

White Paper

Intel Information Technology

Mobile Computing

Intel® Centrino® 2 with

Intel® vPro™ technology

Processor-based Notebooks

Increasing the Business Value of Mobility

Intel is combining new mobile technologies with innovative workspace designs to increase the productivity and satisfaction of its employees and reduce operating costs. In this white paper, Intel IT shares its experiences and insights in designing, implementing and supporting the new environment.

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Executive Summary

Mobile computing has become a strategic asset for Intel. Wireless-enabled notebooks increase the productivity per average employee by more than five percent and help to create a more efficient work environment. Today, approximately 80 percent of Intel employees use a notebook as their primary business tool.

Now we are working to take the mobility of our workers to the next level. Mobile technologies such as PC-based telephony, unified communications, and Voice over IP (VoIP) have matured, and now enable a level of mobility that was not possible before. With these advances, we decided it was time to take a fresh look at our mobile strategy.

The result is a major upgrade of our mobile computing solutions coupled with a redesign of our physical office space. The combination provides a more dynamic and connected work environment, one that gives employees greater flexibility and fosters more spontaneous interaction and collaboration. To date, we have deployed this new work environment to approximately one thousand Intel employees in three separate locations and are evaluating these pilot implementations to plan our next steps.

This white paper describes our experience in designing and deploying the new mobile work environments, and in helping our employees make the transition. It will be useful for IT and business decision makers looking for ways to increase the value of mobility in their own businesses so they can reduce operating costs and improve the productivity, responsiveness, and satisfaction of their employees.

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The Business Value of Mobility

Several years ago, Intel IT conducted productivity studies to assess the value of migrating employees from desktop PCs to notebooks. The results showed that a wireless-connected notebook provided better than five percent time savings in an average employee's workweek. Based on these results, we embarked on a broad transition to mobile computing that has delivered a return on investment (ROI) of USD 26 million (three year net present value).

Approximately 80 percent of Intel employees now use a wireless-enabled notebook as their primary productivity tool and we have deployed wireless networks pervasively throughout our facilities. Employees are more connected, collabora-

tion has improved and work patterns have become more flexible. With these gains, our laptops and wireless infrastructure have become strategic assets for the business.

Taking Mobility to the Next Level

In recent years, a number of new mobile technologies have matured. Some of the most important advances include:

- **PC-based Telephony** – A properly provisioned notebook now empowers an employee to work, communicate, and collaborate effectively from any location that provides a wired or wireless Internet connection.
- **Unified Communications** – Applications available from a variety of vendors now enable employees to manage their communications –voice, e-mail, instant messaging, etc.–from a single application. This can provide faster, simpler, and more reliable access to messages.
- **Voice over IP (VoIP)** – The ability to carry voice and video over wired and wireless corporate data networks introduces major opportunities for infrastructure consolidation and cost savings. It also opens the door to more flexible enterprise management of both data and communications.

The potential for these technologies to increase employee mobility and productivity are clear, yet we had additional reasons for rethinking our mobile strategy. Mobile computing had already caused significant changes in work patterns at Intel. Employees were spending more time working away from their assigned office spaces, whether at home, at client and vendor sites or in common spaces, such as conference rooms. In fact, roughly 50 percent of on-site offices are now unoccupied at any given moment.

Given these changes, Intel executives thought the time was right for a major step forward in the company's mobile computing strategy.

Exploring Options and Requirements

Since mobility had already changed the utilization of assigned office spaces, it was clear the physical environment should be considered in the overall redesign. This task was undertaken by Intel's Corporate Services organization. The resulting recommendations were based on employee surveys and focus groups, extensive discussions with industry experts, and benchmarking with two other companies of similar size and scope.

Results from these sources validated our initial assumptions and indicated that substantial benefits could be realized by creating a workspace in which employees could see, hear, and interact more spontaneously with their neighbors. The discussions with other companies also helped us identify the most highly valued new IT capabilities: high-bandwidth wireless networking and

"softphone" applications. Together, these capabilities enable telephony to be integrated into employee notebooks, so individuals can work and communicate effectively from almost anywhere.

Flexibility was also shown to be important. Every employee has unique needs, and each employee's work mode tends to change throughout the day. At times, effective collaboration is most important. At other times, a quiet place is needed so individuals can concentrate on complex issues. This is certainly true at Intel. We have thousands of intensely-focused design engineers, executives, and knowledge workers of all varieties. We also have many collaborative teams, and most of them are distributed across facilities, campuses, and time zones. A flexible and accommodating work environment is essential.

The New Office Environment—Optimized for Efficiency

To provide greater flexibility for our mobile workforce, the redesigned office space includes:

An Open and Flexible Physical Environment

▪ Flex Zones and Touchdown Spaces –

These small, comfortable spaces are specifically designed to support mobile employees, whether they are visiting a facility in another country or a colleague on another floor. Each space has a notebook docking station and a large monitor. Anyone can sit down in any space and be immediately productive.¹

▪ Conference Rooms and Collaboration

Spaces – Research shows that about 50 percent of meetings are spontaneous and these tend to be among the most productive. We have therefore increased the number of conference rooms. Some can be reserved; others are for ad-hoc use only. We have also added informal collaboration spaces (a few chairs and a table) throughout the workplace.

▪ **Community Zones** – These spaces are designed to promote fun, spontaneity, and relaxation. Standard whiteboards are mounted on much of the free wall space, and a large interactive whiteboard (a touch-sensitive PC display) is available for collaborative work. We also plan to include digital signage for posting information about events, activities, etc.

▪ **Individual Privacy Rooms** – These sound-proof rooms provide a quiet place for phone calls and other private business.

▪ **Standard and Mobile offices** – Employees cubicles remain important and have been updated with improved furniture functionality that utilizes space more efficiently. The saving frees up space on the floor to support new modes of work and interaction.

1. These spaces are also ideal for temporary workers and visitors. However, visitors from other companies could encounter some difficulties, since their PCs may not be compatible with the docking stations.

A “Connected Everywhere” Computing Environment

The office space redesign was important for supporting mobile work patterns, but enhanced IT capability was the key to empowering employees and enabling real productivity gains. In designing the computing environment, Intel IT’s goal was to deliver full connectivity both within and outside the office. We identified four capabilities that were needed to deliver on this vision.

- 1. Full connectivity from anywhere inside Intel facilities –** Intel is focused on making wireless networking stable, reliable, and powerful enough that it can be the primary network for most users. Both wired and wireless LANs were in place prior to this project, but our wireless bandwidth was not sufficient to support all functions for large numbers of users. Our solution was to upgrade the WLAN to 802.11a, which provides more bandwidth, stability, and reliability than our previous solution. With this technology, we can provide ubiquitous connectivity for users at all times when they are in the office.
- 2. PC-based voice calls –** We decided to integrate softphone applications into employee notebooks, so users can make and receive voice calls with their PCs whenever they are connected to the corporate network. The connection can be through a wired or wireless link. It can also be over the Internet, since Intel’s

remote access capability incorporates Virtual Private Networking (VPN) for security. With this capability, Intel employees can have full office functionality from almost anywhere in the world.

- 3. One central point of contact –** In recent years, e-mail has replaced voice mail as the main source of communication for most Intel employees. In fact, voice mail now tends to be checked infrequently, and phone communications sometimes lose their importance by the time they are retrieved. To address this issue, we integrated voice mail into our employee e-mail application. Voice mail can now be received as audio files, so employees no longer need to manage e-mail and voice mail separately. This improves efficiency and helps reduce missed and delayed communications.
- 4. Power to the user –** A major focus of our redesign was to enable employees to connect with each other instantly. However, in a busy workplace, this can lead to incessant interruptions that impair individual productivity. We believe the answer to this challenge is to give users better control over their communications. To accomplish this, we introduced a call control function that enables each user to route his or her voice communications to any device (e.g., notebook softphone, desk phone, cell phone, home phone, etc.). We also provided a presence-awareness feature that enables employees to indicate their availability for calls and meetings. To make the user experience as simple as possible, we integrated these functions into our Instant Messaging (IM) system.

Making It Work

New IT capabilities rarely deliver value automatically. Employees have to invest the time and effort to learn new functionality and then use it to perform common work functions in new ways. Change for endusers is always challenging. It is therefore essential that new applications work seamlessly together to deliver a positive user experience.

Integrating the Technologies

Technical integration of the new capabilities was relatively straightforward, but was complicated somewhat by our continued use of desk phones for employees with assigned offices. These older phones rely on our existing private branch exchange (PBX) rather than the new VoIP-based solution we are using for softphone communications.

We began by testing each new capability individually. We then performed holistic tests on the integrated solution and measured results against predefined outcomes. More than 50 test cases were defined prior to testing, and approximately 10 unique issues were

identified (e.g., headset and speaker echoes; cases in which voice mail messages were not received in e-mail; a failure of caller ID in certain call-forwarding scenarios, etc.). These issues were resolved before deployment to end users.

Creating a support model for the new solution was more complicated. Since the four new capabilities require support from our telephony, e-mail, networking and client teams, diverse skill sets and cross organizational collaboration are needed. We initially created four separate support plans, but quickly realized this approach would not scale well. Instead, we equipped and trained our front-line help desk teams to diagnose incoming issues and relay them to appropriate second-level experts in each of the four categories.

Upgrading Laptops

In general, Intel IT employs a three- to four-year notebook refresh cycle, depending on business needs. Many employees who would be moving into the new workspaces were already scheduled for refreshes within the next six months. After careful consideration, we decided it would be better to provide every participant with a new notebook. By moving to a standard configuration for all participants, we would simplify the sharing of common peripherals in shared areas, such as docking stations, power supplies and monitors. Design, deployment and training would also be simpler, since systems, applications and usage models would be consistent throughout the environment.

In refreshing notebooks, we chose Intel® Centrino® 2 with Intel® vPro™ technology-based systems to provide:

- **High quality communications and responsive applications**, even when audio, video, instant messaging, and productivity applications are running simultaneously (see the sidebar: *New Applications, Increasing Workloads*). We found the high performance of these notebooks was valuable for providing substantially better call quality and for avoiding dropped calls during heavy use.
- **Enhanced range and performance for wireless networking**, to improve connectivity throughout the facility.
- **Integrated cameras** to eliminate the cost and challenges of adding peripheral cameras to existing notebooks.
- **Better management** to reduce support costs and improve security, uptime and compliance. Intel IT is in the first year of a multi-year deployment program to renovate our client management capabilities using Intel vPro technology (see the sidebar: *Improving Client Management while Reducing Costs*). Our wireless environment creates additional management challenges, and we expect to realize dramatic returns over time as we continue to deploy new management capabilities.
- **Improved energy-efficiency** to further reduce operational costs. The latest notebooks deliver better performance with lower power consumption and longer battery life than earlier systems. We also plan to utilize our Intel vPro technology-based management tools to remotely power down systems when not in use (and power them up as needed for management).

We added peripherals based on employee roles and needs, including:

- **A USB headset** for voice communications. Each employee received a single headset that can be used with both notebooks and desk phones.
- **A wireless mouse** for people working in flex areas, so they would not have to manage wired connections.
- **A backpack or travel case** to further improve mobility.

New Applications, Increasing Workloads

Multimedia communications are changing the way people work and placing higher demands on notebook and desktop PCs. Real-time applications, such as telephony, videoconferencing and application sharing, are especially demanding, since employees often run office productivity applications at the same time. IT organizations planning to deploy these kinds of applications should look closely at peak workload expectations in evaluating the capabilities of future client systems. They may also want to consider the cost and quality of support for key peripherals, such as cameras and headsets.

Improving Client Management while Reducing Costs

Intel® vPro™ technology provides built-in, hardware-based capabilities that can help IT organizations improve security, maintenance, and asset tracking. Properly provisioned PCs can be accessed over wired and wireless networks by authorized management applications and support staff, even when the system is off, the OS is unresponsive, software agents are disabled or the hard drive has failed.

Intel IT is moving gradually to integrate these new capabilities into our client management infrastructure and processes. We have already realized significant cost savings and expect our returns to increase dramatically over the next few years.

For more information, visit the Intel vPro Expert Center.
<http://communities.intel.com/community/vproexpert>

Enabling Employees

Considerable effort was devoted to ensuring the new mobile environment was easy to use. However, the transition into the new office environment still involved a lot of change for a lot of people. Everyone received a new notebook, some new applications, and a new workspace in a completely redesigned office environment. Changes of this magnitude are bound to create some level of confusion and disruption. The goal was to ease the transition and enable employees to be productive on day one.

Our solution was to provide flexible training opportunities over an 8-10 week period preceding the physical move. The components of the training included:

- **Classroom Presentations and Pre-Class Training** – This was the most common approach for all employees receiving new notebooks. A trainer and a technical support person conducted each four-hour class. New notebooks were delivered, data was transferred from old notebooks, and new features and usage models were demonstrated and practiced. All attendees were required to view a training presentation (an audio slide show) prior to the class, to familiarize themselves with the new tools. Employees who were unable to attend the face-to-face classes were allowed to receive their new notebooks through the mail.

- **Virtual Training Sessions** – One-hour virtual training sessions were provided twice a day throughout the physical move via an audio bridge and a live meeting application. These meetings were conducted by a PC technical expert, so employees could get answers to specific questions that arose during the move.

- **Business-Unit-Specific Training** – Self-guided installation and training modules were created for applications that were specific to individual business units.

- **Interactive Whiteboard Training** – Multiple face-to-face demonstrations were scheduled during the move so employees could learn how to use this valuable new collaborative tool.

- **Roaming Support** – Two technical experts were available at all times during the physical move to provide hands-on help and support. These teams were highly utilized and particularly valuable.

Our training strategy was largely successful, but we did learn valuable lessons. Most importantly, the 8-10 week delay between the classroom training and the physical move made it hard for many employees to retain knowledge, especially since they were unable to practice many of the advanced notebook functions because the infrastructure was not yet in place. About 30 percent of employees were also too busy to attend the classroom training, which added to the confusion and disruption during the move. For future deployments, we are considering strategies for providing employees with “just-in-time training.”

Results to Date

Optimizing Intel’s mobile work environment is a long-term project. To date, three pilot deployments have been performed across three sites:

1. A portion of a single floor in Chandler, Arizona (Q4 '07)
2. A full floor in Santa Clara, California (Q1 '08)
3. A full floor in Hillsboro, Oregon (Q2 '08)

About 1,000 employees now have access to the new mobile capabilities and are working in the redesigned office spaces. Clear gains have been realized through increased workspace density and better utilization of shared resources. We believe employee productivity and efficiency have also improved, though further study is needed to validate and quantify these gains (see *Where We Go from Here*, later in this paper).

In general, the majority of employees have responded favorably to the move, and we expect enthusiasm to grow with time as they become increasingly comfortable with the new environment. Early feedback indicates that the most valued new IT capabilities are the improved wireless access and the ability to make and receive

voice calls from the notebook (Figure 1). Next in line was the call routing tool, which enables users to automatically route calls to their preferred device.

More specific issues have also emerged. For example, there is a need for more quiet zones, especially for engineers who often need to get away from distractions so they can concentrate on complex technical issues. Many engineers have also requested space for a reference library, since not all information is online—at least not yet. Fortunately, the new workspace design frees up space for these and other improvements in future deployments.

On average, employees were satisfied with the implementation and with the training and support they received. We consider this a good result for a transition of this complexity. Of course, as for any major implementation, we will work to refine our solutions and improve our training and support strategies moving forward.

Capability vs. Importance

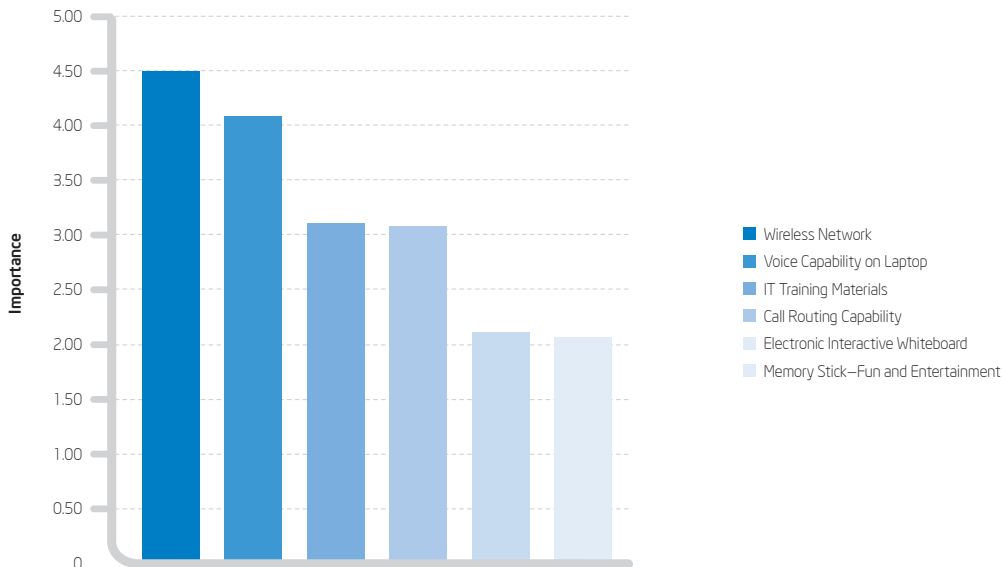


Figure 1. Employees were surveyed following the move to the new work environment. Results showed that the improved wireless network and the softphone application were the most highly valued of the new IT capabilities.

What We Learned

Redesigning our IT and physical environment to improve efficiency and productivity is an important project for Intel. We now have a basic design that enables employees to be instantly productive in any Intel facility.

Flex zones, touchdown spaces, and community zones provide welcome new work options. Employees can remain fully connected to data and personal communication tools, either at these spots or via any broadband Internet connection. This not only impacts the productivity, responsiveness and satisfaction of current employees, but will also play a role in attracting future employees.

Technically, the redesign was an important step toward a new converged communication and mobility framework. However, like many organizations, we did not want to move to a completely new infrastructure all at once, and this created some integration challenges.

As a result, end users had to bear with a somewhat sub-optimal solution in the initial weeks of deployment. Combined with the magnitude of the change and the number of users, this also created management challenges for IT training and support teams.

To address these issues, we anticipate rolling out the new technologies to employees gradually in future deployments. This will give them more time to learn and adapt to each new capability, and will simplify training and support. There is one other significant change we anticipate going forward. Because of the enthusiastic employee response to PC-based telephony, we are considering deploying the softphone application much more widely.

Where We Go from Here

In the first quarter of 2009, we will be deploying our new mobile environment on two additional floors at Intel facilities. Though we will integrate minor changes based on our learnings from the first three implementations, the basic framework will remain the same.

We will also be assessing the value of the new solutions in more detail. We will continue to collect subjective feedback via surveys and focus groups. We also plan to conduct behavioral studies to provide objective information about work patterns, usage models, efficiency, and productivity. All this will take time and unified communications solutions are evolving rapidly. We will continue to assess new technology and product advances and work to determine tradeoffs among cost, risk, and value.

As we move forward, it will be important to maintain close collaboration among all parties, including office space and human behavior specialists, IT, employees, and business units. Many factors interact to determine the success of a work environment, and we want to take as many

as possible into consideration. We plan to prototype future designs and refinements in the Intel Innovation Center, where we can control and study key issues in more detail.

Transforming the work environment in today's technology-based world is clearly a complex undertaking, particularly as we let go of preconceptions based on traditional approaches. We believe we have made much progress, but we still have a long way to go. We also believe it is well worth the investment. Few issues are more important to a business than employee productivity, efficiency, and satisfaction. Based on our experience so far, next-generation mobility and client management solutions can help businesses improve all three, while simultaneously reducing total costs.

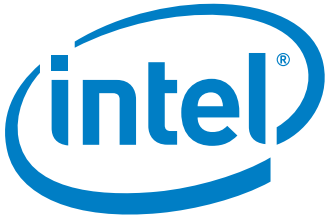
Conclusion

Mobile computing technologies have changed the way people work, helping them become more productive, responsive, and satisfied.

New advances, such as VoIP, PC-based soft-phones and universal communications, offer important new capabilities that have the potential to drive additional improvements. To make the most of these advances, companies may need to rethink not only their technologies, but also the physical design of their office environments.

This can be a complex undertaking, yet we believe the potential benefits of next-generation mobile computing are simply too great to ignore.

Computing devices will continue to get smaller, more powerful, more manageable and more energy efficient, while infrastructure and software solutions will evolve to deliver more functionality and better connectivity. For businesses to stay competitive, they will need to understand these advances, and determine when and how they can use them to deliver significant value to the business.



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Acronyms

IM	Instant Messaging	TDM	Time-Division Multiplexing
LAN	Local Area Network	USB	Universal Serial Bus
PBX	Private Branch Exchange	USD	United States Dollars
PC	Personal Computer	VoIP	Voice Over Internet Protocol
ROI	Return on Investment	VPN	Virtual Private Network
		WLAN	Wireless Local Area Network

More Information

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<http://communities.intel.com/tags/client?communityID=2000>

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