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Enabling a Seamless User Workspace across Devices and Platforms

Our vision is a user's workspace that seamlessly follows the user from one device to another when switching devices.

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Executive Overview

In order to increase user productivity and reduce IT costs, Intel IT plans to make getting a new laptop or switching from one device to another as easy as getting a new smartphone. Historically, our users spend, on average, several days reestablishing their workspace (corporate and personal content, applications, and user personalization) on a new device. Quite often, they require considerable assistance from IT staff.

We are in the early stages of decoupling the user workspace from the OS and hardware to enable our vision of a seamless user workspace that follows the user from one device to another. Using a cloud-based approach, we have implemented this vision for Windows*-based devices; we plan to extend the same technique to include devices running other operating systems.

Our new approach benefits both users and IT:

- Users can more quickly reach the same level of productivity on the new device as on the previous one.
- Improved workspace portability makes the user experience as native to the device as possible yet productive throughout a user's workday.
- IT technicians spend less time building new PCs, which helps reduce costs and frees IT staff to work on higher-value projects.
- IT technicians can provision a new PC as a quick way to restore a user to productivity instead of spending hours troubleshooting a complex issue on the old PC.
- Better integration of IT services with the cloud and software-as-a-service applications can enhance efficiency and agility, provide cost savings, and enhance collaboration.

New technology is often a key way to empower users to be more productive and innovative, and to better enjoy their job. With the benefits of having a seamless user workspace, users are more likely to adopt a new OS and hardware, which enables IT to roll out new platforms more quickly and puts improved technology to work faster.

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Business Challenge

As part of our workplace transformation vision,[1] Intel IT is continually striving to both increase device usability and enable higher employee productivity and IT cost efficiency. User workspace portability is a primary area we are focusing on to meet these goals. Traditionally, user content, applications, and settings are woven into the OS and the hardware. (See What Is in a User Workspace? for more information.) This close coupling of the user workspace and platform presents significant challenges for both users and IT.

The User Experience

As users have more devices available to them throughout their workday and personal life, they expect their content (both corporate[2] and personal), applications, and user personalization to be consistently available across all their platforms, regardless of whether a device is corporate owned or personally owned. For example, in an ideal scenario a user might use a laptop to work on a marketing proposal in the morning, and then switch to a tablet during lunch to check email, make a quick change to the proposal (with the document open to the same page that was last accessed on the laptop a few hours earlier), and show off a new baby photo. Later, at a meeting, that same tablet can be used to collaborate on the proposal. Until now, that seamless scenario was unlikely, because the user workspace on the tablet and laptop were isolated from each other.

Users also say that getting a new laptop should be as quick and easy as migrating from one smartphone to another. They want to have access to a seamless computing environment that allows them to be productive anytime and anywhere. When the user workspace and platform are closely coupled, it can take hours—or even days—for users to regain the same level of productivity they had before, as they copy data, reinstall applications, and reconfigure their user personalization. Even then, users rarely reach the identical state they had on their previous device, creating an inconsistent user experience when moving between devices.

Users are understandably reluctant to begin this time-consuming process, which often causes them to delay refreshing their primary device, preventing them from taking advantage of useful technology available with new versions of the OS and hardware.

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[1] For more information, see the Intel IT Center vision paper "Workplace Transformation," at intel.com/content/www/us/en/enterprise-mobility/workplace-transformation-vision-paper.html

[2] At Intel we store corporate content on the device as the master copy; the content is synchronized to the cloud where a replica is stored. We also have a policy on reasonable personal use that allows users to store some personal content on their corporate device.

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The IT Experience

The close coupling of the user workspace and platform also presents a challenge to IT. As the number of device form factors, operating systems, and applications in use at Intel grows, our job becomes more complex. We build about 50,000 PC platforms per year—30,000 of those builds are PC refreshes and the remaining 20,000 relate to break/fix issues or devices for new employees. Although we have streamlined our IT Client Build and PC delivery processes,[3] restoring a user's workspace to its previous state required substantial IT resources. In our ongoing effort to improve our processes, we wanted to further reduce the time it takes for users to get a new PC and return to their jobs, decreasing the amount of "IT touch" on a new PC. Ideally, users should be able to "grab and go" just like they do with a smartphone.

In 2015 these challenges, combined with the advent of the OS-as-a-service model,[4] prompted us to explore the process of decoupling the user workspace from the OS provisioning process and abstracting the workspace layer (Figure 1). Such an approach will enable a seamless user workspace across devices and platforms.

Solution

In alignment with our commitment to user-centered IT (see the sidebar, The Enterprise Benefits of User-Centered IT), we set a goal to deliver a consistent user experience regardless of the platform and enable users to rapidly resume productivity when they change devices (see Figure 2). To help achieve our goal, we separated the task into three phases, beginning with platforms running the Windows OS. (See Next Steps for a brief discussion of the next two phases, which will extend the initiative to additional operating systems.)

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[3] For more information, refer to the IT@Intel white paper "Creating a Dynamic Client Build Using Driver Management" and "New PC Delivery Process Cuts Employee Downtime."

[4] For more information, refer to the IT@Intel white paper "Best Practices for Operating System Deployment."

What Is in a User Workspace?

At Intel, we define a user workspace as follows:

- **Content.** The data on the user's device, including corporate files, emails, and digital notes, plus personal data such as photos or music.

- **Applications.** Native and cloud-based applications installed by the user (and not provided as part of the core OS image).

- **User personalization**. OS customizations, including fonts, wallpaper, task bar, default printer, and more, plus application-specific settings, like a signature or window size.
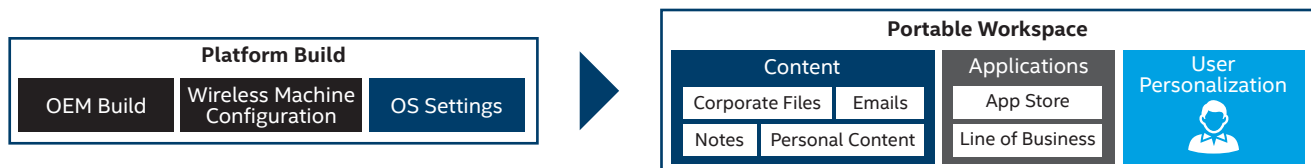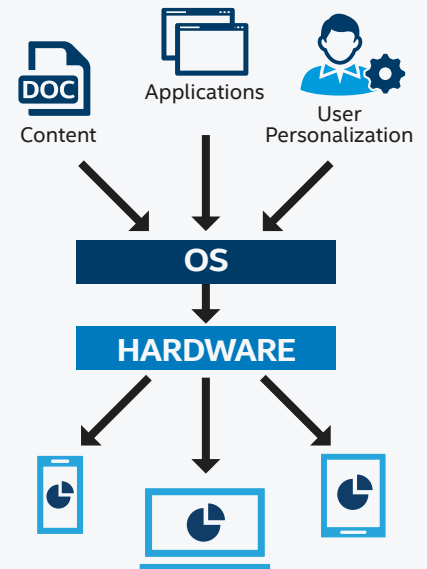

Figure 1. By decoupling the user workspace from the OS provisioning process and abstracting the workspace layer (content, applications, and user personalization) users can seamlessly switch from one device to another with little disruption or loss of productivity.

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As we explored the components of the user workspace—content, applications, and user personalization—we realized that for some aspects of the solution we could use an out-of-the-box tool; for other parts we needed to develop new tools internally because existing third-party tools did not meet our specific needs. Integrating all these tools into a single fluent and cohesive process was not intuitive; it required innovative techniques that are discussed in more detail in the following sections.

All the tools access data from various sources, and how that information is used varies depending on the specific use case.

Data Sources

We integrate four main data sources to help us recreate a user workspace:

- **Intel Software Market.** This is our central storefront for enterprise-licensed business applications and line-of-business (internally developed) software.

- **Software inventory information.** We combine information from several sources to track which non-enterprise software a user has installed on a particular device, which software purchasing agreements and licenses are in effect, and which applications are used most frequently.

- **Employee database.** The user's business group and job role are stored in this database.

- **PC asset management database.** This database records the devices that are registered to a particular user and how those devices are configured (including OS version, hardware version, and so on).

We have automated the process of integrating these data sources, resulting in a process that is flexible enough to accommodate all currently defined use cases.

Use Cases

We have defined four primary use cases where a seamless user workspace can significantly improve user productivity and IT efficiency:

- **The user gets a new PC through refresh.** Our standard PC refresh cycle is two to four years. Sometimes we may refresh hardware on an accelerated schedule to accommodate an OS upgrade, because we believe upgrading the OS and hardware together provides the best results for both users and IT.

  The user's most recently used content is synchronized first, then the workspace applications recommendation engine references the Intel Software Market, showing the user which applications were on the previous device (including non-enterprise software). If the refresh includes a new platform (upgraded OS and hardware), the user can find out whether or not an application is relevant for the new platform. Once the user finishes the automated application installation process, the personal settings are applied automatically.

Personalized Workspace
Associate the user workspace with the user's persona (customization and personal settings) across platforms

Access to Services
User can seamlessly access content and applications in as native a manner as possible, regardless of device

Seamless Device Switching
Provide tools for the user to seamlessly move the user workspace between platforms

Figure 2. Our goal is to provide a seamless user workspace on any registered platform of choice, using the native capabilities of the platform.

- **The user's PC needs a system rebuild.** After the PC is repaired, the user is guided how to restore content, applications, and user personalization, similar to a refresh.
- **The user is a new hire.** This user receives suggestions about which software to install, based on the applications that have been installed by users with similar job titles within their particular organizational unit.
- **The user is performing a specific task.** For example, if the user wants to perform collaborative document editing, the workspace applications recommendation engine provides suggestions about additional software that can enhance productivity.

In all four use cases, our automated processes support self-refresh or self-rebuild of the workspace, keeping users as productive—and satisfied—as possible.

Solution Architecture

For our initial Phase 1 efforts—Windows OS only—we set different goals, depending on the trust level of the device.[5]

For completely managed devices, which have the highest trust level and can access and store Intel Top Secret data, we have enabled seamless user workspaces so that as the user switches between similar platforms the same enterprise workspace is available.

For devices with a lower trust level, which are not completely managed and cannot access the highest classifications of content, we use virtualization and containerization to isolate the user workspace on the device from the OS and hardware. When a user switches to one of these devices, as much of their workspace as is possible follows them in native format.

We use the cloud to enable a seamless user workspace, using XML to store and transfer the information. The workspace applications recommendation engine handles migrating the applications, while the Workspace-as-a-Service engine tracks the state of the user's workspace on their primary device. The state includes which applications and files are open. When the user switches to another device and requests the workspace, the Workspace-as-a-Service engine uses an agent on the device to pull the workspace state information from the cloud. If a frequently used application is missing on the device, the workspace applications recommendation engine offers to install it. This process allows users to quickly and easily resume work on any device.

While Figure 2 shows the integrated result of decoupling the user workspace from the platform, each aspect of the user workspace—content, applications, and user personalization—required its own unique approach and are discussed in the following sections.

Content Delivery

For content, we upload all local data to the cloud so it is accessible from different devices. We found this aspect of the project the easiest to implement. We used different tools for different types of data.

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[5] For more information, refer to the IT@Intel white paper "Granular Trust Model Improves Enterprise Security."

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Corporate Files

A user's corporate files (text files and office productivity suite files) are synchronized using a file-sharing and synchronization service. We simply restore the user's files from the cloud. The solution is optimized to first sync the files that were most recently used. As shown in Figure 3, both off-site and on-site client devices can access the synchronization service using the appropriate level of encryption.

Emails

We use a messaging service for emails. We migrate traditional locally stored mail archives to a cloud-based hosting service. This significantly decreases the volume of content syncing, while making those archives available across all of the user's devices.

Notes

For a note-taking application, we built a separate solution to upload the note files to the cloud. We recommend a single, secure, standardized notes application. The notes are made available to the user from a collaborative application, and then migrated to cloud storage. (Prior to standardizing, users were using various note tools, which increased data leakage risks.)

Personal Content

We recognize that "reasonable personal use" entails users storing personal content, such as non-work-related correspondence and photos, on their corporate device. Our solution needed to sensitively handle migration of that content and, where possible, segregate it, while not taking responsibility for

The Enterprise Benefits of User-Centered IT

Intel IT has adopted a user-centered approach to delivering IT services that enables us to optimize our solutions, improve employee productivity, and increase business velocity. This approach involves proactively engaging and partnering with Intel employees and business groups to learn about their requirements for information, technology, services, and design enhancement, as well as their desired experience. This partnership is helping us develop IT solutions that provide flexibility and choice, as well as improve employee productivity and business velocity.

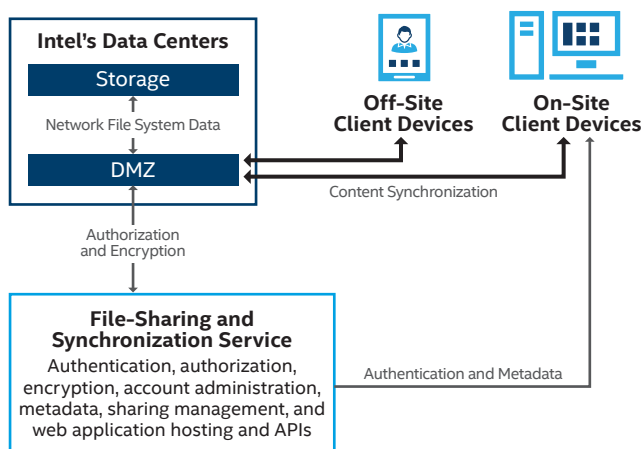## Content Delivery Solution Architecture

Figure 3. Using appropriate security controls, both on-site and off-site devices can access the file-sharing and synchronization service. This enables users' content to seamlessly follow them from one device to another.

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ongoing backup of that content. Our approach was to create a separate synchronization point using our standard corporate file sync-and-share solution. We use public cloud storage for this element, with short-term storage for the duration of the workspace migration. When the content had been verified as restored to the new system, we remove the sync point.

Application Delivery

As mentioned earlier, we built a workspace applications recommendation engine (see Figure 4) that combines data from the Intel Software Market, software inventory information, and data from the employee database.

For refresh and rebuilds, the engine first installs the OS and any necessary security patches and drivers. It then identifies which applications need to be installed and determines where each application came from (the Web or the Intel Software Market). Based on usage information, the engine then sequences the installation, installing the most frequently used applications first and automatically removing obsolete software.

For a newly hired employee, there is no historical data about which applications have been used and how often. In this case, the engine determines what other people with that same job role are using, prioritizes the list, and then begins the installation. When the installation is finished, the user can complete a survey, the results of which we use to improve the business logic of our workspace applications recommendation engine.

If a user does not want to install all applications in the same session, the workspace applications recommendation engine remembers where the user left off. When the user restarts the device, the engine prompts the user to complete the installation process. The user can click "Done" at any time to avoid installing any further applications as part of the migration.
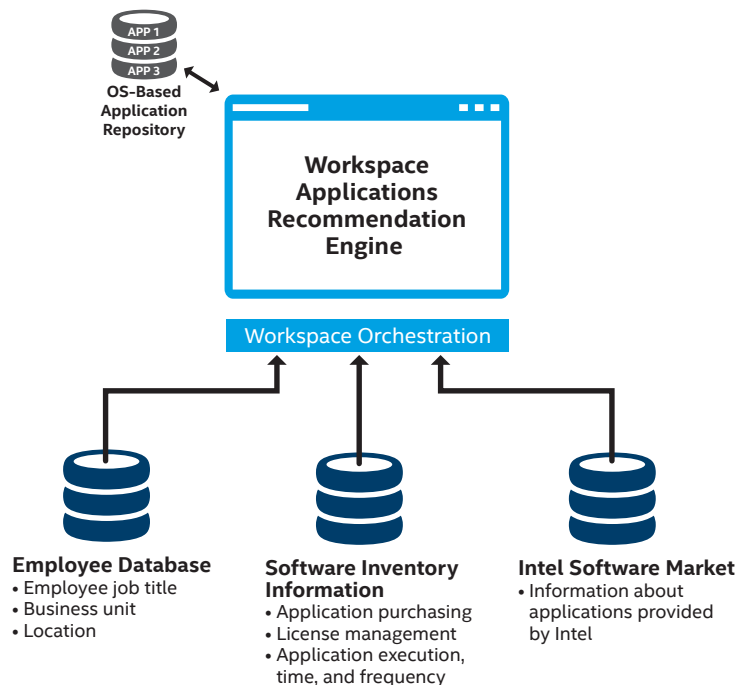

Figure 4. The workspace applications recommendation engine uses several sources of information to automatically determine which applications the user needs and installs them in priority order based on frequency of use.

User Personalization Delivery

In addition to content and applications, the user workspace includes all the customizations that the user has made. As shown in Figure 5, we capture two primary categories of user personalization:

• **OS settings** that relate to aspects of the computing environment, such as wallpaper, installed printers, and other OS configurations.

• **Application settings** for enterprise (including internally developed and third-party) applications. Settings may apply to a broad set of applications or may be specific to one application. Examples of such settings include default font, window size and position, toolbar location and customizations, and so on.

In Phase 1 we are focusing on capturing and migrating user personalization between similar operating systems from a central, cloud-based location. In the future, we plan to perform the same sort of migration between different operating systems.

We learned that it is important to start simple and grow the number of applications for which configurations we want to capture. Because we do not currently capture settings for every single application in use at Intel, we have integrated the workspace applications recommendation engine with the settings information, so users can see at a glance which applications support settings migration and which do not. To help increase the number of applications for which settings migration is available, we are teaching Intel's application developers how to wrap application settings and application data so it can be captured easily and moved between workspaces.
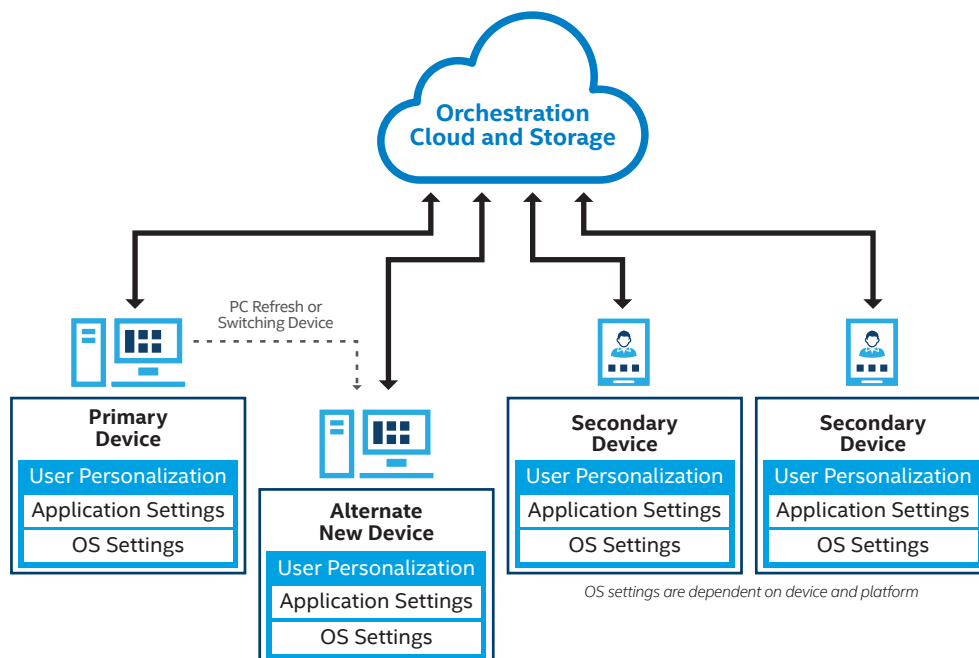

Figure 5. By capturing both OS and application settings and storing them in a centralized cloud-based location, we can quickly restore user personalization as users switch from one device to another.

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Results

While our work is ongoing, we have already enabled a seamless user workspace for Windows-based devices. This effort benefits both users and IT.

User Benefits

Users are no longer hesitant to embrace scheduled refreshes, and they find switching between devices faster and easier, confident that their workspace will be the same on each device. The PC refresh and new-hire PC provisioning processes are much faster, enabling users to restore applications and user personalization and return to productive work in less time than before. Employees appreciate that they do not have to spend time resetting customizations, reopening documents, and reinstalling applications. By giving users a choice of devices while also supporting workspace portability, the user experience is as native to each device as possible and users can remain productive throughout their workday.

We anticipate that our workspace portability work will be one way to enable our users to get a new PC from a "PC vending machine" and quickly self-provision it. This will greatly decrease the time and effort users spend on getting a new device when it's time to refresh.

IT Benefits

Intel IT is continually looking for ways to streamline our PC refresh process. Our efforts to implement a seamless user workspace and to make PC provisioning a self-serve process through "PC vending machines" can help save IT time and money. Subsequently, IT staff has more time to work on higher-value projects. Because users are more likely to refresh the PCs promptly, we have also reduced the ramp time required when introducing a new platform. An added benefit is that the entire solution is well-integrated with the cloud and software-as-a-service applications, which can boost efficiency and agility, provide cost savings, and enhance collaboration.

Next Steps

Our initial efforts (Phase 1) concentrated on the Windows environment. Phase 2 will include additional operating systems to enable a cross-platform workspace applications recommendation engine and Workspace-as-a-Service engine so that no matter what device users choose, their content, applications, and user personalization will migrate with them.

During Phase 2 we will also vigorously promote cross-platform-ready applications by using five criteria (see the sidebar Transforming the IT Ecosystem to Support the Applications and Devices of the Future).

Transforming the IT Ecosystem to Support the Applications and Devices of the Future

We identified five criteria that can lead to a better end-user experience—security, ease of use, platform independence, device independence, and support for emerging devices and interactions. These same five criteria can also contribute to a better application developer experience by removing obstacles and providing readily available tools to increase application developer productivity and efficiency.

Implementing a mobile application development framework enables us to create mobile applications that meet all five criteria. And, although the end result is applications that work better now and can take advantage of future technology changes, our work affects more than application development. It affects many components of Intel's computing environment, including security and privacy policies, mobile device management, mobile application life cycle management, and application testing and scalability.

In Phase 3, we plan to enable "intelligence" in the workspace environment (content and applications) to enable a context-aware engine to set up the workspace. This engine will go beyond the capability of the workspace applications recommendation engine and the Workspace-as-a-Service engine by having the ability to detect what the user is doing and where they are within opened content. For example, if a user is editing page 5 of a document and then switches devices, the document will open to page 5 on the new device.

Conclusion

Intel IT has made great strides toward decoupling the user workspace from the OS and hardware. The result is a seamless user workspace that follows users from one device to another, using cloud services as an enabling technology. By reducing the time it takes to restore the user workspace from days to minutes, we are already achieving the following:

- Boosting user and IT productivity
- Reducing IT total cost of ownership
- Freeing IT technicians from PC provisioning to work on higher-value projects that can further transform the workplace and enable the digital enterprise
- Enabling IT technicians to spend less time troubleshooting issues, because they can quickly provision a new device and enable the user to return to productivity
- Improving employee satisfaction

As we extend the initiative to include devices running operating systems other than Windows, we anticipate even greater benefits.

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We connect IT professionals with their IT peers inside Intel. Our IT department solves some of today's most demanding and complex technology issues, and we want to share these lessons directly with our fellow IT professionals in an open peer-to-peer forum.

Our goal is simple: improve efficiency throughout the organization and enhance the business value of IT investments.

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