

Enabling Emerging Enterprise Usages with Client-Aware Technologies

Client-aware technologies provide an optimized user experience and the potential for enhanced employee productivity by balancing centralized management with a dynamic model for shifting computational workload between client and cloud.

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Executive Overview

Intel IT envisions providing infrastructure, solutions, and services that enable a continuum of personalized computing experiences to our customers—Intel employees. Our goal is for employees to have seamless and secure access to both corporate and personal services, applications, and data on a wide range of devices.

To reach this goal we are building an enterprise private cloud with client-aware capabilities that can detect device type, capabilities, and other attributes; employee location; and preferences defined in user and device profiles. In parallel, we are assessing emerging enterprise usages and designing new solutions based on intelligent desktop virtualization (IDV) and client-aware Web services delivered through the cloud. It is important that we understand future needs and how the associated usage requirements affect client service delivery methods.

To start, we investigated key pain points that businesses face due to consumerization trends. This research identified several challenges that we then organized into three target user experiences: universal collaboration, blended computing, and business assistant.

Within each user experience category, we defined key usage scenarios that best address the pain points we identified in the workplace.

Examples include the ability to initiate instant conferencing to address complicated collaboration tools, and workspace mobility to address the need for location independence. We then validated these usages by conducting internal research with Intel employees and external research with both business end users and IT decision makers.

Following the usage assessment, Intel IT is now exploring solutions based on client-aware technologies for each usage. These client-aware technologies include media and application optimization, data synchronization, policy enforcement, IDV, and rich Internet applications.

Client-aware technologies provide an optimized user experience and the potential for enhanced employee productivity by balancing centralized management with a dynamic model for shifting computational workload between client and cloud. IT finds this approach more manageable in scale, efficiency, and security.

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BACKGROUND

Emerging trends are driving a transition from traditional client computing models toward one in which employees will use a variety of devices to access information anywhere, at any time.

By modifying the way in which we deliver services and support devices, Intel IT is responding to the following trends:

- **IT consumerization.** More and more employees want to use their personal devices to access corporate data. In response to this trend, Intel IT is actively integrating employee-owned devices into our enterprise environment.
- **An expanding continuum of companion devices.** Employees are using an expanding continuum of companion devices, from smart phones and tablets to PCs, all with widely differing capabilities, while continuing to rely on their laptops as their primary device. Delivering services with a one-size-fits-all approach can interfere with an optimal user experience and pose an information security risk.
- **A movement toward more user-centric services.** The trend toward a variety of companion devices requires IT to deliver dynamic services tailored to the employee's and the device's present context. As we develop Intel's private cloud, we envision services that can determine device attributes such as I/O capabilities and sensors, as well as context, including employee location and user preferences.
- **A desire for better performance and a seamless experience across devices.** Employees ultimately want to have consistency and interoperability across all of their devices, making computing a seamless experience. In addition, employees want a consistent quality of service, no matter what device they are using.

To support these trends, we are building an enterprise private cloud with client-aware

capabilities that can detect device type, capabilities, and other attributes; employee location; and preferences defined in user and device profiles. In parallel, we are assessing emerging usages and designing new solutions based on intelligent desktop virtualization (IDV) and client-aware Web services delivered through the cloud. By understanding future needs and how the associated usage requirements affect client service delivery methods, we can be better prepared to provide the appropriate infrastructure, solutions, and services that enable a wide spectrum of personalized computing experiences, where employees have seamless and secure access to both corporate and personal data and services on a wide range of devices.

The solutions we are investigating include emerging virtualization technology, such as IDV and rich Internet applications (RIAs). Other relevant technologies include HTML5, cloud computing, improved graphics capabilities, new operating systems, and support for natural user interface styles, such as gesture and voice, that are based on the human senses. We plan to combine existing methods and new client-aware technologies to provide computing services based on the awareness of client capabilities and the context of the employee.

IDENTIFYING, DEVELOPING, AND VALIDATING CLIENT-AWARE ENTERPRISE USAGES

The emerging trends suggest that today's IT organizational structure, enterprise landscape, and service delivery models will likely change over the next few years. This places a greater burden on IT organizations to understand the evolving usages and develop innovative approaches for new and existing applications.

We already had a general sense of the major categories of emerging user experiences but we wanted to distill these experiences into the most compelling usages and validate our findings both internally and against a broader cross-section of the industry.

To accomplish this goal, we decided on a two-pronged, iterative approach.

- Conduct internal focus groups
- Engage an external market research company

Internal Research

Based on our own knowledge of and experience with a global workforce, IT consumerization, and mobility, we

selected three user experiences for further investigation.

- **Universal Collaboration.** Employees can get in touch and collaborate with their contacts anytime, anywhere, and with whatever device they happen to be using.
- **Blended Computing.** Employees have easy access to work-related and personal applications and services from any device in a way that is seamless for the user but also protects the company's intellectual property.
- **Business Assistant.** Employees can obtain assistance with directions, resource location, information relevant to their context and preferences, and services when they need them, just in time and on-the-go.

After choosing the user experiences, we identified typical business personas, such as Joey the Sales Representative and Cathy the Production Engineer. These personas have associated job roles and other characteristics, based on data gathered from employees and an industry scan. Table 1 shows a sample collection of characteristics for a salesperson; other job roles included subject matter expert, call center support person, factory worker, and IT decision maker.

After identifying job roles, we developed a scenario to illustrate a typical day in the life revolving around one or more personas. These storyboards describe the activities a person in a particular job role might be doing in terms of the user experiences we had defined.

Table 1. Job role identification - Salesperson

Job Role: Sales	
Description	
Characteristics	Early adopters of technology at home and at work, highly mobile
Workspace	Home office or satellite office near customer base, customer site, hotspot locations, car, plane
Most Used Devices	Laptop, smart phone, tablet, personal mp3 player
Most Used Applications	E-mail, instant messaging, customer relationship management (CRM) system, Web browsers, video and data sharing, product data and content repositories
Success Metrics	Making or exceeding product sales targets, customer satisfaction, revenue
Contacts	Customers, product specialists and engineers, peers
Responsibilities and Challenges	
<ul style="list-style-type: none"> ▪ Needs to keep customers informed about the latest product features and future product roadmaps. This increases the likelihood that they will buy Intel products. ▪ Holds frequent meetings with customers to maintain relationship and share product information. Sometimes these meetings are face-to-face at the customer site and sometimes they are virtual. Virtual meetings save travel time and cost, but require advance preparation. ▪ Customers don't always use meeting technologies as that are supported by Intel IT, but the sales representative needs to accommodate customer preferences. ▪ Frequent travel means use of multiple devices. ▪ Frequently uses core Sales applications like CRM and content repositories to keep up to date on the customer and our products. It would save significant time if the applications filtered content based on the customer, sales representative's location, and necessary applications. 	
Future Vision	
<ul style="list-style-type: none"> ▪ More integrated user experience, including access to sales data, collaboration, and product specifications ▪ Device independence ▪ Browser-agnostic, device-agnostic data delivery ▪ Increased responsiveness to customers ▪ More automated processes based on user content 	

Table 2. Usages for each user experience

User Experience	Usage
Universal Collaboration	<ul style="list-style-type: none"> Instant Conferencing Immersive Collaboration
Blended Computing	<ul style="list-style-type: none"> Workspace Mobility Adaptive Device
Business Assistant	<ul style="list-style-type: none"> Business Travel Guide Virtual Admin (Administrative Assistant)

Figure 1 shows a sample storyboard for one job role.

Using the storyboards, we identified two usages for each user experience, as shown in Table 2.

To validate our usage choices, we next conducted internal focus groups, in which we asked participants to rate each usage based on how appealing and innovative the usage was, and to note any concerns.

Using the feedback from the focus groups, we assigned each usage an overall score, which helped us pick the most relevant usages.

External Research

In parallel with our internal research, we also engaged an external market research company to conduct a study that included business IT decision makers and business end-user audiences in the United States, China, and Europe. The study gave us feedback on usages from a statistically

significant number of respondents across multiple demographic segments. The usages tested in this study were similar to those that we were validating through internal research.

For each of the usages in Table 2, we provided participants with detailed descriptions of what each usage is like today, what it might be like in the future, along with an illustration, and the value employees could get from the new usage.

UNIVERSAL COLLABORATION USAGE: INSTANT CONFERENCING

Today, Intel is working to increase the use of virtual meetings. These virtual meetings use video, voice, and data sharing, and are complex to schedule and join, especially when traveling. All meeting participants must use the same operating system and browser and, for the most part, cannot participate from a smart phone or tablet over a 3G or 4G connection.

In the future, it will take fewer steps to initiate or join audio, video, or data conferencing with

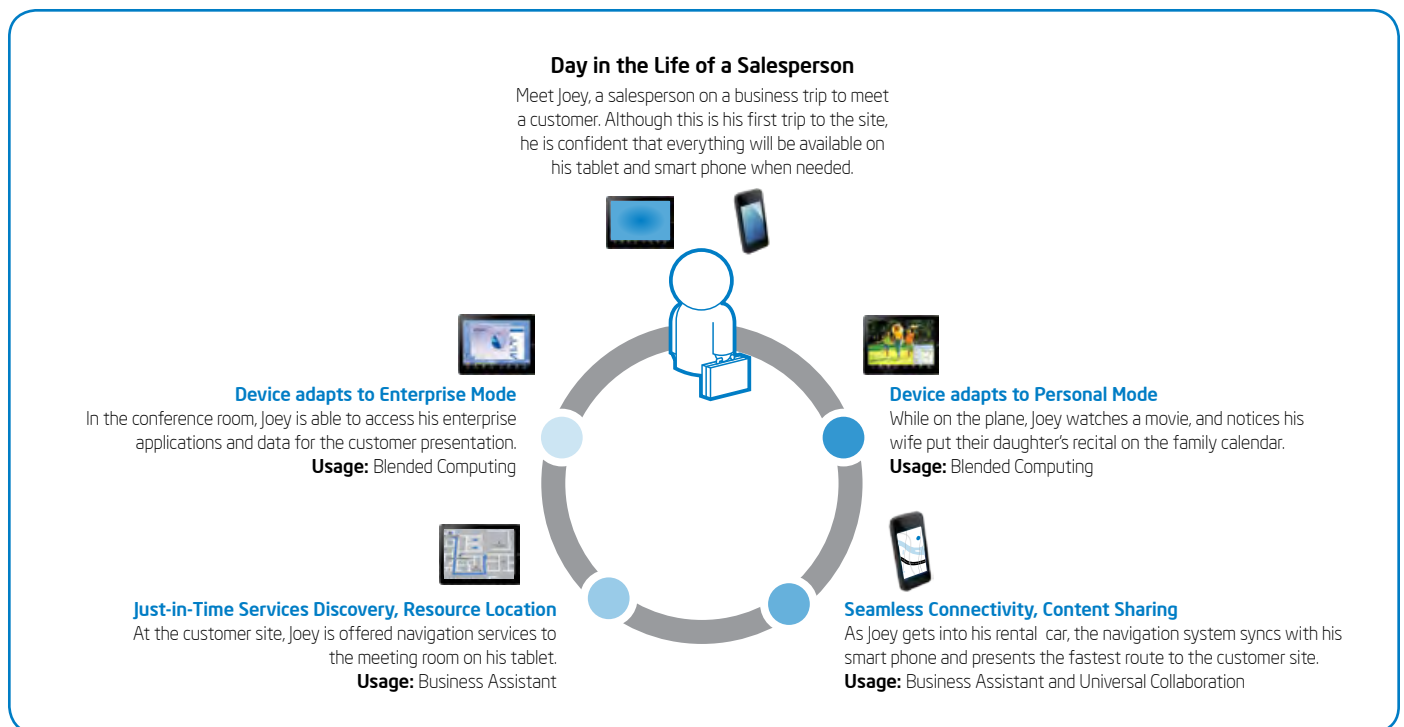


Figure 1. Storyboards helped us define more specific usages for each user experience.

one or more colleagues, and employees can perform these steps from any laptop, smart phone, or tablet. With a single click, employees can initiate a virtual conference with multiple colleagues, and the system determines how to best engage each participant based on his or her location, time zone, user preferences, and the device type and status.

By reducing the complexity of connecting to other devices and letting employees use their most convenient device to join and participate in virtual team meetings, instant conferencing helps improve employee productivity.

BLENDED COMPUTING USAGE: WORKSPACE MOBILITY AND ADAPTIVE DEVICE

The increasing consumerization of IT, along with the explosion of personal devices in the marketplace, contributed to the popularity of two blended computing usages—workspace mobility and adaptive device—among focus group participants.

Workspace Mobility

Today, employees generally rely on their corporate PC for access to applications and data. When employees are on the move and do not have instant access to their corporate PC, they can use a smart phone or tablet to access their e-mail and selected applications, but not having applications and data available to continue working, regardless of the location or the device, compromises productivity. In addition, accessing data and services can require many start-up steps, which can vary from device to device.

In the future, IT can let employees configure a mobile workspace that includes the applications they need in their particular business area, as well as data folders that save both personalized application settings and the content on which employees are currently working. Through a combination of cloud-based content synchronization, client awareness, and virtualization, this workspace

can be made available on any device the employee uses.

For example, an employee can start on a sales presentation on a PC, save the work in progress, leave the work premises, and then later resume working from a tablet, because through client-aware intelligent content synchronization, the latest changes are captured on the back end.

Adaptive Device

Today, many corporate IT organizations must secure and manage bring-your-own (BYO) companion devices while at the same time mobilize business applications effectively across different architectures and operating systems. The support costs are high given the need for multiple management systems and development environments. For employees, it is inconvenient to reset their devices when they move between work and home. To do so requires multiple reconfiguration of many user preferences, such as default printer, display settings, and network connections. Furthermore, the applications employees use at work differ from those frequently used at home. Yet the screen dimensions, input type, and organization of content displayed on the device remain the same regardless of which device employees use or where they are.

In the future, how a device interacts with resources will change as employees move from home to work and back and perhaps even between different settings at work, such as conference rooms and warehouses. End-to-end security, device management, and business applications delivered through the cloud and end-point device capability can help simplify and streamline management costs, provide full mobilization of business applications across multiple platforms, and help orchestrate IT policy and user preferences to safeguard intellectual property as well as an employee's private information. The BYO device can switch between personal and

business use and access pertinent services based on context.

For example, the productivity applications that an employee uses most frequently at work will be visible and easily accessible, and each device can connect to local printers, projectors, and other devices in the office. All personal data and applications can be accessible in the background, and personal data and privacy are protected. At home, the device automatically adapts to the employee's home configuration, including connections to TVs, stereos, and printers, and frequently used personal applications are visible on the device's screen. Employees can manually switch between profiles at any time, so that if they're working from home, they can switch to a work profile for efficient access to work-related data and applications. With this technology, devices adapt to different computing needs in different situations, and help improve employee productivity.

BUSINESS ASSISTANT USAGE: BUSINESS TRAVEL GUIDE

When traveling for business, smart phone applications can help employees find restaurants, hotels, shopping, and other non-work related services. But, in unfamiliar surroundings on other Intel sites, it can be difficult to locate an available conference room, the nearest printer, or even another employee.

In the future, smart phones or other computing devices can automatically detect services and resources that are available locally or available through the cloud, and let employees select these resources from a list. Applicable resources may include cafeterias, printers, available conference rooms, automated teller machines, restrooms, and emergency exits. An indoor navigation application can guide employees to the selected resource.

For example, a device can provide turn-by-turn walking directions on a visual map, with

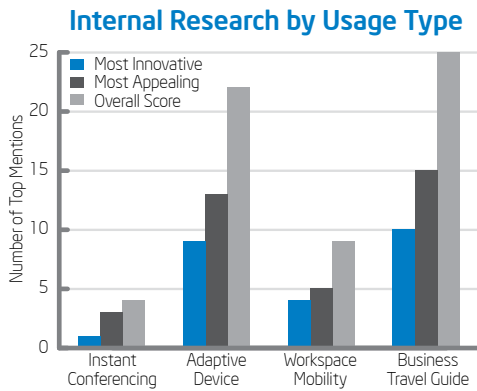


Figure 2. Our internal research indicates Intel employees consider these four usages as the most appealing or innovative or both.

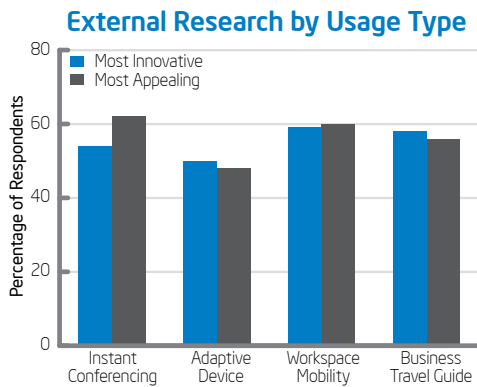


Figure 3. Results from the external study highlighting the same four usages

optional spoken directions if a headset is available. Based on your walking pace, the guide provides the distance and time to the destination. As another service, the device could check to see if a colleague is nearby and available for a conference, and suggest an available conference room. With this technology, employees can navigate confidently inside unfamiliar buildings and reach a destination on time—spending more time thinking about and preparing for the business meeting and less time managing travel logistics.

Results

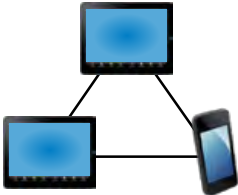
The internal data we received from the focus groups matched closely with the results of the external study—both studies resulted in the same four usages being most highly ranked out of all usages tested, although the individual usage rankings varied.

Figure 2 shows the results of our internal research. In this figure, we graphed how many focus group participants mentioned a particular usage as most appealing or most innovative. Of the six usages we originally studied, the four that received the most top mentions were the same as

the most highly-ranked usages surveyed in the external study, shown in Figure 3. The external results are reported in terms of the percentage of respondents who found the concept extremely appealing or innovative or both.

The external study determined that business end users, regardless of their work location are interested most in how technology can offer increased flexibility, improving their daily activities. For example, they value the ability to connect to basic print resources, join virtual meetings, use applications across a variety of personal devices, and access basic services, such as reserving conference rooms.


Based on the overall scores, we decided to focus our initial efforts on four of the six original usages. Figure 4 shows the top usages identified in both studies. They are mutually beneficial to both IT and employees: The primary IT benefit is security, and the primary employee benefit is convenience. Taking advantage of compute services based on the context of the employee's needs helps increase productivity while minimizing operational cost and data center build out.



Universal Collaboration

Instant Conferencing


The ability to initiate with ease audio, video, or data conferencing with one or more team members, from any laptop, smart phone, or tablet



Blended Computing

Adaptive Device

The ability to dynamically adapt to the environment through the use of multiple personalized profiles—where settings, appearance, and services match the employee's needs whether at work, home, or while travelling



Business Assistant

Business Travel Guide

The ability to use location services to help visitors quickly find available local corporate resources such as a conference room, printer, or scanner

Workspace Mobility

The ability to foster continuity of work by providing trusted access to an employee's applications and data from any device and location

Figure 4. We decided to focus on four usages, based on overall scores from internal and external research.

ENABLING NEW USAGES THROUGH CLIENT-AWARE SOLUTIONS

Having identified several usages to focus on, we are exploring how emerging client-aware technologies can help us implement optimized solutions. Combining the context underlying the usage with client awareness leads to a better solution than one-size-fits-all or lowest common denominator approaches.

By proactively investigating these client-aware technologies—media optimization, application optimization, data synchronization, policy enforcement, IDV, and RIAs—many of which are described in detail in the white paper, “Applying Client-Aware Technologies for Desktop Virtualization and Cloud,” and standardizing platforms and systems that support these technologies, we can prepare to support our emerging enterprise usages as client-aware technologies mature and become widely available.

Media Optimization

Media optimization is a process that dynamically delivers the right content in the right format to provide an optimized experience for the end user based on the device’s attributes and capabilities. Media optimization—including a determination of the appropriate media format to stream—is very important in the universal collaboration user experience because each participant in the meeting or other collaborative activity may be using different devices with varying capabilities and available bandwidth. Dynamic optimization of the content delivery results in a better user experience and puts conservative demands on client, network, and server resources. For example, if the end-point device is a smart phone with a relatively small, low-resolution screen, it doesn’t make sense to send all the data needed to render a high-definition video on a large screen.

Application Optimization

Depending on the device’s processing capabilities and available network bandwidth and latency, client-aware solutions can determine whether an application should run locally or in the cloud, using workload shifting technologies such as multimedia redirection (MMR), command remoting, and reverse seamless. For universal collaboration, intelligent application and data sharing is crucial for optimizing the user experience. The service, delivered through the cloud, must be able to select the appropriate tools and methods for collaboration depending on the device and employee contexts on both or all ends of the collaborative engagement, such as location and preferences. For example, if one conference attendee is using a smart phone over a 3G connection while another is using a laptop connected to the office local area network, the service has to provide a collaboration tool that is appropriate for both attendees.

Data Synchronization

In situations where devices have encrypted storage containers and adequate storage capacity, we may want to conditionally synchronize data between the cloud and a device, or directly between two devices. In other situations, the device may not have the capability to adequately or securely support synchronization, or the employee may have specified in a user profile that synchronization is not desired or is desired only under certain circumstances.

For example, both the adaptive device and workspace mobility usages rely on data synchronization, because as employees move from device to device, they expect to have access to the latest data and changes they have made to content and applications.

Policy Enforcement

Mediation of work and personal data and applications using IT policy and user preferences is central to supporting blended

computing usages, such as workspace mobility. Mediation refers to the intelligence that determines what data and applications are available in a given situation based on context. Mediation also determines when IT policy overrides user preferences if conflicts arise.

Devices that do not meet certain security and management requirements can be disqualified from accessing or storing corporate data locally. Device awareness and use of data-loss prevention capabilities can help to determine, in accordance with IT policy, how trusted the end-point device can be to protect sensitive data. This model lets us provide a level of access that is appropriate to the trust level of the device. For example, if a manufacturing employee is in a non-secure environment, such as outside a manufacturing facility, policy enforcement could restrict viewing and access to top-secret corporate data.

Intelligent Desktop Virtualization

IDV, enabled by workload-shifting technologies such as MMR, command remoting, and reverse seamless, can result in a balanced user experience and better application performance by offloading workload to the client if the client is capable.

Intel sees IDV as an optimal desktop management solution that can provide the control IT requires and the rich user experience employees desire. IDV uses three main principles:

- Manage centrally, execute locally where possible
- Deliver layered images intelligently
- Use device-native management

IDV provides the following benefits to both IT and the employee:

- **Operational excellence.** Images remain synchronized, regardless of the device being used or where the device is. Also, the computing device becomes more active in its own management.

- **Better economics.** Computing is done on the client whenever possible, saving server resources and avoiding costly data center build out and higher operational costs.
- **Flexibility.** Client hypervisors can change computing platform modes to suit employees, and local execution on intelligent clients benefits all desktop delivery models.
- **Scalability and efficiency.** By reducing server and network infrastructure load, IDV supports a higher virtualization density in the data center. Also, using IDV, IT can develop a single service instead of one for each device feature set.

Workspace mobility solutions can rely heavily on IDV to optimize the user experience. For example, if an Intel employee is using a thin client, IDV can detect that and decide to run applications on the back end. If an employee is using a mobile business PC, IDV can detect that as well, and can take advantage of device capabilities and local execution. The benefit to the employee is all these workings are seamless; everything in the workspace looks and acts the same.

Rich Internet Applications

Intel is investing in application programming interfaces that let developers write RIAs that detect real-time hardware information from the client, such as processor performance, battery life, and network bandwidth. Applications can use this information on a dynamic basis, removing the limitation of developing applications for the lowest common denominator.

For example, the business travel guide usage could benefit from HTML5-based RIAs. A traditional Web mapping application cannot detect device capabilities, and therefore

cannot optimize the presentation of information for a particular device. In contrast, an RIA for mapping could detect whether a device has a global positioning system, compass, or an accelerometer. If a device has any or all of these capabilities present, the RIA uses them; if they are not present, the RIA provides a less robust experience.

CONCLUSION

In response to industry trends such as IT consumerization and a shift toward user-centric services, Intel IT identified three emerging user experiences: universal collaboration, blended computing, and business assistant. Using both internal and external research, we also identified usages associated with these user experiences, including instant collaboration, workspace mobility, adaptive device, and business travel guide.

Having further analyzed these usages, which Intel employees scored highly for appeal and level of innovation, we are now in the process of exploring client-aware technologies that can enable each one. For example, IDV, using workload-shifting technologies and central image management, shows great potential for the workspace mobility and adaptive device solutions. RIAs, based on HTML5, can make Web services—such as those that are used by and delivered through a business travel guide—a reality; and media optimization is key to implementing universal collaboration usages.

Client-aware technologies offer these benefits to both employees and IT.

- **Employees.** Optimized user experience and the potential for enhanced employee productivity and satisfaction by balancing centralized management with a dynamic model for shifting computational workload between client and cloud
- **Intel IT.** Better scale, efficiency, and security

Both groups benefit as we continue to fine-tune and improve our solutions as new client-aware and compute continuum technologies emerge.

FOR MORE INFORMATION

Visit www.intel.com/IT to discover additional IT@Intel white papers and briefs about our private enterprise cloud:

- “Applying Client-Aware Technologies for Desktop Virtualization and Cloud”
- “Cloud Computing: How Client Devices Affect the User Experience”
- “The Future of Enterprise Computing: Preparing for the Compute Continuum”

For more information on Intel IT best practices, visit www.intel.com/it.

ACRONYMS

BYO	bring-your-own
CRM	customer relationship management
IDV	intelligent desktop virtualization
MMR	multimedia redirection
RIA	rich Internet application

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