

Preparing the Enterprise for the Impact of Alternative Form Factors

Intel IT plays a critical role in creating the future workplace by researching, evaluating, and analyzing emerging technologies that accommodate many form factors.

Executive Overview

The explosion of connected devices in the marketplace is compelling Intel IT to shift away from the traditional enterprise client computing model. Our focus now is on providing greater productivity and flexibility for Intel employees by enabling seamless access to services and data from multiple devices, while maintaining enterprise security and without significantly increasing IT costs. We are actively preparing for a future workplace that incorporates many alternative form factors, such as handhelds, tablets, and smart TVs, as well as many input methods, including touch, voice, sensor, and gesture.

To integrate new form factors and input methods into our environment, we need a more flexible approach to delivering services across a range of devices. We are building the foundation for this vision now by refining our information security architecture, investigating service delivery models, preparing our infrastructure, and developing a new, adaptive support model.

Intel IT plays a critical role in creating the future workplace by researching, evaluating, and analyzing emerging technologies that accommodate many form factors. We conduct proofs of concept (PoCs) including:

- **Bring-your-own-Mac program.**

Participants in this program use their own Apple Macintosh* computers—from home or at work—to access the full range of IT services. While Macs are not strictly speaking a new form factor, we will apply many of the things we're learning during

this program to future programs associated with new form factors.

- **Middleware for application development.** This PoC used a third-party central middleware product to detect a device's screen size and adjust the application graphical user interface (GUI) accordingly to improve the user experience.
- **Manageability suite to improve security.** We recently completed a PoC that used a third-party manageability suite to verify that handheld devices have sufficient hardware, software, and security settings to receive e-mail attachments.

These activities help us transition from the traditional IT model of end-device control and management to a device-independent, services-based model, and provide valuable information as we actively prepare the enterprise for the impact of alternative form factors.

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BUSINESS CHALLENGE

Enterprise client computing is at an inflection point. A number of trends and pressures—including the explosion of connected devices in the marketplace—are driving a transition from the traditional client computing model toward a future in which employees will use a variety of devices to access information from anywhere, at any time. Intel envisions a Compute Continuum that provides a seamless, consistent experience across devices.

Intel IT's goal is to provide greater productivity and flexibility for Intel employees by enabling them to access information and IT services from multiple devices. To date, we have provided companion devices that complement employees' mobile business PCs through a corporate handheld device program. We also offer a very successful personal device program that enables employee-owned devices to access corporate data. Participants in these programs report saving almost an hour a day by accessing e-mail, calendar, and contact information from their handheld devices.

However, addressing employees' needs for flexible usage models doesn't stop with smart phones and other handhelds. Employees want multiple devices optimized for their locations and their tasks. For example, employees may want to use a smart phone to view contact information when riding in a taxi. If they are at home, they may want to access the same information from a smart TV. We must continue to enable alternative form factors with an expanding set of non-traditional input methods such as voice, touch, sensor, and gesture.

Integrating new device types and input methods into our environment poses challenges to how we develop and deliver services. To actualize the future workplace, in which employees enjoy a seamless, consistent experience across a continuum of devices, the Intel® IT Innovation Center (see sidebar) researches, evaluates, and analyzes emerging technologies to accommodate many form factors. Our goal is to continue to increase employee productivity and satisfaction while reducing IT costs.

MANY FORM FACTORS BUT A SINGLE VISION

Alternative form factors already play a part in enterprise computing at Intel. As the consumer marketplace continues to introduce new devices at a rapid pace, Intel IT is actively exploring how to prepare service development, delivery, and security for even more alternative form factors, such as smart TVs. This advance preparation will enable us to achieve the greatest benefit from these devices.

The Intel IT Innovation Center plays a crucial role, providing a means of experimenting with and evaluating new technology through proofs of concept (PoCs) and pilot projects. This type of "learning by doing," combined with our collaboration with Intel business units and the IT industry, enables Intel IT to provide Intel with the greatest benefit associated with each advance in technology.

Combining Many Form Factors with Many Input Methods

Intel's employees have long used desktop and mobile business PCs as their primary compute and collaboration tools. They are increasingly turning to companion devices such as smart phones, netbooks, and tablets to gain increased flexibility to perform their jobs and access corporate services. Employees expect to use devices dedicated to specific uses, depending on where they are and what they want to accomplish. In the future, we anticipate that even more form factors with different input methods will be used to access corporate applications.

In our experience, each different form factor fills a useful niche.

- **Handhelds.** As companion devices to mobile business PCs, employees currently use handhelds for phone service, e-mail, contacts, calendar, and Web access.
- **Tablets.** We currently support tablets in the same way we support handheld devices, and they can access e-mail, calendar, and contact information. However, employees would also like to take advantage of tablets' larger screen size and keyboard to share presentations and create documents.
- **TV-like appliances.** These appliances, such as smart TVs and set-top boxes, look and act like regular TVs. However, they can also display content from other devices such as handhelds, tablets, and PCs, and access content directly if supported. In the near future, we expect employees to be able to remotely access an "enterprise desktop" from the family TV room using one of these appliances.

These form factors exist today, some in rudimentary form, and we anticipate that improvements to these device types and development of new devices—such as in-car

computers and wireless displays connected by Intel® Wireless Display—will accelerate. We want to be ready for those changes and improvements.

INPUT METHODS

We believe the future workplace will incorporate devices that use many input methods beyond the traditional keyboard and mouse. As these input methods become more integrated into all form factors, IT will have to support these models.

- **Touch.** Many consumer devices use touch as the primary input interface. Users now understand that they need to pinch a track pad to zoom, swipe to scroll, and perform multiple-finger actions for specific commands that go far beyond traditional mouse movements.
- **Voice.** Most consumer devices have some type of built-in voice command system. For example, on some smart phones, users can push a button and then speak the words "call <name>" instead of pressing number buttons.

Additionally, some devices can read incoming text messages aloud and take dictation to send text messages. One example is an in-vehicle infotainment (IVI) system that can read e-mail messages and calendar reminders aloud to the driver.

- **Sensor.** In a client-aware environment, sensors can identify client capabilities to optimize application delivery and end user experience across a range of devices in a secure fashion. Increasingly, OEMs are adding sensors to platforms so they can be used for payment, authorization, and identity. These include sensors for many other factors beyond traditional location and connectivity, such as humidity, temperature, and ambient light.

These sensors will enable IT shops to gather more information about a device's

Intel® IT Innovation Center

The Intel® IT Innovation Center provides services to promote the development of innovative and disruptive technologies and capabilities that influence the industry. The center supports the investigation and hands-on demonstrations of Intel® products and platforms for information technology solutions and use cases.

The center also fosters engagements with and between internal Intel business groups, external industry partners, academia, and the broader community. Through collegial dialogues, we help other companies grow by sharing our experiences and, in turn, we learn and improve from the experience of others. The centers also host innovation workshops and technology demonstrations to support Intel industry events such as the Intel Developer Forum (IDF) and the International Sales & Marketing Conference (ISMC).

environment than ever before, enabling better decisions about service offerings and service delivery. Users also benefit, receiving the services they need for a particular location, time, and environment.

- **Gesture.** With some devices, employees can use a hand gesture to control a slide presentation. This input method, powered by a technology called “z camera,” works by capturing motion in three dimensions. We are exploring the use of z camera technology to enable gestural inputs to traditional user interfaces and plan to conduct PoC testing of this technology.
- **2-D barcode tags.** Also known as matrix codes, 2-D barcode tags make use of the vertical dimension to include more data than conventional one-dimensional linear barcodes. This type of barcode is becoming a popular way to transfer data. A handheld device can scan a 2-D barcode to display a video or register the owner for an event. We expect that 2-D barcodes will become a common input method for some form factors in the enterprise.

In the future, we anticipate using many additional input methods.

Preparing to Support Many Form Factors

Traditionally, IT has delivered services in a “one-size-fits-all” manner. However, with the advent of many alternative form factors and input methods, we need a more flexible approach to service delivery that can support appropriate services across a range of devices. We are building the foundation for this vision now by refining our information security architecture, investigating service delivery models, preparing our infrastructure, and developing a new, adaptive support model.

INFORMATION SECURITY ARCHITECTURE

Traditional information security models have taken an all-or-nothing approach to protecting corporate data: A user is either granted access to all services or to none. We are developing a new information security architecture that provides dynamic access privileges based on several factors, including the type of security controls available on a particular device. While not all security technologies exist today for full implementation of this model, we are actively encouraging industry-wide research and technology development toward this end.

TIERED SERVICES

Our goal is to have one set of services for all form factors; however, we will provide these services using a tiered model. Those devices with more security controls and that are therefore more trusted will be able to access more services and data than less trusted devices with fewer controls. For example, until recently, certain smart phones could receive e-mail but not e-mail attachments because we could not verify that data stored on these devices was protected. Although we have addressed this particular limitation with a third-party manageability suite, we anticipate that tiered services will continue to be necessary as we support additional form factors and extend service offerings.

Client-side virtualization is key to enabling tiered services. Hardware-based Intel® Virtualization Technology (Intel® VT) provides centralized management, enhanced security, and reduced operating costs. As shown in Figure 1, client-side virtualization enables us to deliver tiered services more securely to any number of devices.

As new form factors proliferate in our environment, we are moving away from

managing device hardware and are beginning to abstract services from devices. By taking advantage of a combination of technologies and trends—such as ubiquitous Internet connectivity, virtualization, and cloud computing—we have an opportunity to redefine the way we provide services to meet changing user requirements.

Those devices with larger screens, better graphics, enhanced security, and faster performance are clearly more capable than others. An important aspect of our tiered services model is the ability to write an application only once, in such a way that we can deliver the service, or a subset of it, to a variety of devices and optimize both application delivery and end-user experience.

In 2010, we conducted a PoC to deliver Intel’s internal Web-based air shuttle reservation tool to small form factor (SFF) devices. We provided access to the existing unmodified Web-based tool using a virtual private network (VPN) connection. Because we did not optimize the graphical user interface (GUI) to respect the form factor, users’ experiences were not positive, and they did not adopt the service. This PoC helped us understand the importance of considering the form factor when delivering a service.

PHYSICAL INFRASTRUCTURE

We are also evaluating the impact alternative form factors will have on our physical infrastructure, such as our network. We are currently exploring allowing smart phones to access Intel’s enterprise Wi-Fi* network, which will involve building virtual LANs (vLANs) on top of the physical network to accommodate security requirements. We are also upgrading our entire network to 10 gigabit Ethernet (10 GbE) to accommodate future bandwidth requirements.

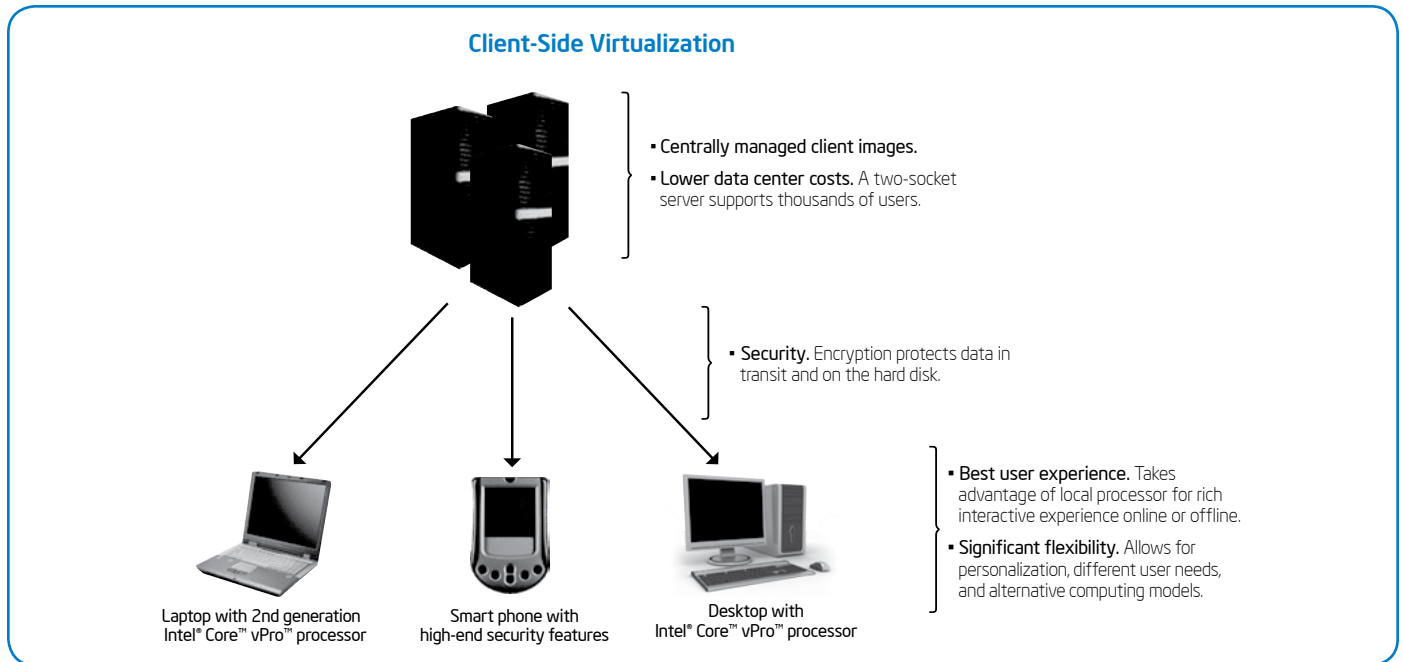


Figure 1. Client-side virtualization enables more secure delivery of tiered services to a wide variety of form factors.

The proliferation of form factors has the potential to affect other aspects of our data center infrastructure, as well. For example, as we adopt new centralized services, we may need additional servers. And although we have found that client-side virtualization is the best way to deliver services for intelligent clients such as mobile business PCs, we may want to add some server-hosted virtualization (SHV), combined with new technologies such as multimedia redirection, to our data center capabilities so we can choose the best service delivery method for a wide variety of form factors.

ADAPTIVE SUPPORT MODEL

The consumerization of IT is shaping the future of enterprise computing, and the converse is also true—the increasing technical knowledge of consumers is shaping our support model. In our experience, employees

who are using alternative form factor devices, particularly employees using personally owned devices, are more willing to accept responsibility for device support. To that end, we are building online self-help communities that offload much of the burden for device support from IT to the users themselves.

RESULTS WE'VE ALREADY ACHIEVED

Implementing personal devices such as smart phones has resulted in significant benefits to both program participants and to IT. We anticipate that these benefits will multiply as we integrate more alternative form factors into our environment.

Benefits include:

- Increased productivity.** Employees using personal devices report saving 47 minutes per day on average—about 10 percent of an eight-hour workday. This adds up to total time savings of more than 1.2 million hours per quarter. Looking at data that included use of both corporate and personal devices yielded similar results—an average of 51 minutes saved per day.
- Improved flexibility.** Employees send approximately 2.27 million business-related e-mail messages each quarter from corporate and personal devices.
- A high level of employee satisfaction.** The satisfaction rate exceeds 90 percent among employees using personally owned devices.

- **Relatively low cost to Intel IT.** Analysis shows that carrier service plans account for most of the cost of associated with handheld devices. With personal devices, employees usually pay for the service plans, so the cost of adding new devices is low.
- **No impact on support.** The number of Service Desk tickets related to handheld devices has not increased significantly, despite the addition of 15,000 personal devices to our environment. Averaged across all corporate and personal devices, the number of tickets per user has actually decreased.
- **Enhanced business continuity.** If employees' mobile business PCs are temporarily nonfunctional, personal handheld devices provide partial backup and access to a limited number of tools—enabling employees to accomplish some tasks until their PCs are repaired.
- **Greater security and loss prevention.** Our personal device program provides a secure and managed way for employees to use their personal devices, which protects Intel data. Internal incident data indicates that employees tend to take better care of their own belongings and

lose personal devices less frequently than corporate-owned devices—also enhancing information security.

ON-GOING INVESTIGATIONS

To help us refine our information security architecture, tiered services model, physical infrastructure, and support model, we are conducting several PoCs. These investigations are providing valuable information as we prepare to support alternative form factors, and we can apply the results to future endeavors.

Each of the PoCs, listed in Table 1, has direct business benefits and will lead us toward increased employee productivity, enhanced IT flexibility, and lower IT costs.

We plan to expand these PoCs, continue evaluating new form factors, and define new PoCs that further explore how we can integrate alternative form factors into our IT environment while protecting Intel data.

CONCLUSION

We envision a future workplace where employees use many alternative form factors, such as handheld devices, tablets, and smart TVs, as well as many input methods, including touch, voice, sensor, and gesture, to perform their jobs. Our goal is to provide users with a seamless, consistent experience across devices without compromising information security.

The research and experimentation we are conducting helps us move from the traditional IT model of end-device control and management to a device-independent, services-based model. We are actively preparing the enterprise by investigating the long-term implications for how we deliver services, maintain information security, build our physical infrastructure, and support new form factors.

By preparing now, we can build on the benefits we've already achieved by enabling handheld devices in the enterprise, including increased employee satisfaction and productivity and reduced IT costs.

Table 1. Current Proofs of Concept Related to Alternative Form Factors

Description	Business Benefits
<p>Bring-your-own-Mac program</p> <p>Participants in this program can use their own Apple Macintosh* computers—from home or at work—to access the full range of IT services. Employees are responsible for their own hardware support and data restore, and have access to an online community support forum. IT is responsible for minimal infrastructure support, such as hosting the forum and monitoring the Macintosh servers, and for virtual private network (VPN) connectivity issues. While Macs are not strictly speaking a new form factor, many of the things we're learning during this program will apply to future programs associated with new form factors.</p>	<ul style="list-style-type: none"> ▪ Users: Enhanced productivity, flexibility, and job satisfaction ▪ IT: Reduced IT costs due to the self-help support community and the fact that employees carry the cost of the hardware
<p>Middleware for application development</p> <p>Different form factors have an array of screen sizes, resolutions, and input methods, and re-writing applications for an optimal user experience on each one is not practical. This proof of concept (PoC) explores using a third-party central middleware product that detects a device's screen size and adjusts the application graphical user interface (GUI) accordingly.</p>	<ul style="list-style-type: none"> ▪ Users: Enhanced user experience ▪ IT: Simplified application development
<p>Manageability suite to improve security</p> <p>We did not allow e-mail attachments on certain handheld devices because we could not verify that they met our security requirements for storing data. We recently completed a PoC that used a third-party manageability suite to enable attachments on these devices. This suite verifies that the required hardware, software, and security settings exist on the device, thereby increasing the device's level of trust so that we can allow it to receive attachments. The PoC was a success, and this capability is now available to all devices in use at Intel.</p>	<ul style="list-style-type: none"> ▪ Users: More available services ▪ IT: Enhanced information security

FOR MORE INFORMATION

Visit www.intel.com/IT for white papers on related topics:

- "Rethinking Information Security to Improve Business Agility"
- "Benefits of Enabling Personal Handheld Devices in the Enterprise"
- "Maintaining Information Security while Allowing Personal Hand-Held Devices in the Enterprise"
- "The Future of Enterprise Computing: Preparing for the Compute Continuum"
- "A Roadmap for Connecting Smart Phones to the Intel Wi-Fi* Network"
- "Cloud Computing: How Client Devices Affect the User Experience"
- "Benefits of Client-Side Virtualization"
- "Using Virtualization to Integrate Mac OS X* into PC-centric Environments"

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ACRONYMS

GbE	gigabit Ethernet
GUI	graphical user interface
IDF	Intel Developer Forum
Intel® VT	Intel® Virtualization Technology
ISMC	International Sales & Marketing Conference
IVI	in-vehicle infotainment
PoC	proof of concept
SFF	small form factor
SHV	server-hosted virtualization
vLAN	virtual LAN
VPN	virtual private network


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