IT@Intel
Delivering an Enterprise App Store

The Intel® Software Market simplifies employees' ability to search, download, and launch apps from PCs and mobile devices.

Gavin Morriss
IT Architect and Engineer, Intel IT

Izhak Haddad
Manager, Intel IT

Sagi Bar-Or
Business and System Integration, Intel IT

Liat Almor
Project Manager and Product Manager, Intel IT

Executive Overview

IT consumerization and bring your own device (BYOD) continue to grow and influence the expectations of Intel employees. One of the most obvious examples is the need for business apps. Until recently, Intel maintained multiple app stores and delivery platforms, resulting in inconsistent experience, quality, and support.

Our primary goal was to improve the user experience. Intel IT developed an integrated enterprise app store, the Intel® Software Market, which simplified employees' ability to search, download, and launch apps from PCs and mobile devices. We initially explored purchasing a solution, but it was clear that in order to provide a consistent, branded user experience, the best approach was to develop our own solution.

We began with developing the PC app store, using a native client to begin consolidating the existing app store experiences by implementing a single database and web service. We used an open backend to support the future demands of BYOD.

Employees rapidly adopted the new app store and word of mouth spread quickly. Employees also provided positive feedback about the rapid response they received to their questions and suggestions. Their inquiries significantly contributed to the improvement of the user experience.

This strong positive feedback also inspired us to expand the app store design to Intel's existing mobile app store using the same architecture and user interface (UI). We have not yet merged the PC and mobile app stores and we are still in the process of migrating apps from the old stores. However, creating a consistent UI across the two platforms has provided users with a seamless experience regardless of platform.

Contents

Acronyms

BYOD	bring your own device
CSS3	Cascading Style Sheet version 3
DSL	Definitive Software Library
HTML5	Hypertext Markup Language version 5
JSON	JavaScript Object Notation
SOAP	simple object access protocol
UI	user interface

The improved processes and close communication between app owners and users has led to a better overall user experience. As adoption of the new PC app store grows we continue to improve overall quality and standards, leaving behind apps that are no longer of value and focusing our attention on the most useful apps.

Background

Intel employees have an increasing need for business apps on their PCs and mobile devices. Because devices often serve different purposes, employees need to download apps to multiple devices. They also upgrade their devices more often than before, requiring repeat downloads of the same content. Previously, obtaining these apps involved accessing multiple app stores and delivery platforms with a wide range of user experiences, quality, and support.

Due to IT consumerization, employees have sophisticated expectations. To meet these expectations, we wanted to streamline the way employees obtain business apps for their devices through a consolidated online tool and with improved user experience.

Our Starting Point

Until early 2013, Intel IT maintained four major apps stores, each using its own database, logic, and infrastructure. This created challenges for the store owners and the employees looking for apps. Each store was maintained by a different group within IT, and in some cases the technology was nearing its end of life. Employees were experiencing compatibility issues, and some stores required an IT agent to help navigate the purchasing process. There was also a significant difference in user experience between the mobile stores and the PC stores because apps needed to be downloaded from several locations, requiring employees to navigate between multiple platforms and processes.

Our Goals

Embracing the trend toward IT consumerization and bring your own device (BYOD), our goal was to deliver a single place for employees to find, download, and launch apps for PCs and mobile devices. Improving the overall user experience and meeting employee expectations was the main goal. To achieve this, we focused on the following areas:

- **Consistent user experience.** Deliver the simplicity of commercial app stores for installing and launching apps with minimal user interaction, including a list of top-rated and most-downloaded apps.

- **Search capabilities.** Use a single database and catalog to improve employees' ability to easily search for all apps across stores, including the use of autosuggestions and category browsing.

- **Feedback loop.** Improve our feedback mechanism to better assess the usage and value of apps in the store as well as provide that feedback directly to app owners.

- **Cross-platform/device support.** Deliver an open, client device-agnostic backend that enables app owners to manage their apps, such as restricting access to specific groups using a single portal.

- **Lifecycle management.** Provide app owners with tools and processes to manage the app lifecycle, such as adding, updating, and removing apps.

- **Consolidated delivery mechanisms and support.** Standardize security access and the process to download and install native apps on all devices.

Our Approach

We recognized that consolidating the existing stores into a single "one-stop shop" experience for employees was a significant effort, spanning multiple teams and technologies. We decided to approach it as a program, developing a holistic solution. When faced with decisions about integrating technology or changing existing workflows, we considered the user experience first.

We initially explored the option of purchasing an off-the-shelf solution. It quickly became clear that third-party suppliers focused in one area— either mobile or PC, but not both. To provide a consistent, branded user experience, we determined that the best approach was to develop our own solution.

> When faced with decisions about integrating technology or changing existing workflows, we considered the user experience first.

Solution

As with any app developed at Intel, we needed to first decide on the appropriate delivery mechanism—Hypertext Markup Language version 5 (HTML5), native, or hybrid.[1] Our first decision was whether to develop a native client or use HTML5. HTML5 offers multiplatform support of the tagging language which would allow us to build a unified user interface (UI) for PCs with a variety of operating systems as well as for tablets and smartphones. However, additional criteria led us to choose a native approach:

- **Compatibility.** We wanted our app store to run on all devices and browsers in use at Intel, including those that are not compatible with HTML5.

- **Native client presence.** To perform application inventory and verify that apps are still installed for targeted app updates, the app store requires access to a local resource on the client.

- **Time to market.** Since our team was already familiar with native app development, their experience would enable us to deliver apps more quickly than if we spent time on training for the HTML5 and Cascading Style Sheet version 3 (CSS3) development environments.

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[1] For more information about app delivery mechanisms at Intel, refer to the white papers "Optimizing the Developer and User Experiences for Cross-Platform Applications," "Implementing a Cross-Platform Enterprise Mobile Application Framework," and "Building a Mobile Application Development Framework."

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Our initial focus was the PC app store. However, we wanted to build a solution that included a UI that could adapt to differing screen sizes so that the UI was consistently user friendly, regardless of the device. For these reasons we decided on a native client graphical UI for PCs. The program included consolidating the existing app stores into a single database, catalog, and web service.

We used an Agile development approach with frequent software deliveries and an ever-increasing feature set—and we met our goal of delivering a solution within six months.

Solution Architecture

Though our initial focus was on PCs, in order to accommodate later versions of the enterprise app store, which we branded as the Intel® Software Market, we split the client architecture into separate components: service and data.

The architecture components include the following (illustrated in Figure 1):

- **Web services.** RESTful web service middle layer exposes the two end points: traditional simple object access protocol (SOAP) for PC and JavaScript Object Notation (JSON) for mobile.
- **Definitive Software Library (DSL).** A security group restricts access to the DSL to exclude nonmembers of that group, which is defined by the app owner. With new inventory capabilities we also handle license management.
- **Application catalog.** A database of all relevant information and metadata for the apps, such as descriptions, icons, and screenshots. Additionally, the catalog manages all user profiles, including what the user downloaded, when, and to what machine or device.
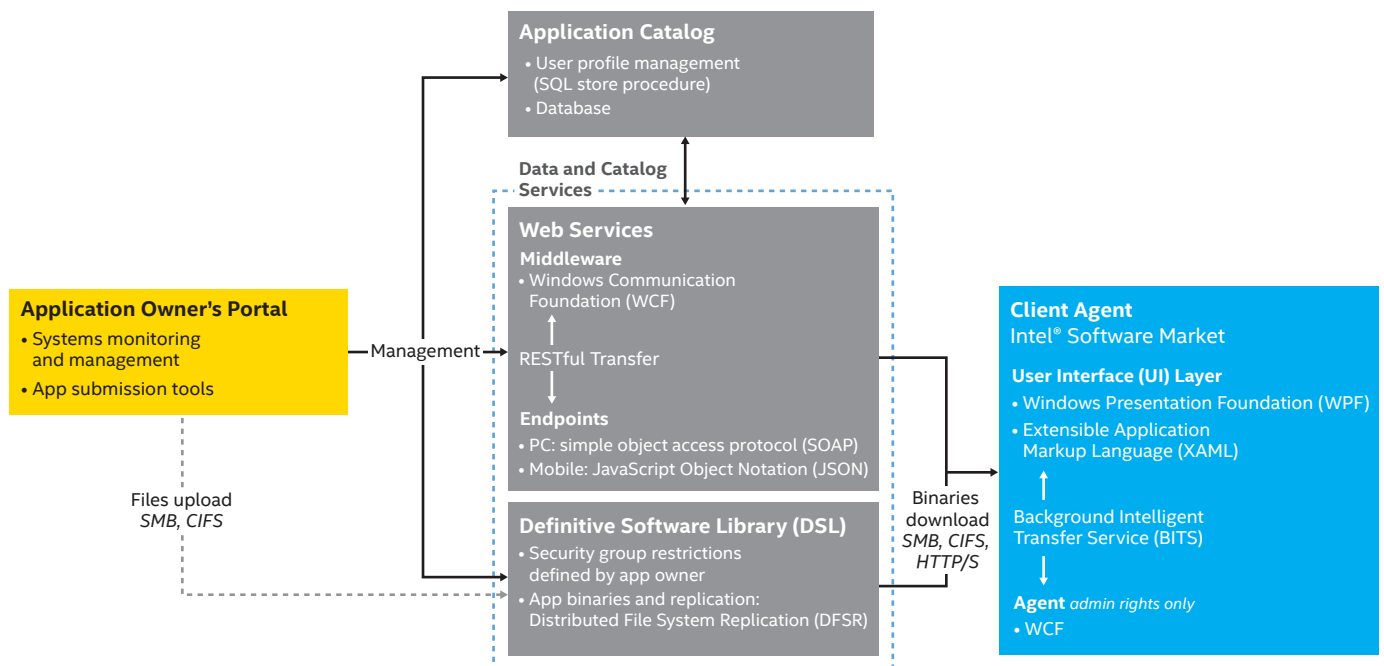

Figure 1. The client architecture is separated into service components and data components to accommodate later versions of the Intel® Software Market.

- **Application owner's portal.** App owners submit apps to the market using an automated process called the application lifecycle. This process includes well-defined steps that indicate what path the app will take from upload to appearance in the store. Apps appear immediately to the app owner and quality assurance team for testing before becoming available to end users.

- **Intel Software Market client agent.** The client agent manages software download, installation with specific configuration, and reports back app inventory on the machine. To achieve this, it is designed as a separate agent for handling all operating system interaction with privileges to execute commands.

With this solution architecture, the only component that needs to be changed across devices for updates is the UI layer (illustrated in Figure 2). The data models and intermediate classes that call the client agent and web services for data can be reused across different clients and operating systems. This enabled us to save coding hours by using the same libraries. It also enabled us to simply replace a single Dynamic Link Library file rather than reinstall the client agent when new versions are released.

Solving Technical Challenges

Developing the technical architecture resolved many issues by creating a seamless user experience that was easy to update across platforms and devices. However, managing the content was still a challenge. Not only did we have legacy apps in several places that needed to be migrated to the new Intel Software Market, but we also needed to select the apps that were most useful for employees, improve the search functionality while restricting inappropriate access, and manage the quality of apps yet to be developed.

Migrating Existing Apps

Identifying existing apps and their locations proved to be one of our biggest challenges, as was deciding which ones to migrate. Thousands of apps are submitted to our existing app stores every year. Because a consistent user experience was a core goal of the project, we didn't want to migrate apps that were no longer in use or didn't meet the minimum requirements for quality and metadata. At the same time, we knew that the new PC app store needed enough relevant apps to make it useful for employees. We determined that all apps needed to be analyzed to validate whether they were needed and used.

In spring 2013, we created a packaging team to evaluate and migrate the most frequently used and highest-rated apps to the Intel Software Market first. We migrated about 200 apps and left the others behind to natural obsolescence or to be migrated by the app owners based on demand.

Intel® Software Market Client Agent

User Interface (UI) Layer
• Manages app installations and updates
• Pushes notifications and updates
• Enables access to user accounts

Background Intelligent Transfer Service (BITS)

Agent *admin rights only*
• Manages BITS and network drops
• Manages software inventory
• Reports app inventory for managed apps
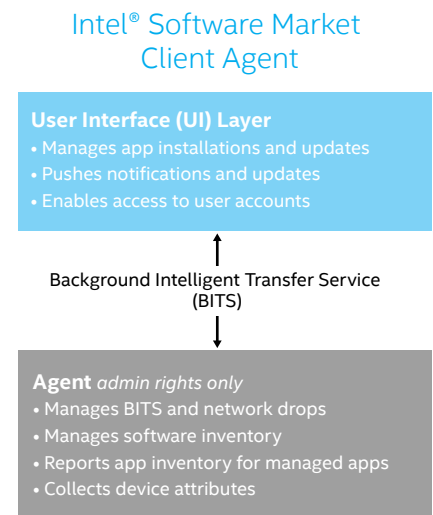• Collects device attributes

Figure 2. In the Intel® Software Market client agent, the only component that needs to be changed across devices for updates is the user interface (UI) layer.

Enhancing Search

Another challenge was providing an easy, accurate, and fast way to search for apps, whether the app is for desktop or mobile, or whether it is purchased or free. The search function needed to perform a deep search within the app metadata to consider multiple factors. We also wanted the search function to suggest other potentially relevant apps to the user. Full-text search appeared to be the answer, so we created a full-text index. Once the full-text table was populated, queries returned results and ranked them based on the following:

- A partial- or full-string match
- The given search text as a prefix of the word
- Metadata, such as application name, description, vendor name, and keywords

We gathered more information about the search capability from our users' feedback. Complex search results can be difficult for the user to understand if they are not aware of the search algorithm. This leads to confusion about why certain apps appear in the search results. In the future we may provide options for basic search, such as app name only, as well as advanced (deep) search.

Implementing an Application Lifecycle

We developed a new application lifecycle that included quality standards. The lifecycle outlines a well-defined list of steps that indicate what path the app goes through from the time the owner uploads it to the Intel Software Market to when it appears to employees. Apps in the new store needed to include all the appropriate metadata as well as meet the quality standards. To manage apps consistently, we created an application owner's portal, and we identified mandatory and optional steps in the process.

- **Application owner's portal.** This is a single location where app owners can manage all aspects of their apps, from submitting and updating apps to tracking customer use and feedback.
- **Lifecycle process.** Apps submitted to the app store are viewable immediately by the owner and the quality assurance team, but they are not available for download until we verify that they meet our quality standards. Some steps in the lifecycle process are required for all apps, such as applying a core set of metadata including name, description, and version. But not all steps are required for all apps. The process allows us to consistently apply the basic requirements without burdening the app owners with unnecessary steps. The following are examples of ensuring metadata quality:
  - Application names must be clear and correct, and cannot be composed of acronyms.
  - Icons and screenshots must meet the minimum requirements for resolution and content.
  - Descriptions need to clearly depict what the app is, who can use it, and how.

The application lifecycle ultimately makes app owners accountable for the quality and overall user experience of their apps.

> The application lifecycle process allows us to consistently apply the basic requirements without burdening the app owners with unnecessary steps.

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Securing Content by Access Levels

The new design uses a hierarchy directory service to access the DSL. All users can see the app in the Intel Software Market; however, only authorized users can download and install the app. This new design, along with new capabilities for managing inventory, solves license management issues in addition to access security.

Solving Organizational Challenges

Prior to adopting the application lifecycle process, app quality was largely self-policed. Providing a consistent user experience required new IT-governed standards and workflows, which was a new requirement for many app owners. With the new PC app store, each app is governed by the Intel Software Market admin to meet the basic user experience requirements.

In addition, we supply an optional IT certification workflow in which apps are prepared and verified by the packaging and quality assurance teams.

We engaged several business groups to test and validate our PC app store base functionality. Communication was a key part of the migration. We communicated early and often across multiple channels, informing employees of changes to the app store in the following ways:

- Support and discussion forums on the Intel intranet
- Referrals on the homes pages of existing app stores
- Application owner's portal for information about lifecycle and migration

We received positive feedback from employees regarding the rapid response to their email suggestions and from those who were pleased with the new UI. We also received requests for additional apps that may not have been migrated at the time and requests for version numbers. As we expected, many people wanted to know when we would extend the PC app store to mobile devices.

App Quality Standards

We implemented significant quality standards for apps in the new Intel® Software Market. Previously, each app owner was responsible for the quality of their app. Since some app owners were more comprehensive about descriptions and metadata than others, it created an inconsistent user experience. With the Intel Software Market, all apps are verified to meet basic metadata requirements, such as a clear name and appropriate description.

Now app owners create installation packages based on minimum user experience standards. For example, users should not be required to select options unless absolutely necessary, and redundantly clicking "Next" was eliminated. Every app goes through a quality assurance check by the Intel Software Market admin.

Some app owners initially considered the changes as intrusive, but the feedback from users helped app owners understand the value in a standardized user experience. New app owners who do not follow the quality standards are referred to the documentation for instructions on improving the package, while veteran app owners appreciate that the additional effort helps to ensure error-free apps.

Results

With the multichannel communication approach we took during migration, we received positive feedback from employees. And while app owners were initially wary about potentially receiving negative feedback from users, they soon discovered that since the communication process was improved, this helped the team to continually improve the apps as well as the store.

The Contact Us feature is now monitored by an admin, ensuring that questions and suggestions are immediately routed to the appropriate person for resolution. Employees have provided positive feedback related to the rapid response to their initial inquiries. This feature has allowed us to shorten the support process between app users and owners, and it also allows the owners to better understand how their apps are being used. App owners have become accountable for the app quality and overall experience through direct feedback from users.

In addition to the direct feedback, employees can rate apps based on a standardized five-star system. Similar rating systems existed in the previous app stores, but due to the number of stores, the ratings were inconsistent.

During the pilot phase and moving into the present, employees have rapidly adopted the new PC app store, and word of mouth has helped increase the number of downloads. Employees have sent feedback expressing enthusiasm for the new design (see Figure 3), such as "Congratulations on launching such a nice tool which will be very helpful for everyone" and "I like your new Intel Software Market place very much. Nice interface." We also received questions about where employees can find specific apps, helping us further identify the most valuable apps to migrate.

With improved analytics (Figure 4), we can track the number of apps available in the Intel Software Market as well as user statistics and top downloads.
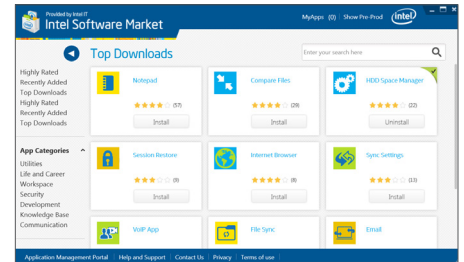
Figure 3. The Intel® Software Market homepage for PCs provides links to application categories as well as links to featured apps: highly rated, recently added, and top downloads.
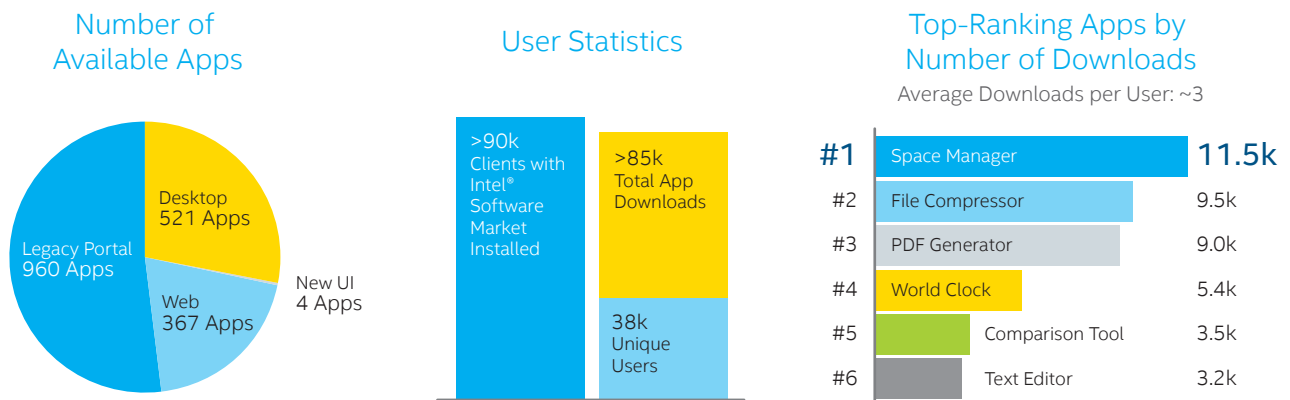
Number of Available Apps

Desktop
521 Apps

Legacy Portal
960 Apps

Web
367 Apps

New UI
4 Apps

User Statistics

>90k
Clients with Intel® Software Market Installed

>85k
Total App Downloads

38k
Unique Users

Top-Ranking Apps by Number of Downloads

Average Downloads per User: ~3

Rank	App	Downloads
#1	Space Manager	11.5k
#2	File Compressor	9.5k
#3	PDF Generator	9.0k
#4	World Clock	5.4k
#5	Comparison Tool	3.5k
#6	Text Editor	3.2k

Figure 4. As of early 2014, the Intel® Software Market has been accessed by more than 90,000 devices, downloading the newly migrated apps.

Expanding to Mobile

With the PC app store receiving strong positive feedback from employees, we started migrating Intel's mobile app store to the new architecture and UI. We decided against merging the stores into one because of the different underlying technology required for managing PC and mobile apps. Instead, we developed a consistent UI across the two platforms to give users a seamless experience regardless of platform. In late 2013 we completed the following functionality for the mobile app store:

- Search
- Browse
- Download and install
- App categories
- App metadata
- Integration with the PC app store catalog

We reused parts of the PC app store's backend infrastructure, and we used the same catalog.

In the next phase we will address feedback and ratings in the mobile app store, autonotifications of updates, and the "My Apps" feature. We anticipate complete migration of mobile apps by the end of 2014.

Future developments in the app stores include considering additional opportunities to consolidate the PC and mobile stores. We will then reevaluate the buy-versus-build question and determine whether it is better to purchase a mobile app store that integrates to our PC store backend or build one with our existing mobile device management store. Some suppliers are improving their true cross-platform solutions, which we will monitor as we design a consolidated store. If we continue to consider the build model, we will explore opportunities to build future solutions on a supplier's platform and provide application programming interfaces for publishing.

"We chose to dive in headfirst and become Agile overnight. Now, this wasn't easy. But it did enable us to deliver a useable product in a reasonable amount of time."

–Sagi Bar-Or
Business and System Integration, Intel IT

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Conclusion

Intel IT has developed a seamless UI across PC and mobile platforms through an integrated build approach that focuses on delivering a consistent user experience. As we continue migrating our existing app stores, the new Intel Software Market is becoming a "one-stop shop" for Intel employees to search, download, and launch apps that make them more productive in their daily work.

The increase in IT consumerization and BYOD is strongly evidenced by employee expectations for business apps. Though we explored third-party solutions, it was clear that to provide a consistent, branded user experience we needed to develop our own solution. Starting with the PC app store, we consolidated the existing app experience into a single, seamless UI by using one database, catalog, and web service.

Fueled by positive feedback for the PC app store, we then refocused our efforts on the mobile app store using the new architecture and UI. Though we have not yet merged the PC and mobile app stores, creating a consistent UI across the two platforms has provided users with a seamless experience.

The improved processes and communication between app owners and their users has led to a better experience for employees. As adoption grows, we continue to see improvements in overall quality and standards, leaving behind apps that are no longer of value and focusing on the most useful apps.

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