Digital Personal Assistant for the Enterprise

Executive Overview

Intel IT is developing an enterprise-oriented digital personal assistant—Virtual Assistant—which takes into account where employees are and what they are doing, as well as the specific capabilities of the device being used. Virtual Assistant gives employees the power to automate routine tasks—using user profiles to provide a personalized experience, anticipating the employee's needs, and filtering distractions so employees can focus on their most important tasks.

As one employee stated: “Virtual Assistant will free me to do my job.”

Digital personal assistants already exist in the consumer environment; however, consumer products do not meet Intel’s enterprise needs:

- Intel employees need workplace-related information and services.
- Digital personal assistants must meet Intel’s information security standards and privacy principles.
- Intel employees need an assistant that runs on all form factors including business Ultrabook™ devices, laptops, and desktop PCs.

We plan to deploy the first version of Virtual Assistant in the first half of 2013 and are already working on subsequent releases that will incorporate more functionality and use additional Compute Continuum capabilities such as speech recognition, natural language processing, touch, eye tracking, and gesture recognition.

Through our efforts, Intel IT is providing a significant proof point for the benefits Intel’s Compute Continuum can bring to the enterprise.

1 In previous white papers, Virtual Assistant was referred to as Business Assistant.

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BACKGROUND

Emerging trends are driving a transition from traditional client computing models toward one in which employees are increasingly using an expanding continuum of devices—many of them personally owned—at work. Employees expect these devices to enable them to access information anywhere, at any time. Based on their experiences with such devices in the consumer world, Intel employees expect the same level of interactivity and service to be available in the corporate setting. In response to these expectations, Intel IT studied emerging user experiences and identified three for further investigation.\(^2\)

One of these emerging user experiences is Virtual Assistant, an enterprise-oriented digital personal assistant. Digital personal assistants are popular in the consumer marketplace for their ability to deliver information to the user and perform tasks on their behalf. However, consumer-oriented digital personal assistants do not provide the type of information Intel employees need in the workplace, and they are not secure enough to meet our security standards. Also, in the consumer marketplace voice modality is emphasized on these applications, whereas in an enterprise setting the availability of other modalities, such as touch and gesture, are also important.

Consumer-oriented digital personal assistants are primarily limited to use on small form factor (SFF) devices, such as smartphones. However, in the corporate environment, this type of application must run on all supported OSs and platforms, including notebooks, business Ultrabook™ devices, tablets, smartphones, and mobile business PCs.

Intel is developing a set of capabilities that will make it easier for developers and ISVs to create applications that anticipate users’ needs and that work seamlessly and collaboratively across all devices and platforms. Many of these capabilities may eventually lead to the development of new Intel\(^*\) services.

As a result of our efforts, Intel IT is providing significant evidence for the benefits Intel’s Compute Continuum (see sidebar) can bring to the enterprise. Our work is helping employees perform their jobs more efficiently and can help define enterprise requirements and use cases for Intel product groups as they develop products for the marketplace.

VIRTUAL ASSISTANT

Virtual Assistant\(^3\) is an enterprise-oriented digital personal assistant that provides Intel employees with indoor navigation, resource location, information relevant to their context and preferences, and services when they need them—just-in-time and on-the-go.

Intel’s Virtual Assistant will allow employees to automate routine tasks by recognizing the individual employee to provide a personalized experience, anticipating needs, and filtering distractions so employees can focus on the most important things they need to do—while respecting their privacy preferences.

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\(^1\) In previous white papers, Virtual Assistant was referred to as Business Assistant.

\(^2\) For more information, refer to the white paper, “Enabling Emerging Enterprise Usages with Client-Aware Technologies,” February 2012.
Virtual Assistant features are based on the following principles:

- Technology must work for and adapt to the employee, instead of the other way around.
- Today’s devices must be easy to use and manage.
- An employee’s devices must be able to communicate with each other, to synchronize preferences and personalization, and to share the content.
- Devices and applications must continue to learn, based on the employees’ behavior, selections, and preferences.
- Employees must be able to locate the information they need when they need it.
- Employees need more time to concentrate on the task at hand.

Similar to a human professional assistant, Virtual Assistant acts as a trusted advisor, reliably helping employees manage their complex work lives. Virtual Assistant allows employees to automate routine tasks—using user profiles to provide a personalized experience, anticipating the employee’s needs, and filtering distractions so employees can focus on their most important tasks.

Virtual Assistant’s integrated capabilities and task-oriented interface offer the following attributes:

- A consistent and seamless user experience across devices in the Compute Continuum, working independently and in tandem
- A set of reusable capabilities, such as mapping or scheduling, that multiple applications can access
- A way for capabilities to interact with one another
- Application, email, text, speech, and camera-based interface methods

Virtual Assistant takes into account where employees are and what they are doing, as well as the specific capabilities of the device being used. For example, Virtual Assistant provides turn-by-turn indoor navigation to help a business traveler find the conference room for his or her next meeting.

Table 1 describes Virtual Assistant’s capabilities. Some of these capabilities are not currently available and are planned for future releases. Specific form factors, such as a smartphone, tablet, or laptop, and specific use cases will include additional tasks and capabilities.

<table>
<thead>
<tr>
<th>Table 1. Virtual Assistant capabilities</th>
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<tbody>
<tr>
<td><strong>People-based Capabilities</strong></td>
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<tr>
<td>• Check scheduled meetings</td>
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<tr>
<td>• Schedule an instant meeting</td>
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<tr>
<td>• Look up information about a colleague in the corporate directory</td>
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<tr>
<td>• Create a watch list of people, places, and words to alert the employee, based on specific rules</td>
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<tr>
<td>• Find a contact’s location</td>
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<tr>
<td>• Find an expert</td>
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<tr>
<td>• Integrate with other enterprise applications to enhance the user experience (for example, initiate a voice call or an instant message session)</td>
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<tr>
<td>• Spontaneous collaboration by inviting one or more people into a chat or voice session</td>
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<tr>
<td><strong>Information-based Capabilities</strong></td>
</tr>
<tr>
<td>• Read Intel news in a magazine format</td>
</tr>
<tr>
<td>• Share information through a blog, micro-blog, and Twitter*</td>
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<tr>
<td><strong>Location-based Capabilities</strong></td>
</tr>
<tr>
<td>• Browse information about a selected Intel campus</td>
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Intel’s Compute Continuum

Most of the application-development industry is focused on consumer solutions. Intel IT’s Compute Continuum team is chartered with piloting solutions that provide similar efficiencies and user experiences in an enterprise setting. With more and more users bringing their consumer devices into the enterprise, these solutions must work seamlessly and coexist with consumer applications and services on the same device. Developing these applications is an opportunity to showcase Intel’s Compute Continuum and encourage the ecosystem to develop services focused on the enterprise.

Intel’s Compute Continuum is a two-pronged initiative. It promotes on-platform silicon and firmware capabilities, embedded in Intel® architecture-based devices, as well as device-level capabilities that enable seamless access to information across a wide variety of devices. Intel’s Compute Continuum initiative also promotes a cloud services platform that provides services accessed through RESTful (representational state transfer) APIs. This platform enables developers to use Intel architecture to create solutions that work seamlessly and collaboratively across operating systems and devices. For example, the cloud services platform supports federated identity, user profiles, personalization, and recommendation engines, while providing the level of privacy that employees expect.
A Phased Implementation
Ultimately, Virtual Assistant will support four primary usage models (Figure 1):

- Business Travel Guide
- Virtual Admin
- Executive Admin
- Collaboration Assistant

Our first release of Virtual Assistant is focused on the Business Travel Guide. Subsequent releases will add the Virtual Admin and Executive Admin usage models, as well as further capabilities. On traditional PCs and business Ultrabook devices, we anticipate that our work will be consistent with the Microsoft Windows* 8 user experience on Intel® architecture.

RELEASE 1: BUSINESS TRAVEL GUIDE

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

The Business Travel Guide automatically detects onsite resources and allows an employee to select resources from a list. These resources can include cafeterias, printers, available and unoccupied conference rooms, ATMs, and emergency exits. Once the employee selects a resource, the Business Travel Guide uses indoor navigation to provide walking directions using a visual map.

In addition, the Business Travel Guide can alert employees to the proximity of co-workers, based on their expressed privacy preferences, and can check for mutual availability and the nearest available conference room. With this technology, employees can navigate confidently inside unfamiliar buildings and reach a destination on time—spending more time solving business problems and less time managing travel logistics.

SUBSEQUENT RELEASES:
VIRTUAL ADMIN AND EXECUTIVE ADMIN

Building on our first release, subsequent releases of Virtual Assistant will add capabilities (see “Next Steps”), which include providing three new usage models.

Virtual Admin
Virtual Admin enables the employee to sort requests from co-workers and people outside the company, services, and devices, according to defined and observed preferences, calendar availability, and the context of the work being performed at the time. For example, if Virtual Admin senses that an employee might not get to his or her next meeting on time, it automatically notifies the meeting organizer and optionally negotiates a new time to meet. Or if it recognizes the employee is in “deep problem-solving mode” Virtual Admin will filter incoming communications so that the employee can be interrupted only by project team members and others that the employee identifies.

Virtual Admin roams across an employee’s devices, either assisting an employee on the current device or providing support from a companion device, such as a smartphone while the employee is working on a laptop. Virtual Admin can analyze the activities occurring on all devices, automatically ensuring access to the latest file versions. This service will use Intel’s Compute Continuum APIs and established connectivity and will be able to support device-to-device or device-to-cloud paths.

Executive Admin
The Executive Admin understands the user’s goals and preferences and can use that knowledge to gather the information the employee needs at the appropriate time, providing visibility into layers of information across the enterprise. The Executive Admin uses the employee’s current context to help him or her decide what can be shared. This usage model also anticipates an employee’s needs and is allowed to take action without being told every step.

Collaboration Assistant
The Collaboration Assistant usage model includes features such as the wireless use of projectors and virtual whiteboards and the ability to identify a participant in a meeting or conference call.

Figure 1. Virtual Assistant will support four primary usage models.
Developing a Task-based User Interface

In the consumer environment, most users start an application by selecting the icon that represents that application. Although this action becomes second nature for experienced users, the actual thought process behind the action involves an initial series of steps before a user can accomplish any work-related tasks.

In contrast to an application-centric environment, we found that a task-centric user interface offers more efficiency and provides a better user experience in an enterprise setting. By focusing on tasks, employees do not have to deal with application names that may be unrelated to the application’s purpose, supplier names that dictate a folder structure that can make navigation difficult, and internal project names that may not be meaningful in a released product. Figure 2 shows how the steps to start an application differ between an application-centric environment and a task-centric environment.

Virtual Assistant groups application functions into tasks. To enable this capability, we have established a standard nomenclature that enhances usability and lays the foundation for future voice and natural language processing interfaces. Our standard nomenclature is based on object and task description pairings.

**OBJECTS**

Every task must be associated with an object, which serves as a form of shorthand for the task itself. Objects can make the process of searching for and sorting information more meaningful for the employee. When defining an object, we avoid the use of common verbs such as “Get,” “Show,” or “Display, which might make it difficult for an employee to easily identify a task. So, for example, we use “Campus Map” instead of “Show Map,” and “Walking Directions” or “Driving Directions” instead of “Get Directions.”

Using a task-centric system makes achieving a goal easy and transparent to the user. Therefore, when defining objects, we avoid idiosyncratic names; to that end, we do not use application names or project names as objects. Table 2 provides some examples of poorly constructed object names that rely on verbs, compared to better constructed object names that clearly reveal the task’s functionality.

**Table 2. Examples of object names**

<table>
<thead>
<tr>
<th>Problematic Nomenclature</th>
<th>Task-based with Standard Nomenclature</th>
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<tbody>
<tr>
<td>Find a Phone Number</td>
<td>Campus Phone Numbers</td>
</tr>
<tr>
<td>Show Maps</td>
<td>Campus Map</td>
</tr>
<tr>
<td>Get Directions</td>
<td>Walking Directions or Driving Directions</td>
</tr>
<tr>
<td>Locate Printers</td>
<td>Printer Locations</td>
</tr>
<tr>
<td>Set Preferences</td>
<td>User Preferences</td>
</tr>
<tr>
<td>List Available Conference Rooms</td>
<td>Conference Room Availability</td>
</tr>
</tbody>
</table>

Figure 2. A task-centric user interface offers more efficiency and provides a better user experience in an enterprise setting.
TASK DESCRIPTIONS
Beneath the name of each object we provide a longer description of the task. In the task description, we do use verbs such as “Get” and “Show,” as the following examples show:

- Display campus map
- Find Intel employee
- Display phones for the current campus

Figure 3 shows an example of how an object/task pairing actually displays.

In Figure 3, the object “Campus Phones” is direct and avoids the use of verbs such as “Show” or “Display.” The task description itself uses the verb “Display” and clarifies the meaning of the object, without the use of an application or project name.

Properly constructed, object-task pairings can provide a much more usable method of accessing system functions that minimizes the cognitive load on the user. Instead of having to remember locations and names of specific applications, the user is able to execute tasks based on a natural language representation of them.

Establishing the Underlying Architecture
We are using a mobile enterprise application platform (MEAP) to develop Virtual Assistant. This approach enables us to address specific enterprise challenges associated with security and privacy. For example, consumer-oriented digital personal assistants pose security and privacy risks because commands and searches performed by the user may become publically available, consumer applications may collect more information than the user wants them to, and consumer application suppliers may use the collected information for monetary gain. As shown in Figure 4, The MEAP enables Virtual Assistant, running on an SFF device, to interface securely with our back-end services.
We typically encourage developers to minimize native development because it requires multiple coding efforts for separate devices. Although our initial pilot uses a web portal, we are using a third-party MEAP product that allows us to create a hybrid web application container, which is a set of libraries Virtual Assistant uses to access services. This enables developers to take advantage of both native applications—and therefore the capabilities of the underlying platform, such as touch, voice, or sensors—and HTML5 applications. The hybrid container approach enables developers to access Intel's Compute Continuum elements that would be difficult to access using browser-based HTML5 only.

The goal of our architecture is to make Virtual Assistant simple to use for both developers and employees. In particular, it must be easy for developers to add a new task in Virtual Assistant and integrate that task within the Virtual Assistant framework so that the user experience is seamless.

We encourage developers to take advantage of underlying device capabilities through Virtual Assistant instead of building capabilities from scratch. Also, we promote modular coding practices and functionally isolated sections of code. This approach results in reusable modules that can be added or removed without impacting any other code section. Finally, we prefer that developers use built-in Intel® technologies, such as mapping capabilities, whenever possible, instead of using third-party tools.

**NEXT STEPS**

With Release 1 of Virtual Assistant scheduled for release in the first half of 2013, we are already looking ahead to Release 2 and beyond. In the second release, we plan to enable new use cases and new usage models. We also expect to expand some of the other Compute Continuum solution components, such as providing more context awareness and more perceptual modalities.

**Use Cases and Usage Models**

Release 1 focuses on the Business Travel Guide usage model; Release 2 will add a blend of the Virtual Admin, Executive Admin, and Collaboration Assistant usage models.

Release 2 will include the following capabilities:

- Imitation of a human personal assistant, an ability to understand the user and perform actions based on this understanding
- Consistent experiences between Virtual Assistant on PCs and Virtual Assistant on smartphones—a preference that Virtual Assistant learns on one system will be remembered when the employee uses Virtual Assistant on another system
- Improved location awareness, such as knowing whether the employee is on or off the Intel campus
- Device awareness, which can determine whether Virtual Assistant is being used on a smartphone, tablet, PC (laptop, desktop, or business Ultrabook device), or TV
- User awareness, which can identify the employee using Virtual Assistant
- Service discovery, which can determine what services are available within the employee’s vicinity
- Connectivity and seamless transition between various form factors, which includes user and session state capture and replay. The session state of the user is transferred from one device to another seamlessly without losing any data, content, or session state information

**Context Awareness and Perceptual Modalities**

Over time Virtual Assistant will begin to use more components of Intel’s Compute Continuum such as the context decision framework, user and device profiles, standardized location and navigation services, federated identity, and the connectivity framework.

We plan to focus on building more context awareness into the platform and applications. We will also expand the breadth of support for the OS and form factor, standardize more of the underlying back-end services that will be developed, and incorporate additional user interface options such as voice recognition, natural language processing, face and gesture recognition, eye tracking, and augmented reality.
CONCLUSION

Traditional client computing models are giving way to a new Compute Continuum, where employees expect to use a broad selection of devices at work, choosing a device based on personal preference, work style, and the task to be accomplished. Employees expect their devices to be interactive, to work together, and to be able to access information anywhere, at any time—similar to user experiences available with consumer products. To support this trend, Intel IT is developing Virtual Assistant, an enterprise-oriented digital personal assistant that supports Intel’s Compute Continuum initiative and uses many of its capabilities.

Virtual Assistant will eventually, based on users’ privacy settings, be able to detect where employees are and what they are doing, as well as the specific capabilities of the device being used. Intel’s Virtual Assistant empowers employees to automate routine tasks through the recognition of the individual user, anticipation of the user’s needs, and the filtering of distractions so employees can focus on their most important tasks.

We plan to release the first version of Virtual Assistant, which includes the Business Travel Guide usage model, in the first half of 2013. This release will provide employees with information about corporate resources, such as printers or conference rooms; co-workers; and other external points of interest, such as hotels or entertainment options. Future releases will expand the service offering to include other usage models such as Virtual Admin, Executive Admin, and Collaboration Assistant.

FOR MORE INFORMATION
Visit www.intel.com/it to find white papers on related topics:

- Companion white paper, “Enabling Emerging Enterprise Usages with Client-aware Technologies”
- Indoor navigation, “Getting a Headstart on Location-based Services in the Enterprise”

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