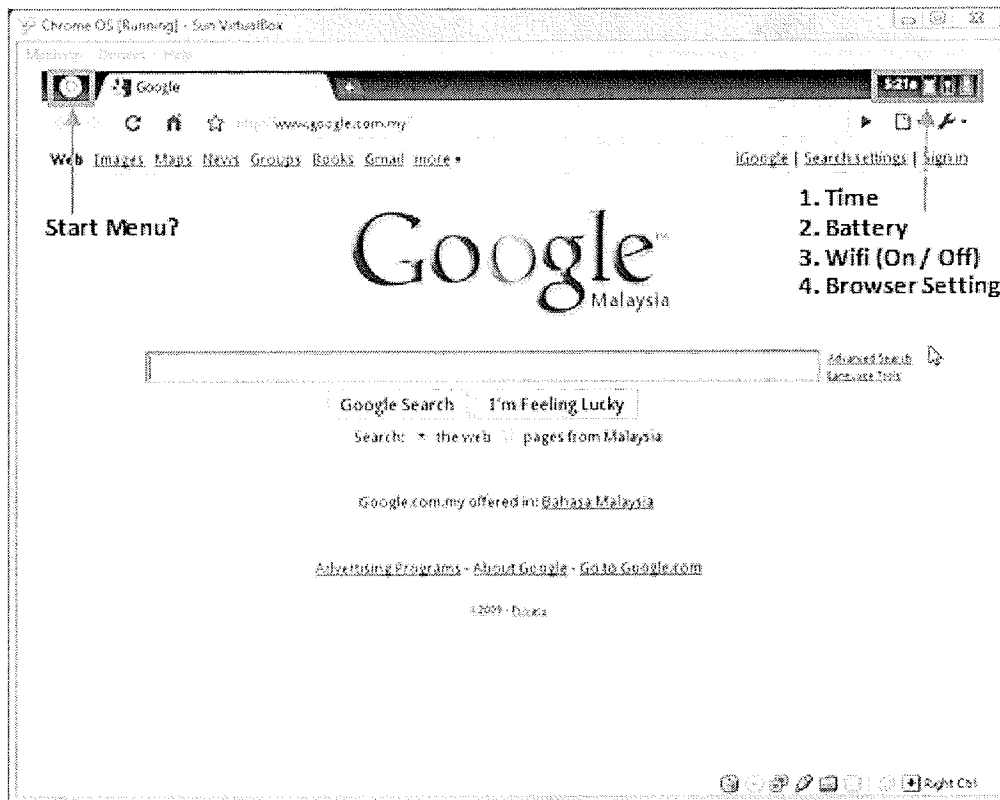
I got mine to work without much problem. Upon launching the image, this is what I got:



A standard login page! I entered my username and password, click Enter and it began to log me in.

So wait a minute! Does this mean that the Chromium OS require us to be connected to the Internet? Looks like it. Hehe.. this is cool. Stateless....

Once logged in, this is what I saw.



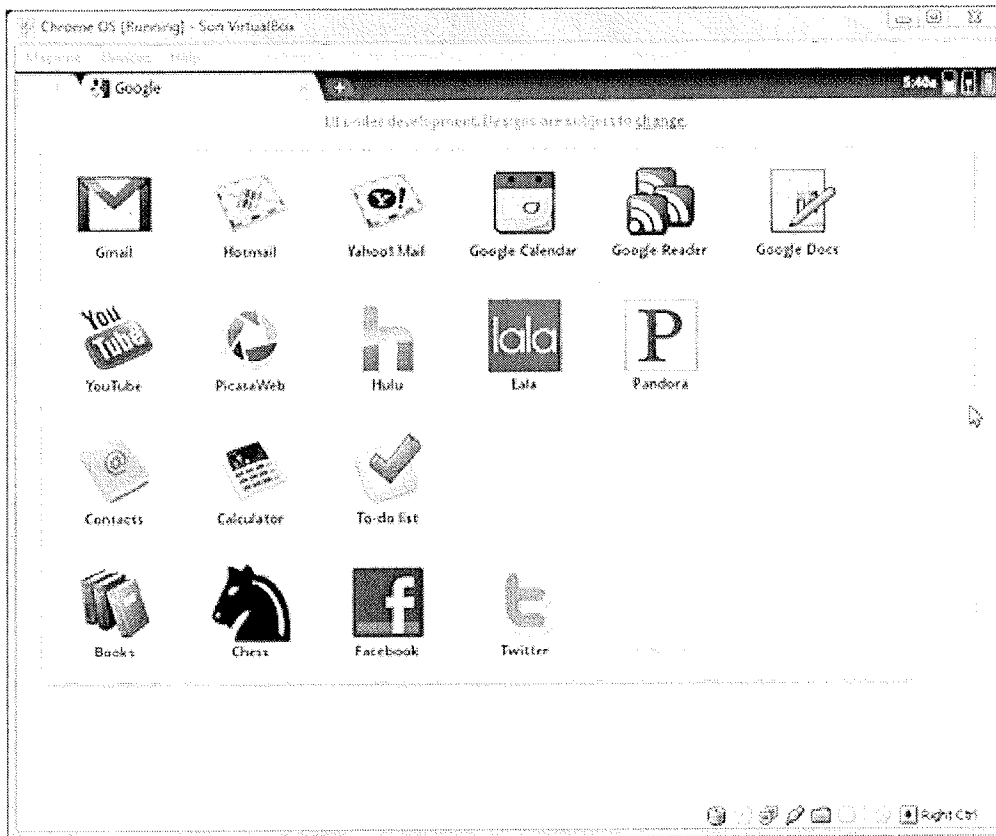
It looks like it's a Google Chrome browser! Yippee... no desktop!

On the top left is a Chrome OS button, I think it's a start menu.

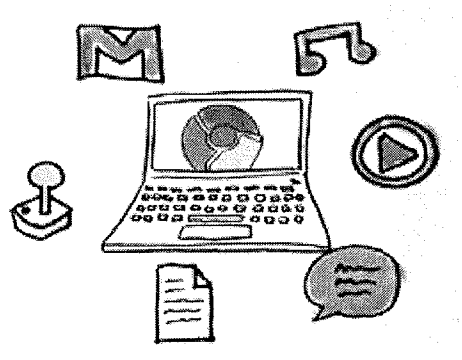
On the top right is the time, battery indicator, wi-fi (on/off) capability and lastly the browser settings.

So looks like the task bar is being placed on top rather than at the bottom.

Clicking on the top left Chrome OS button, it shows a Google Account login page which required for my password again. Upon entering the detail, this is the screenshot:



Notice that it's stated that the UI is under development and the designs are subject to change. But for now, I like what I'm seeing. Very simple and straight forward access to all our common web application. Even my mom knows what to do with it!



It looks like as more and more applications are being hosted on the cloud, the concept of this Operating System might just work for many.

If this OS allows us to install Virtual Machines to run Windows-based applications whenever necessary, I don't see why I won't be switching to this OS as the host OS, when it's made available.

Most of my time are spent on emails and working on web-based application anyways. As long as the OS starts up quickly and doesn't give me much problems with viruses or BSOD, it should work fine for me.

 What do you think about this concept of Google's Chromium OS? I'm definitely looking forward to its launch date!

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