

Increasing Productivity with Mobile Business PCs

Mobile business PCs are by nature highly portable, and their robust feature set provides a productivity advantage to Intel employees while meeting the majority of our company's diverse requirements.

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Executive Overview

After investigating various options, Intel IT has selected mobile business PCs as our standard computing platform. Mobile business PCs are by nature highly portable, and their robust feature set provides a productivity advantage to Intel employees while meeting the majority of our company's diverse requirements.

- **Mobility.** Provide the flexibility employees need to work from any location.
- **Productivity.** Enable employees to continue creating value for the enterprise, even when they are offline, and to collaborate across time zones and geographic regions.
- **Flexible compute models.** Currently support local execution, streaming, virtual hosted desktop (VHD), Web applications, and more—plus virtual containers in the future.
- **Managed information security.** Protect Intel's intellectual property and data while providing employees with a secure environment that can support emerging and evolving technologies.
- **Business continuity.** Allow employees to telecommute from unaffected areas in cases of natural disaster or other interruptions to "business as usual."

Our mobile business PC strategy also reduces costs:

- USD 14 million savings attributed to video conferencing.
- Estimated USD 1 million savings in 2009 from deploying Unified Messaging.
- Projected USD 1 million savings by 2011 from deploying Intel® vPro™ technology.
- 67-percent decrease in total cost of ownership over 11 years.

As we continue to assess the needs of our users and evaluate emerging technologies and capabilities, mobile business PCs will enable further enhancements to employee productivity.

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BACKGROUND

Intel's computing environment supports a diverse user base spread across time zones and continents. To enable employee collaboration throughout all areas of the enterprise, Intel IT must provide a standard computing platform that supports high levels of productivity, mobility with the freedom to work from any location, a variety of compute models, and device capability. The platform must also satisfy requirements for information security and business continuity while minimizing costs.

Our current user base consists of about 80,000 employees located at 150 sites, with more than 90,000 PCs and about 100,000 servers. Our installation base consists of 1,669 distinct applications, which have been downloaded a total of 1.24 million times in the last year. Every month, Intel employees generate 177 million e-mail messages, 2,183 terabytes (TB) of WAN traffic, and 18 petabytes (PB) of storage with 3.9 TB of backup per month. Two-thirds of Intel teams are virtual, and one-fifth of our employees have remote managers.

As we began identifying these trends more than a decade ago, our environment consisted of about 80 percent desktop PCs and 20 percent laptop PCs. We have strategically reversed that ratio, transitioning to a fleet that consists primarily of laptop PCs. At the end of 2009, we had 81 percent laptop PCs and 19 percent desktop PCs.

To keep our applications and hardware up-to-date, we refresh our laptop PCs every two to four years based on user segmentation.

We do not lease our PCs; rather, total cost of ownership (TCO) analyses have revealed that buying hardware outright is the best choice for us. Because we determined that PC acquisition costs account for only 20 to 30 percent of TCO, we don't focus on these costs alone. Instead, we align our PC fleet investments and management practices with Intel's strategic goals. We focus on factors that not only reduce TCO but also deliver business value to Intel, adding capabilities that keep Intel agile and competitive. The effectiveness of this approach is illustrated by the 67-percent decrease in TCO we have achieved over 11 years with our mobile business PC strategy.

Because IT management is not static—technologies and users' needs change constantly—we continually monitor workforce changes, performance demands, environmental concerns, cost reduction, and an increasing emphasis on collaboration. As we look forward, we also identify and take advantage of technology and computing trends that accelerate the delivery of business value to Intel.

TECHNOLOGY ASSESSMENT

As part of our proactive approach to PC fleet management, we evaluated our current strategy of using mobile business PCs to see if a thinner solution offered any advantages.

To assess platforms, we compiled an inventory of compute models and devices, detailed in Table 1. We also assessed employees' needs and business requirements for both the IT organization and the enterprise as a whole.

Defining Our Requirements

We studied employees to determine exactly what they do to fulfill their job functions, which baseline computing features enable them to do their jobs, and which features

enable optimum efficiency and productivity. We also considered our organization's future computing needs, especially in the areas of information security, business continuity, manageability, and Service Desk

support. Intel's strategic goals include cost control, business growth, and collaboration. Table 2 summarizes the resulting list of categories and specific needs.

Table 1. Inventory of Compute Models and Devices

Term	Definition
Application streaming	The client OS is locally installed, but applications are streamed on demand from a server to the client, where they are executed locally.
Cloud computing	Typically refers to accessing compute resources and applications over the Internet. In this model, software is delivered from Web servers, and data may reside on the servers as well.
Client-hosted desktop virtualization	IT creates and manages virtual images or containers, including the OS and/or applications. But instead of running the virtual image on the server—as in the VHD model—the container is streamed to the client for local execution.
Handheld	A pocket-sized computing device, including smartphones and personal digital assistants (PDAs)
Mobile business PC	A highly mobile PC with a robust feature set and support for managed security.
Netbook	A category of small, lightweight, inexpensive laptop computers suited for general computing and accessing Web-based applications and e-mail; generally used as companion devices to augment a user's mobile business PC.
OS streaming	The OS image is streamed to the client over the network, where it executes locally using the client's own CPU and graphics. Application data is stored in a data center. The client can be a PC with no hard drive that uses RAM for caching the OS.
Terminal services	A server-based computing model in which the client is merely a display and input device. All computation is performed on the server, and all data is stored in a data center.
Thin-client solution	Computers or computer programs that depend on other computer resources to fulfill traditional computer roles, with limited compute and/or storage resources. Examples of thin-client solutions include VHD and terminal services.
Virtual hosted desktop (VHD)	As with terminal services, all computation and storage are centralized, with the display pushed over the network to the client. The major difference is that VHD can offer users their own complete virtual machine (VM) and customized desktop, including the OS, applications, and settings.

Table 2. Summary of Computing Requirements

Category	Specific Needs
Mobility and flexibility	<ul style="list-style-type: none"> Ability to work offline Increased flexibility so employees can choose where and how work; ability to take systems with them and telecommute—sometimes 100% of the time Greater choice of software applications, including employees' personally owned applications Collaboration features including desktop sharing, multimedia, and Voice over IP (VoIP) to facilitate global teamwork Support for unified communications and collaboration
Productivity	<ul style="list-style-type: none"> Ability for users to create content, store work-in-progress, manipulate data, analyze, and innovate
Robust feature set and high performance	<ul style="list-style-type: none"> Support for compute- and network-intensive tasks: <ul style="list-style-type: none"> Graphics and multimedia, including high-definition video and full graphics processing unit (GPU) Animation and real-time collaboration 3-D virtual worlds Ability to distribute processing for applications and compute models so that network traffic and user performance is not negatively affected Efficient access to the enterprise portal, which integrates security, content, and enterprise resource planning (ERP)
Flexible compute models	<ul style="list-style-type: none"> Local execution Cloud computing and software as a service (SaaS) Internet applications OS and application streaming Virtual hosted desktop (VHD) Virtual containers Remote execution
Information security and business continuity	<ul style="list-style-type: none"> Ability to encrypt hard drives so that data is protected in case of lost or stolen equipment Support for remote management, including monitoring and repair
Innovation	<ul style="list-style-type: none"> Ability to create and adopt new usage models

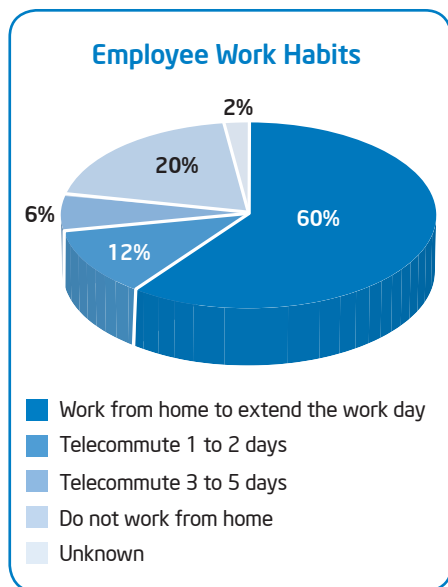


Figure 1. Mobile business PCs provide Intel employees with flexible telecommute options.

Evaluating a Thin-Client Solution

Inline with our proactive management philosophy, we evaluated thin clients as a potential alternative to mobile business PCs as our standard computing platform. We determined, however, that thin clients were unable to provide employees with needed capabilities in each category of our requirements.

- **Mobility and flexibility.** Thin clients do not support the offline usages that our highly mobile users need, such as while traveling or out of range of wireless networks.
- **Productivity.** Our users need to be highly productive to meet Intel's strategic goals. Thin-client solutions do not support the level of productivity we need.
- **Robust feature set and high performance.** Thin clients do not provide our users with a satisfactory user experience or enhanced productivity in situations where local processing and caching is necessary.
- **Flexible compute models.** Thin clients do not support a wide range of compute models;

in particular, our users need support for local execution, streaming, and, in the future, virtual containers. We need a platform that supports both cloud and local application delivery.

- **Information security.** Although the thin-client model has only one protection point, we found that the many access points increased the risk of infection for our entire infrastructure.
- **Business continuity.** In the event of natural disasters, epidemics, or other business disruptions, thin clients do not support business continuity.
- **Innovation.** Thin clients would limit our ability to create and adopt new usage models.

Although there is a continuum of solutions between the "thinnest" client, defined as remote execution on a dumb terminal, and high-end mobile business PCs, each point on this continuum is associated with tradeoffs in mobility, productivity, security, business continuity, innovation, and cost. In our analysis, thin-client solutions involved too many compromises to provide an adequate platform for our users.

COMPANION DEVICES

Netbooks and handheld devices have a place in our computing strategy as companion devices because they provide alternative form factors to the PC that can boost employee productivity. However, due to their limited functionality and flexibility, these devices cannot replace a mobile business PC.

Evaluating Mobile Business PCs

Based on our requirements, we validated our proven strategy of providing Intel employees with mobile business PCs. Mobile business PCs balance the capabilities users need to perform their jobs in Intel's global enterprise environment with strategic business requirements for managing cost, life cycle,

information security, and business continuity. Additionally, mobile business PCs position us to adopt innovative future technologies.

MOBILITY AND FLEXIBILITY

Intel employees are highly mobile: Each day, 70,000 people use our remote access service, which has shown a 50-percent increase in usage over the past two years. Plus, as Figure 1 shows, about 80 percent of employees work from home at least part of the time.

The mobile business PC platform provides critical value propositions for employees—the ability to work from any location—as well as the enterprise—the ability for employees to create value for Intel even when connectivity is not available.

PRODUCTIVITY

Our mobile business PC platform supports flexible work models even when users are offline, experience low bandwidth, or do not have secure access to the network. Our studies show that mobile business PCs provide greater than 5 percent time savings per employee per week.

With mobile business PCs, employees can work offline, such as when travelling, and then connect to send data later. Mobile business PCs enable our users to create content, store work-in-progress, manipulate data, analyze, and innovate. Some tasks, such as working on a spreadsheet, building a sales presentation, or doing interactive design work with rendering, are just not practical on a small-form-factor device or a laptop with a less extensive feature set.

Also, many users who create content and manipulate data need local storage to support remote usage. This may require larger onboard PC storage requirements not possible or standard with some smaller devices.

ROBUST FEATURE SET AND HIGH PERFORMANCE

Employees' PCs serve as offices—and they need the feature set and performance that such a usage model requires. Our mobile business PC platform supports a full range of business applications, including high-performance graphics, Unified Communications and collaboration, multimedia, and our enterprise portal.

Unified communications and collaboration

Unified Communications and collaboration capabilities—including real-time and asynchronous messaging, video conferencing and chat, integrated voice and softphone, and Webcasting—as well as related tools such as application sharing and social networking, are enabling greater productivity and a more immersive user experience.

These types of real-time multimedia application workloads perform optimally and are best experienced when executed locally on mobile business PCs. Unified Communications and collaboration services are becoming more widely used at Intel. The number of people concurrently sharing server resources and/or LAN segments is also increasing. It therefore becomes even more important to distribute processing to help ensure the best possible user experience—not only for the people using collaboration tools but for all who are dependent on the server and network infrastructures.

In 2009, we deployed Unified Messaging to increase employee productivity. Employees now use their mobile business PCs for all messaging—voicemail and e-mail—and can also access the system by phone while on the road. We estimate that moving to Unified Messaging has helped Intel avoid about USD 1 million in costs related to legacy voicemail systems.

Multimedia

High-definition video and 3-D graphics are processor- and graphics-intensive applications that require a platform such as mobile business PCs.

Video use is growing across Intel. We increasingly use video conferencing technology to enable employees to share ideas and collaborate with peers worldwide without leaving the office. This effort eliminated USD 14 million in travel expenses and saved employees 43,156 travel hours in 2009.

Internal studies show that 75 percent of meeting attendees using video report that these conferences are as effective as in-person meetings. Employees have the ability to participate in video conferences from their desks using webcams and can access advanced video conferencing facilities at many sites. In 2009, we added additional video capabilities so that dispersed teams could collaborate more effectively, reduce travel, and accelerate decision making. Facilities now include a range of video conferencing options—from rooms that simulate sitting across a table from remote colleagues to rooms that enable engineers to share critical design documents.

The demand for video is so strong that business units are creating their own tools. For example, one business unit recently built a cross-site video communication, collaboration, and training tool. To date, 4 percent of Intel employees have created accounts to use this tool, and we expect this trend to increase. In February 2010, employees uploaded 110 videos and viewed about 2,700 videos. In a small case study, use of the tool resulted in a 33 percent reduction in network traffic compared to the previous method of sharing videos.

Enterprise portal

Intel uses an enterprise portal—an integrated Web-based tool with a single point of access to applications, content, enterprise resource planning (ERP), and services including the Intel intranet. The portal provides a personalized, role-based interface that can be customized to individual needs, and users require a well-equipped laptop to take advantage of its extensive use of JavaScript*, cascading style sheets, and graphics.

We achieved a 30 percent performance improvement on average with the new mobile business PC platform, compared to the same solution on a three-year-old mobile business PC, as measured in user response time. The new mobile business PCs support the local processing and caching necessary to provide a satisfactory user experience.

FLEXIBLE COMPUTE MODELS

Our mobile business PC platform supports a range of current and future application delivery models: local execution, cloud computing, streaming, and remote execution. This inherent flexibility enables our users to choose the computing model that best fits a particular scenario.

For example, working with high-resolution graphics is usually more efficient with local execution; however, server-side execution can provide acceptable performance in situations where the workload is static and predictable, there is no requirement for mobility, or there is no requirement for high availability. Mobile business PCs enable users to access both of these service delivery models on a single platform—allowing Intel IT to select the delivery mechanism that best suits the application without limiting user access.

Mobile Business PCs Enable the Virtual Intel Sales and Marketing Conference

For several years, Intel has held an annual Sales and Marketing conference, flying employees to the conference from around the world. In 2010, Intel held its first virtual Intel Sales and Marketing Conference (V-ISMC). This event was marked by high attendance, quality instruction, and expanded reach (see Table 3); it would not have been possible without mobile business PCs.

By making attendance easier, we provided training to 900 additional people compared to 2009's conference. We were also able to make materials available on demand after the conference. Mobile business PCs, with their robust feature set and high performance, enabled conference attendees to fully participate, just as if they were physically present. Overall, Intel attributes a savings of USD 14 million to video conferencing.

Table 3. Highlights of 2010 Virtual Intel Sales and Marketing Conference

Attendance	<ul style="list-style-type: none">4,683 unique attendees, compared to 3,391 in 2009's face-to-face conference63 countries in attendance51,923 total attendee logons
Content	<ul style="list-style-type: none">2.4 terabytes downloaded68,271 document views71,908 videos viewed420,863 files downloaded
Interaction	<p>We interacted with about 30 percent of attendees in each booth</p> <ul style="list-style-type: none">2,577 visits to Intel IT booths8,209 chats accepted110 chats moderated

Cloud computing and local processing

Cloud computing is not synonymous with a thin-client solution. Neither is cloud computing a method of executing services—instead, it is a new model for delivering services. Some cloud services use delivery methods that thin clients cannot support. For example, a cloud service may download a real-time collaboration tool that will not execute efficiently on a thin client. As another example, a video repository may be hosted in the cloud as a service; however, viewing these videos is dependent on a video player on the local device that enables the graphics processing to occur locally and prevents video streaming from negatively affecting network performance.

In contrast, on a thin client the video would execute on the server, resulting in a poor-quality video on the end point or requiring an expensive graphics processing unit (GPU) in the server or on the end point device to provide a comparable experience. In addition, in situations where many users are accessing the video simultaneously, the thin model would potentially impact performance for other users on the subnet due to increased network volume. Mobile business PCs let our users run applications, such as e-mail, learning tools, and expense report tools, using local resources on the PC, so that they can work offline. When users connect to the server, data is synchronized. Intel IT testing has shown that local processing is essential for graphics, multimedia, animation,

real-time collaboration, and a range of other compute-intensive tasks. We found that using a server-hosted, thin-client virtual hosted desktop (VHD) model to support these applications resulted in high server and network utilization and unacceptable application responsiveness for our users. In our case, local execution provides the best, most immersive user experience.¹

MANAGED INFORMATION SECURITY AND BUSINESS CONTINUITY

Our mobile business PC platform provides the ability to monitor and manage PCs remotely, enabling us to proactively and quickly resolve issues related to information security and business continuity.

Information security

Our mobile business PCs are equipped with advanced security features and robust system performance to proactively protect business data through encryption, antivirus, spyware, backup, and so on. Our remote management applications minimize Service Desk costs and enable remote control and remote patching.

Platform management is a critical factor in our use of mobile business PCs. There is a lingering perception that distributed computing is not as secure as a thin-client solution; however, when managed correctly, distributed computing can be well secured.

We have found that with thin clients users are more likely to create hard copies of sensitive data or transfer data to a portable storage device. These devices are easily lost and are not very secure, as most people don't take the time to encrypt them. We prefer a usage model that protects the entirety of employee and customer data on the primary compute device—the PC—while supporting diverse usage models and business needs.

¹ "Streaming and Virtual Hosted Desktop Study: Phase 2." Intel Corporation, April 2010.

Business continuity

In a disaster scenario, mobile business PCs offer several advantages. They can be built remotely and shipped to affected users, and they can be managed remotely. Employees can take their PCs with them wherever they need to go. In addition, employees already know how to work from any location so no training is needed in a time of disaster.

We have experienced several recent disaster situations, such as a snowstorm and a flooded building, that demonstrated the benefits of mobile business PCs. During the snowstorm, 5,000 employees telecommuted, avoiding dangerous conditions. When the building flooded, 7,000 gallons of water destroyed about 80,000 square feet of office space. About 450 employees were displaced during renovations—250 of them for two months—but they could work effectively from home.

In these potentially disruptive scenarios, our mobile business PC platform enabled us to minimize impacts on operations and avoid the costs associated with declaring a “state of disaster.”

USING AND SUPPORTING EMERGING TECHNOLOGY

Intel’s computing environment is dynamic, and we strive to investigate new technology platforms proactively.

We update our computing platform as necessary based on continuous evaluation of our strategies against industry trends such as:

- Increased security threats
- Consumerization of IT
- Alternative devices and evolving technology capabilities
- Changing workforce and user demands

- Static and shrinking budgets
- Increased pace of business
- New service delivery models

Using highly capable mobile business PCs enables us to quickly and easily incorporate new technologies and capabilities into the standard platform, without having to simultaneously refresh the entire PC fleet to a newer, more capable model at any given time, which is not practical.

Remote Management

Automation solutions such as Intel® vPro™ technology can enhance productivity and cut costs. By encouraging employees who embrace the consumerization of IT to use an Intel vPro technology-enabled device, we can eventually implement virtual container provisioning as well as other supported security and remote management features. This will simplify corporate build management and enhance information security.

Because thinner clients don’t support advanced remote management and security features, they are subject to expensive deskside support visits even when onsite. We saw the reduction of deskside visits as a key benefit and cost savings area in our transition to the mobile business PC platform more than a decade ago, and this is a key factor in our 67 percent reduction in TCO. Remote management capabilities may be useful in a VHD context, allowing IT to troubleshoot devices that fail to connect to backend infrastructure.

In the future, we plan to run managed virtual machine (VM) containers on top of client native hypervisors, also known as type 1 hypervisors. With the protections provided by Intel vPro technology, plus the better isolation that type 1 hypervisors provide between containers, we can provide a more secure way to access corporate resources without sacrificing mobility.

The latest generation of Intel vPro technology includes several potentially useful technologies, such as keyboard-video-mouse (KVM) remote control and “fast call for help,” which lets IT manage and repair a PC even if it’s outside the firewall. As we adhere to our standard refresh cycle, we will incorporate these capabilities into our remote management strategy.

Solid State Drives

We began to deploy up to 10,000 mobile business PCs with solid-state drives (SSDs) instead of hard disk drives (HDDs) in 2009. In 2010, all newly issued and refreshed mobile business PCs will include SSDs because of their many benefits to IT and to users. SSDs are shockproof and don’t get fragmented. They are also faster than traditional HDDs and offer new capabilities that allow greater security, new improvements in display technology, and support for more feature-rich graphical user interfaces (GUIs). Additional benefits include:

- 90 percent lower failure rates
- 96 percent reduction in IT support time for PC rebuilds
- 44 percent gain in productivity
- 18 to 33 percent system performance improvement over standard HDD system, depending on the speed of the HDD used for comparison
- 41 percent improved performance in Intel IT workload tests

SSDs also provide better support for virtualization and mitigation of performance degradation caused by disk encryption. We have also found that the Intel IT-specific image build process tests finished about 30 minutes faster on SSDs than on traditional HDDs. The performance benefits of the drive can also speed the delivery of other support services like data migration or restoration.

CONCLUSION

Intel IT's assessment of computing platforms demonstrated that the ability to perform local computing on the client offers the best user experience and the flexibility to run different types of applications. We therefore continue to standardize on mobile business PCs rather than a thin-client solution because they best match our requirements for superior mobility, productivity, information security, and business continuity.

The mobile business PC computing platform enables users to achieve productivity gains because their PCs are flexible and powerful enough to support every usage scenario in our environment. Collaboration across time zones and geographies and advanced video conferencing are only a few examples of the powerful capabilities mobile business PCs provide.

We are constantly exploring new technologies and developing innovative solutions that provide the best balance of flexibility, productivity, and

cost efficiency. With mobile business PCs, we are positioned to take advantage of emerging technologies that can further enhance employee productivity, as well as implement the level of platform management necessary to maintain acceptable levels of information security and business continuity.

By managing our client PCs as strategic assets, streamlining our processes, and buying higher-specification PCs that improve productivity and security, we deliver measurable business value year after year.

FOR MORE INFORMATION

Find additional IT@Intel white papers at www.intel.com/IT.

- "Evaluating Thin-Client Security in a Changing Threat Landscape"
- "Evaluating Netbooks for Enterprise Use"
- "Transitioning to Unified Messaging from Legacy Voicemail Systems"
- "Enterprise-wide Deployment of Solid-State Drives"

ACRONYMS

ERP	enterprise resource planning
GPU	graphics processing unit
GUI	graphical user interface
HDD	hard disk drive
KVM	keyboard-video-mouse
PB	petabyte
PDA	personal digital assistant
SaaS	software as a service
SSD	solid-state drive
TB	terabyte
TCO	total cost of ownership
VHD	virtual hosted desktop
V-ISM	virtual Intel Sales and Marketing Conference
VM	virtual machine
VoIP	Voice over IP

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