White Paper
Client Virtualization
Enterprise Mobility

Chrome OS based devices in the Enterprise

2015 Edition

Executive Summary

According to IDC, 4.6 million Chromebooks were sold in 2014, roughly twice as many as in 2013. And Chromebook sales are expected to reach 14.4 million units by 2017 according to Gartner[1]. Most of the Chromebooks are currently sold into the U.S. education sector. The adoption of Chrome OS devices in the Enterprise is by far slower. This might be related to concerns regarding application availability, manageability & security and the complexity of adopting yet another platform to the IT infrastructure. There may also exist reservations in regard to hosting business data in the public cloud. But Chrome OS devices may also be used for accessing non-public cloud based applications & data and even legacy apps. The latter has been recently enabled by joint ventures of Google & VMware and Citrix who announced Chrome OS support for their application and desktop virtualization technologies. Having the ability to access Windows applications from a Chrome OS Client significantly increases the versatility of those devices. Business customers now basically have three ways of utilizing Chrome OS (see also table 1).

Google Chrome Apps for Business, Android Apps and Web Apps

This is the "classical" Google solution for business. Utilizing Google Apps for Business and other Web applications, like salesforce.com for example provides businesses with a cloud based working environment that suits many companies' IT requirements and scales from a few users up to 10.000's of users. This is an excellent option for companies with an IT strategy that is based on a "cloud first" model and with few to non-legacy applications. It requires companies to adopt the Google ecosystem and accept that business data is stored in the public cloud.

Chrome OS clients can run three different kinds of applications: Web apps, which run in the Chrome web browser and typically only work when connected to the Internet, Chrome apps, which are stored on the device and can often be used in offline mode and more recently also Android Apps.

Although not all apps support offline usage currently, more & more do. In fact, Google announced that all legacy apps without offline support will be removed from the Chrome Web Store listings in April 2015 and starting October

Table of Contents

2015 those apps cannot be uploaded to the Chrome Web Store anymore[2]. Developers are encouraged to work on new versions of their apps that will eventually support offline usage. Examples of Chrome apps for business that support offline usage include Gmail offline, Google Keep (note taking) and Google Docs for creating and editing documents. A quick check on the Chrome Web Store revealed that there are 391 productivity apps listed that support offline mode (as of March 2015) and the number is rapidly growing.

On the other hand, Web applications like salesforce.com and Microsoft Office Online for example, currently do not support offline usage on Chrome OS clients and require an active internet connection.

Relatively new is the possibility of running Android apps on Chrome OS. Since this feature was announced at Google I/O 2014, 25 Android apps have been made available (as of March 2015) on the Chrome Web Store. Besides bringing a range of new and interesting applications to Chrome OS users, it will further expand the breadth of offline applications available on Chrome OS devices.

Virtual remote Apps and corporate Web Apps

Both Citrix and VMware announced support for Chrome OS. Citrix certified a number of Chrome OS devices which are listed at their Citrix Ready marketplace[3]. VMware's HTML Access with VMware Horizon View 6 and Citrix's HTML 5 Receiver both provide access to backend hosted virtual infrastructures through the Chrome Web browser. In addition, at the end of last year Citrix released[4] a native Chrome OS receiver (Citrix Receiver for Chrome 1.5) which supports direct access to system resources, including printing, audio, video and other benefits above & beyond the HTML 5 based Citrix receiver. These solutions enable Chrome OS clients to access virtualized Windows desktops and applications that are non-cloud/ non-Web app enabled.

Customers adopting these solutions have the option of utilizing Windows servers or desktops in their datacenter or can alternatively rent virtualized Windows desktops or applications from service providers offering DaaS (Desktop as a Service) and/or SaaS (Software as a Service) services. VMWare vCloud Service Provider

Public Cloud	Private Cloud	Hybrid Model
Chrome Apps, Web Apps and Android Apps	Web Apps and/or Virtual Remote Apps & Desktops utilizing Thin Client model	Use combination of public & private cloud model

Table 1: Chrome OS device usage models

Partners (VSPPs) or Citrix Service Provider Program Partners (CSPs) are most likely the right contacts for such offerings.

While Windows and Linux based clients support Windows Multimedia and Flash redirection, Chrome OS clients do have some limitations when it comes to redirecting digital media computations from the server to the client. Neither the Citrix HTML 5 receiver nor the new native Receiver for Chrome support Windows media and Flash redirection (see the Citrix Receiver feature matrix here). Therefore, digital media decoding & recoding needs to be done in the data center which will put a significant load on the server CPU, especially if there is no GPU support available.

There are two major options to bring GPU support into servers: add a graphics card that is supported in VDI type of environments or deploy servers with CPUs that have the GPU integrated on the chip like the Intel® Xeon® processor E3-1200 product family of server CPUs for example. These integrated GPUs can significantly increase the number of users supported per server when access to digital media is required since they offload certain processing from the CPU to the GPU. On May 12th 2015, Citrix announced Intel GVT-d (GPU pass-through) support with its Service Pack 1 (SP1) for XenServer 6.5[5]. Customers now have the capability to deploy GPU pass-through using the natively integrated GPU of the Intel Xeon processor E3-1200 product family, without the need for additional GPU hardware and can deploy virtualized desktop infrastructures with GPU pass-through at no extra cost. Additionally, use of a standard Intel® Graphics Driver within the guest VMs reduces image management overhead of deploying and maintaining these virtualized application and desktop infrastructures.

One category of users that would benefit from GPU support in backend servers are Knowledge Workers. They demand digital media access because they usually run applications like Powerpoint, use PDF files – potentially with embedded interactive 3D graphics, watch Adobe Flash videos and attend webcasts that include digital video. GPU enabled servers reduce the load that those type of applications put on the CPU and therefore improve user experience and enable new media rich applications to be hosted in the data center which was not possible a few years ago.

Hybrid Model

This is simply a combination of the above two models to allow users to access Google enterprise services in the public cloud as well as virtualized application and/or desktops through the Thin Client compute model.

One area that businesses using Microsoft Skype for Business formerly called Microsoft Lync) should take into consideration is that currently there is no practical solution to enable collaboration between Google Hangouts and Skype for Business users. This can be a major issue for corporations requiring seamless collaboration of Chrome OS and Windows users.

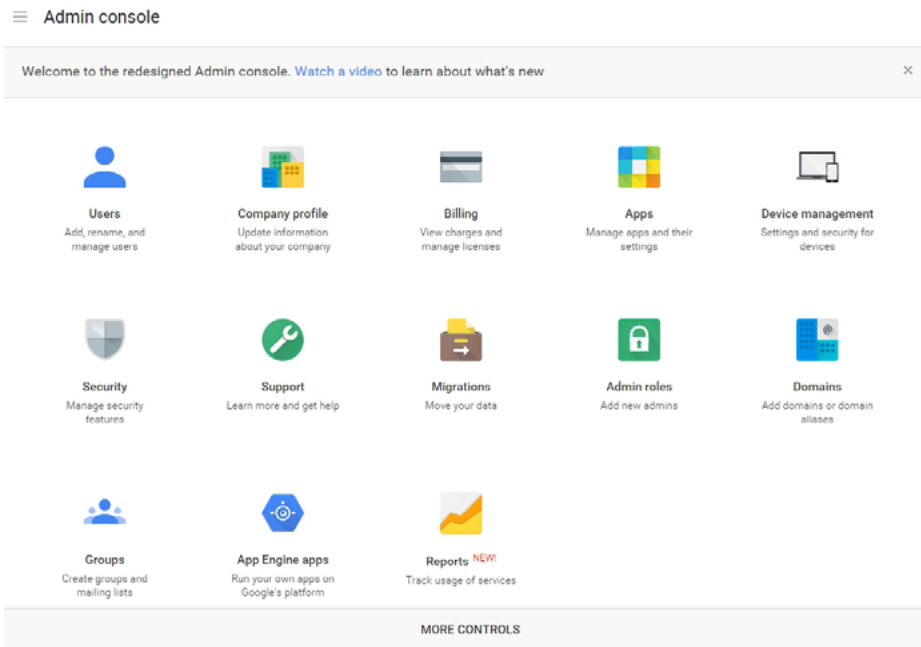

Figure 1: Google's Chrome Management Console

Independent of the usage model, an important aspect of using Chrome OS clients in business is how those devices can be managed.

Management of Chrome OS Clients

The Chrome Management Console is Google's cloud based tool for managing Chrome devices. It allows IT to configure security settings and install applications for individual devices or groups of devices from a single, central web-based portal. Devices can be auto-enrolled when a user first logs in, creating a zero-touch deployment experience. Once a user is logged in, Chrome OS devices are automatically configured with the designated apps, network and other settings without any manual IT intervention.

Chrome device management is available for Chrome OS devices purchased directly from Google or an authorized reseller. To manage Chrome devices from third-parties, a management license must be purchased separately from the Google Chrome devices for Business or Education sales teams. On the 8th of October 2014, Google announced a new licensing model that includes support and device management for an annual fee of $50 per device/year[6].

Chrome device management enables IT to configure Chrome features, setup network access (e.g. VPN and WiFi), pre-install Chrome apps and extensions amongst other things. Settings can be applied to organizational units or an entire company. Policies can be enforced or allow users to change default settings after the provisioning process. Policies are applied at login and periodically synchronized. Devices can only be managed if they are part of a domain and users must have a Google or a Google Apps account. Large enterprises can use Google Apps Directory Sync[7] to synchronize user data between an existing LDAP directory (e.g. Microsoft Active Directory) and the Google Apps directory. This does not solve the issue though that Chrome devices and their users will be managed separately from other devices and users stored in the existing enterprise Active Directory.

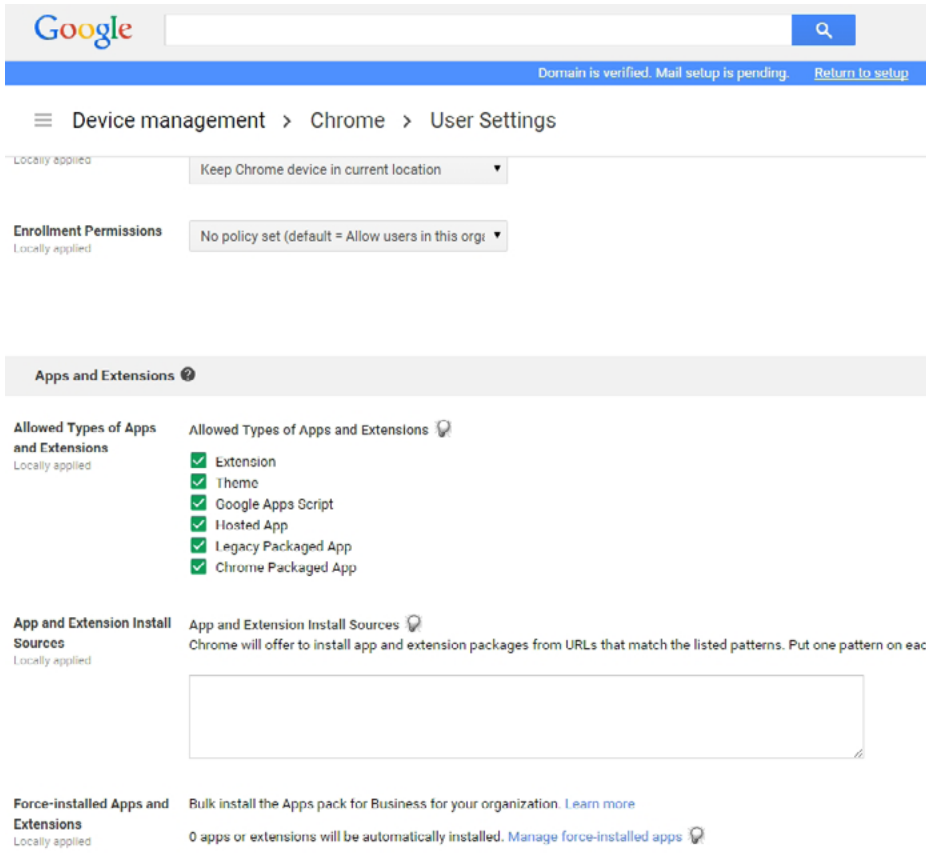

Figure 2: Example of Chrome User Policies

The Chrome Management Console can be accessed at admin.google.com and the following types of policies can be managed:

User settings

Group of Policies for Chrome device users within an organizational unit. For example, allow or block apps and extensions. Pre-install apps and extensions and create private collections of Chrome apps for domain users in the Chrome Web store.

Public session settings

Public sessions allow multiple users to share the same Chrome device without requiring a user to sign in with his or her Google credentials. Use cases for public sessions are for example: hotel internet access, business center, retail store kiosks.

Device settings

Policies for enrolled Chrome devices within an organization. The policy applies to anyone who uses the device, even if the user is in Guest mode or signs in with a Google account outside of the organization. One example of an important device setting is Auto-Update: it specifies whether Chrome OS devices automatically update to new versions of Chrome OS as they are released or not. For security reasons it is highly recommended to always update to the latest version of the OS automatically.

Network settings

Configure Wi-Fi settings for all of the Chrome devices enrolled in a domain, or for logged-in users from specific sub-organizations within a domain. Also VPN settings can be configured with these policies.

Applied policies can be viewed in the Chrome Web browser using chrome:// policy as the address. User policies affect all users signed into the Chrome browser with the Google or Google apps account, independently of the platform being used. Device related policies only affect users of Chrome OS devices, not those using Chrome on devices running Windows, Mac OS or Linux.

A few Words about Security

Chrome OS devices are highly secure. The OS protects itself from malware, does not allow users to install any software from unknown sources that interact with the OS directly and uses an encrypted file system to protect data stored locally. It also takes care of updating the integrated virus protection system and protects apps from each other through a technology called sandboxing.

Verified Boot: Chrome OS is digitally signed by Google and pushed down to the device. At boot time the device verifies that the OS is intact and has not been tampered with. If it detects any issues it tries to repair itself and can fall back to the last known good version of the OS.

Automatic Updates: The integrated virus protection stays up-to-date automatically. Chrome OS manages updates silently in the background.

Sandboxing: Each Web page and application runs in a restricted "sandbox" environment. If one tab is infected, it is isolated from the other tabs and therefore cannot infect other apps or data on the device.

Encrypted File System: All stored data is encrypted and the encryption keys are saved in a TPM. Because of that removing the built-in storage device and attaching it to a different system does not provide access to stored data. In addition, users cannot access data from a different accounts because every user has its own protected storage area.

Not addressed by local device security though is privacy in the cloud. By using the public cloud a lot of business (and most likely private) data is stored in remote data centers. Besides of securing this data from hackers, cloud service providers must also secure it physically and legally. Particularly US based providers might be obliged to breach European data protection and privacy laws by US authorities seeking access to such data[8].

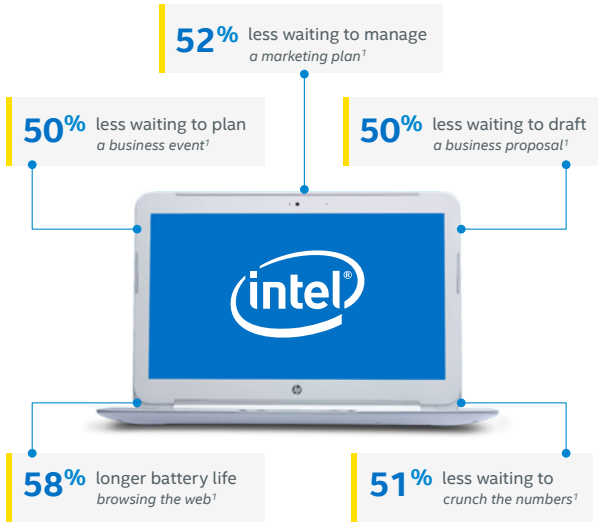

Figure 3: Principled Technologies Benchmark results[3]

Intel® Architecture based Chrome OS Client Benefits

The Chrome OS is based on Linux and Intel is one of the biggest contributors to the Open Source community in general and the Linux kernel in particular. More than 1,000 software engineers at Intel are spending their time working on Linux and Chrome OS in order to unleash the maximum potential of the Intel silicon. This includes performance, energy efficiency and security optimizations for the Intel® platforms. The successful work of those engineers becomes apparent in Industry benchmarks that show that Intel® processor-based Chromebooks are leading in performance and energy efficiency.

Principled Technologies compared the enterprise performance of a Chromebook based on Intel® Celeron® processor 2955U with a Samsung Chromebook that includes the Exynos 5 processor[9] (both dual-core) and came to the conclusion that the performance of Intel processor-based Chromebook is in many cases at least 50% higher while at the same time the battery life is also 58% better (see Figure 3). This of course means that users are less waiting because tasks are completed faster and can rely on all day battery life of their mobile Chrome OS devices.

Principled Technologies recently published a new benchmark for Chrome OS devices called CrXPRT 2015[10]. CrXPRT provides an objective measurement of Chrome OS performance qualified battery life through real-world Web Application usages such as Photo Effects, Face Detection, Offline Notes, Stocks Dashboard, DNA Sequence Analysis, 3D Shapes and Photo Collage. For battery rundown, the Web Application usages are woven into a day-in-a-life scenario which includes Video Playback, HTML5 Game, Audio Playback and Idle time. A battery life rating can be produced in three and a half hours. CrXPRT results are published here.

Using CrXPRT 2015 Intel compared the performance of two new entry-level Chromebooks from Asus and Hinsense. The Asus Chromebook C200 is based on the Intel Celeron processor N2830 whereas the Hinsense Chromebook uses a Rockchip RK3288 CPU. The benchmark results clearly demonstrate that the Intel Celeron processor based Chromebook leads in performance in all of the CrXPRT use cases (see Figure 4). In addition, CrXPRT performance qualified battery life test demonstrated that the Intel® architecture based Chromebook lasted 4.9 hours longer than the competitive product resulting in a total battery life of 11.1 hours.

Conclusion

Chrome OS devices are still a minority in the enterprise but IT departments are increasingly looking at those clients to see how they may fit their requirements. With the announced support for Chrome OS in VMware and Citrix based virtualization environments the versatility of those devices has increased and Chrome OS users are now capable of accessing legacy Windows applications in the data center. IT has the option to use those devices as an alternative for their established Thin Clients. Especially Chromebooks seem to be an attractive replacement for mobile Thin Clients due to their low cost and zero-touch deployment support.

For companies that are following a "cloud first" IT strategy and are fine

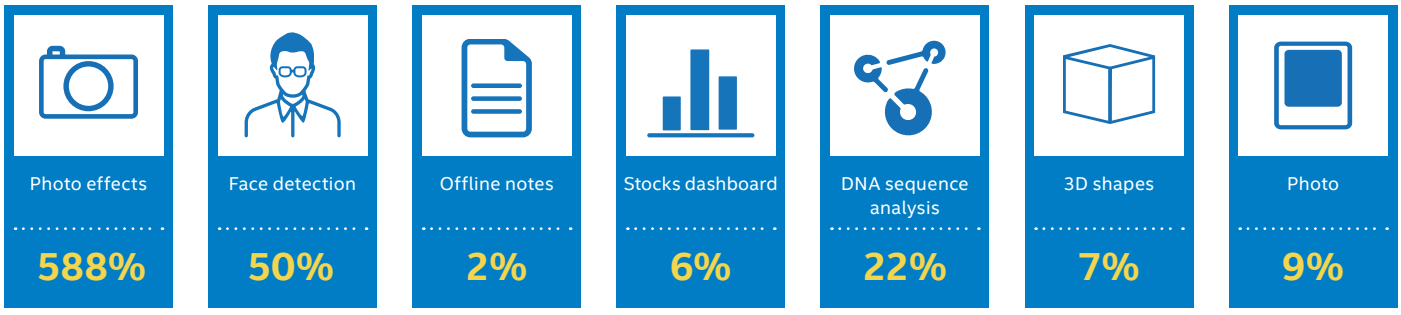

Figure 4: Comparing performance of Intel Celeron N2830 based Chromebook with Rockchip RK3288 based Chromebook using CrXPRT 2015. Numbers show Intel performance lead in % for specific use case.

with hosting their data in the public cloud, Chrome OS devices might be a good fit, especially if legacy apps are not big concern. If Microsoft Office is required, Office Online can be a solution. It provides free web based access to Word, Excel, PowerPoint and OneNote, although only basic functionality is supported and users must be online.

So in summary: companies should take a look to experiment with Chrome OS devices in areas where it may make operational sense. The expectation is that Google will address current limitations over time and Chrome OS devices will eventually become totally Enterprise ready.

[1] http://www.gartner.com/newsroom/id/2819917

[2] http://blog.chromium.org/2014/06/migrate-your-legacy-packaged-apps-to.html

[3] http://citrixready.citrix.com/ready/en_us/category-results.html?category=c1-computers-and-mobile-devices/c2-chromebooks

[4] http://www.citrix.com/downloads/citrix-receiver/chrome/receiver-for-chrome-16.html?_ga=1.187551467.234691832.1409734176

[5] http://blogs.citrix.com/2015/05/12/xenserver-v65sp1/?_ga=1.171896547.234691832.1409734176

[6] http://googleforwork.blogspot.com.au/2014/10/chromebooks-for-work-more-manageable.html

[7] https://support.google.com/a/answer/106368

[8] http://www.zdnet.com/u-s-search-warrant-can-acquire-foreign-cloud-email-data-judge-rules-7000028828/

[9] Findings by Principled Technologies as documented in Comparing Chromebooks for Enterprises and Comparing Chromebooks for Small Business:
http://www.principledtechnologies.com/Intel/Chromebook_enterprise_0214.pdf
http://www.principledtechnologies.com/Intel/Chromebook_small_business_0314_v2.pdf

[10] http://www.principledtechnologies.com/benchmarkxprt/crxprt

System Configurations used for CrXPRT 2015 benchmark:

Hisense* Chromebook* with Rockchip RK3288, 4T/4C, 1.8 GHz, 2 GB memory, 16GB eMMC, 11.6" display @1366 X 768, Chrome OS v.42.0.2311.87, XX WHr battery, $149 US (Walmart May 1, 2015)

ASUS* Chromebook C200 with Intel® Celeron® processor N2830, 2T/2C, 2.16 GHz up to 2.46 GHz, 2 GB memory, 16 GB eMMC, 11.6" display @1366 X 768, Chrome OS v.42.0.2311.87, 48.5 WHr battery, $179 US (Walmart May 1, 2015)