

Evaluating Intel® Pro Wireless Display for Enterprise Use

Intel IT and Intel's product development team are working together to craft a product—Intel® Pro Wireless Display (Intel® Pro WiDi)—that meets enterprise needs.

Executive Overview

Recognizing the significant benefits wireless display technology can bring to the enterprise, Intel IT and Intel's product development team are working together to craft a product—Intel® Pro Wireless Display (Intel® Pro WiDi)—that meets enterprise needs. These groups have collaborated to define feature requirements and then implement them in a user-friendly product.

Intel's wireless display technology now incorporates those features that are most important in an enterprise setting and provides benefit to both end users and to IT.

Wireless display technology provides several benefits to users, including the following:

- Improves the user experience in conference rooms by eliminating the need to use cables or to trade seats when sharing content from transmitter devices—such as laptops, business Ultrabook™ devices, and tablets.
- Facilitates collaboration in less formal meeting areas. This ability is becoming increasingly important with the growing diversity of devices in use at Intel, both IT-supplied and personally owned, many of which do not include wired cabling capabilities.

Intel IT can also benefit from wireless display technology:

- Expenses for cabling and switch equipment in newly constructed facilities can be reduced.
- It enables us to manage bandwidth competition during concurrent use as well as global policies for both transmitter and display devices, and provides interoperability with the enterprise Wi-Fi* network.

We plan to conduct a proof of concept (PoC) in late 2013 and start targeted deployments of Intel Pro WiDi in 2014.

Omri Barkay
WLAN Engineer, Intel IT

Dave Buchholz
Principal Engineer, Intel IT

Dan Codorean
Client Engineer, Intel IT

Doug DeVetter
Technology Evangelist, Intel IT

Baz Stevens
Project Manager, Intel IT

Contents

Executive Overview..... 1

Background 2

Wireless Display Technology
in an Enterprise Setting 3

 A Deeper Look at
 Intel's Wireless Display
 Technology..... 3

Transforming a
Consumer Product into an
Enterprise-ready Product..... 4

Enterprise Benefits of
Intel® Pro Wireless Display 5

 User Benefits..... 5

 IT Benefits..... 6

Conclusion..... 7

For More Information..... 7

Acronyms..... 7

IT@INTEL

The IT@Intel program connects IT professionals around the world with their peers inside our organization – sharing lessons learned, methods and strategies. Our goal is simple: Share Intel IT best practices that create business value and make IT a competitive advantage. Visit us today at www.intel.com/IT or contact your local Intel representative if you'd like to learn more.

BACKGROUND

In the modern enterprise setting, the traditional approach to collaboration using cables to connect transmitting devices to display devices is no longer adequate. For example, displaying a computer screen in a conference room using a projector and a VGA cable is outmoded—employees dislike having to take turns connecting to display devices using cables, and fewer devices are equipped with a VGA port, requiring employees to carry their own adapters. In addition, it is difficult to find a common wired port on transmitting devices.

Intel employees are adopting an increasingly mobile lifestyle made possible by Wi-Fi* along with a proliferation of consumer devices. They expect to connect wirelessly to desired services whenever and wherever they want, especially at work. In addition, our strategy over the next three years is to transition away from the traditional wired network, making wireless the default access for Intel's corporate network.

To support our highly mobile workforce and to take advantage of mobile productivity benefits, we are rapidly deploying touch-enabled business Ultrabook™ devices and tablets running Microsoft Windows* 8 on the latest generation of Intel® architecture, as well as encouraging the use of smartphones as companion devices. We are also creating an environment that supports seamless sharing of content between a wide variety of devices. Our challenge is how to adjust our services to support the growing variety of client devices and allow content sharing in conference rooms and informal meeting areas without requiring a specific port or cable.

Intel's wireless display technology has the potential to significantly enhance dynamic content sharing (see Figure 1). Wireless display technology enables transmitting devices (such as laptops, business Ultrabook devices, and tablets) to create a peer-to-peer Wi-Fi Direct* connection without using the corporate Wi-Fi network. (See Table 1 in the sidebar for a more detailed explanation of terminology, technologies, and features associated with Intel's wireless display technology.)

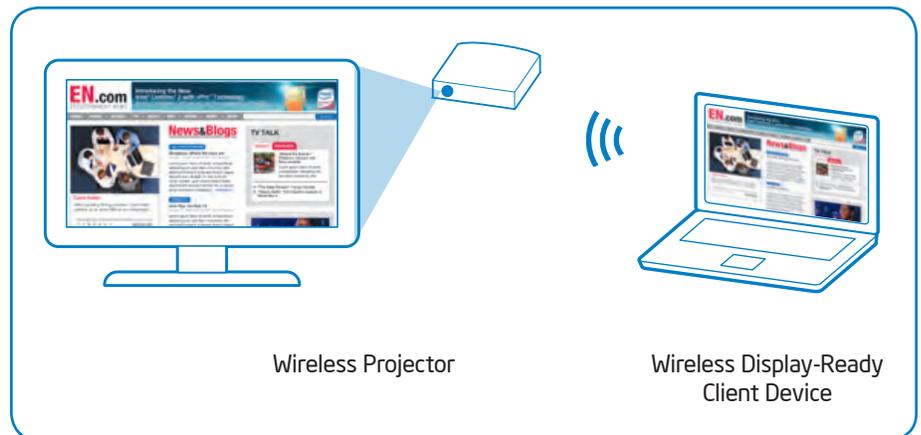


Figure 1. Intel's wireless display technology enables employees to share content without requiring cables and port adapters.

Virtually all client devices, such as laptops and business Ultrabook devices, at Intel are capable of using Intel® Wireless Display (Intel® WiDi¹). This means they can support wireless streaming of content directly to the connected display device, such as a TV, projector, or digital whiteboard, without using any cables.

WIRELESS DISPLAY TECHNOLOGY IN AN ENTERPRISE SETTING

Intel employees are already familiar with Intel WiDi, which focuses on consumer uses such as screen mirroring or display extending, movie-streaming, and gaming. As with many emerging technologies in the consumer marketplace, such as location-based services, context-aware computing, and touch-enabled applications, employees are enthusiastic about wireless display technology and expect similar capabilities in the enterprise.

Both consumer and enterprise usages of wireless display technology can benefit from the premium wireless display capabilities of Intel WiDi, including high-definition display, protected content, extended display mode, surround sound, support for the Miracast* standard and Blu-ray*, and USB over Wi-Fi. However, there are significant differences between the use of wireless display technology in the home and in an enterprise setting, as summarized in Table 2, on the next page.

¹ Requires a system enabled with Intel® Wireless Display (Intel® WiDi) and an Intel WiDi-enabled receiver device. 1080p and Blu-ray* or other protected content playback available only on 3rd or 4th generation Intel® Core™ processor-based PCs with built-in visuals enabled, a compatible receiver device and media player, and supporting Intel WiDi software and graphics driver installed. Consult your PC manufacturer. For more information, see www.intel.com/content/www/us/en/architecture-and-technology/intel-wireless-display.html.

A Deeper Look at Intel's Wireless Display Technology

A wireless display connection consists of two primary components: a transmitter device (sometimes referred to as the source device) with wireless display capabilities and a display device (such as a TV, projector, or digital whiteboard), which must be equipped with a receiver. For legacy display devices, the receiver is an external adapter; some display devices do not require an external adapter because they have built-in wireless display capabilities.

Intel® Wireless Display (Intel® WiDi) provides substantial benefits over other wireless display technologies. (For a definition of some of the technologies and acronyms associated with Intel's wireless display technology, refer to Table 1.) Intel® Pro Wireless Display (Intel® Pro WiDi) includes all of the features associated with Intel WiDi, and adds additional features tailored for use in an enterprise. Intel Pro WiDi requires a 3rd generation Intel® Core™ vPro™ processor-based platform^Δ and an Intel Pro WiDi-certified receiver.

Intel's implementation of Wi-Fi Direct* creates the connection between the transmitter device and the receiver using HDMI* and the Miracast* standard, which allows content sharing while maintaining the existing Wi-Fi* connection to enable network connectivity.

The primary difference between Intel WiDi and Intel Pro WiDi centers on the receiver and client configuration. Clients capable of connecting to Intel Pro WiDi-certified receivers can also connect to Intel WiDi receivers, but clients configured to connect to Intel WiDi receivers cannot connect to Intel Pro WiDi-certified receivers.

Table 1. Wireless Display Technology Terms and Acronyms

Term or Technology	Definition or Benefit
Bidirectional I/O	Communication flows from both the transmitter device and the display device.
Extended Display Mode	Several wireless display technologies allow users to share media content, or mirror a display. A feature of Intel WiDi is that in addition to mirroring a display, users can also extend a display using standard Microsoft Windows* controls, just as if they had a second display physically connected.
Intel® Wireless Display (Intel® WiDi)	Intel's wireless display technology targeted for the consumer market includes capabilities such as peer-to-peer connectivity using Wi-Fi Direct, high-definition display, protected content, surround sound, support for the Miracast standard and Blu-ray*, and USB over Wi-Fi*.
Intel® Pro Wireless Display (Intel® Pro WiDi)	Intel's wireless display technology targeted for the enterprise setting, adding important manageability and interoperability capabilities to the premium features that are already part of Intel WiDi.
Miracast*	An open standard for sharing video and audio that supports interoperability.
Panel self-refresh	A feature that shuts down the video processor and associated circuitry when the image is static, saving battery power and reducing Wi-Fi bandwidth consumption.
Wi-Fi Direct*	A standard that enables devices—even if they are made by different manufacturers—to connect easily to each other without requiring a wireless access point and to communicate at typical Wi-Fi speeds.
Wireless personal area network	A short-range wireless network, used for linking one device, such as a laptop, to another (such as a display device).

^Δ These platforms are equipped with processor graphics, which greatly enhance the performance of wireless display technology. For more information on processor graphics, refer to "Processor Graphics Systems Provide Significant Business Value."

For example, at home, wireless display is typically used by a single person and has few bandwidth constraints. In the enterprise, multiple presenters may be using wireless displays in many conference rooms at the same time. This level of usage could lead to competition for bandwidth, resulting in a reduced user experience if the technology is not designed for enterprise use. Also, information security and manageability, which may raise few concerns for the home user, are a primary concern in the enterprise.

TRANSFORMING A CONSUMER PRODUCT INTO AN ENTERPRISE-READY PRODUCT

Intel IT and Intel’s product development team are working together to produce a product that meets enterprise needs. These groups have collaborated to define feature requirements and then implement them in a user-friendly product. Examples of the type of feedback we provide to the product development team include human factors engineering input, security requirements, bandwidth considerations, and manageability concerns.

In 2010, Intel IT performed an initial technical evaluation of Intel WiDi. We were intrigued by the potential for dynamic collaboration and infrastructure simplification, and provided specific feedback to the product development team based on our evaluation. With the next iteration of the technology, which addressed some of our usability concerns, Intel IT conducted a limited proof of concept (PoC). During this PoC we performed a formal evaluation that included a usability study, an analysis of the client build, and a Wi-Fi consumption analysis. We also deployed the technology in 30 conference rooms with 50 participants. After the PoC ended, we worked closely with the Intel product development team, sharing our PoC findings and providing input on features and capabilities. The product development team incorporated our feedback, creating Intel Pro WiDi.

In particular, we identified the following five challenges associated with wireless display technology in the enterprise, and continue to work with the product development team to address them:

- **Different user experience requirements.** As listed in Table 2, users have different needs between the home and enterprise environments. Intel Pro WiDi has implemented several features to address these differences.

- **Concurrent use in dense Wi-Fi environments.** Multiple simultaneous proximate wireless display sessions could impact the corporate Wi-Fi bandwidth. The implementation of panel self-refresh (PSR) significantly reduces bandwidth usage, enabling session coexistence.
- **Dynamic frequency selection (DFS) channel avoidance.** A DFS channel avoidance feature is included with the latest release of Intel Pro WiDi. Our ongoing efforts include implementing a separate channel management feature, allowing Wi-Fi Direct and WLAN traffic to operate on different channels.
- **Remote management.** Remote management is available with Intel Pro WiDi. We are working on out-of-band management and certificate-based connection security to manage wireless display devices.
- **Conference room architecture compatibility.** Intel Pro WiDi supports HDMI* sync signal timeout, allowing screen-saving features and auto-input switching.

We are currently performing a technical evaluation of the next release of Intel Pro WiDi, which is the first version that is specifically tailored for enterprise use. The solution includes novel methods

Table 2. Comparison of Home and Enterprise Use of Wireless Display Technology

Home Setting	Enterprise Setting
Typically used by a single person.	Multiple presenters require speedy handoff.
Typically used in a single room.	Typically used in multiple conference rooms with concurrent use.
Few bandwidth constraints exist.	IT needs to be able to configure bandwidth usage to provide a good user experience for everyone, enabling coexistence with the production office WLAN.
High-speed/low-latency performance is required for streaming games; high quality is required for movies.	Low-latency performance is important for most enterprise use cases, such as fast mouse response while editing documents.
Often preinstalled on transmitter and display devices.	Although wireless display-ready, transmitter devices are not typically preconfigured to use wireless display technology; installation needs to be quick and easy for the user and manageable by IT.
Information security and manageability are not major concerns.	Information security and manageability are paramount.
HDMI* devices are prevalent.	Video graphics array (VGA) devices are still widely in use.
Backchannel (bidirectional) feature typically used when using a tablet as a gaming console.	Bidirectional communication used for collaboration. For example, presenters can stand at a touch-enabled display and control their client desktop as they present, or write on a touch-enabled whiteboard and the content is instantly transferred to the client PC. Another enterprise use would be to plug in a wireless presenter tool (such as a pointer) to use with presentations.

of addressing enterprise-level challenges, such as coexistence with the corporate Wi-Fi network, enterprise manageability, and multi-user support. We are performing a Wi-Fi analysis, testing the configuration of various new features, and evaluating management of receivers. When the technical evaluation is complete, we plan to conduct a second PoC in late 2013. We will then share our PoC results with the product development team to help them further refine Intel Pro WiDi.

ENTERPRISE BENEFITS OF INTEL® PRO WIRELESS DISPLAY

In addition to the consumer-based capabilities that are part of Intel WiDi, such as screen mirroring or extended display mode, high-definition display, and surround sound, Intel employees appreciate many other enterprise-specific features of Intel Pro WiDi. The product also offers many security and manageability features that are of value to IT.

Because it is standards-based, Intel Pro WiDi enables interoperability within a broad ecosystem of projectors, displays, and adapters. Beyond the interoperability afforded by the Miracast standard, Intel Pro WiDi enhances performance, quality, and reliability, resulting in a premium display-sharing solution that meets enterprise requirements for manageability, privacy, and security. Intel Pro WiDi offers many benefits to end users and to IT.

User Benefits

The following list, as well as Table 3 summarizes the user benefits of Intel Pro WiDi in the enterprise environment.

- **Improved conference room experience.**

In the typical enterprise conference room, wires often sprawl over and under chairs and tables. Wireless display technology eliminates the need for wires between clients and display devices, which improves the user experience.

Meeting attendees can present from anywhere in the room, with no need to trade seats in order to reach a cable. Intel Pro WiDi enables users to connect in seconds, and presenters can hand off presenter-status quickly and easily.

- **Freedom from adapters.** Intel's support for the consumerization of IT enables employees to choose from many devices—including desktop and laptop PCs, business Ultrabook devices, tablets, and even smartphones—that they can use at work. Intel Pro WiDi supports devices with and without VGA, as well as devices with a variety of digital-out form factors—meaning no adapters are needed.

- **Longer battery life.** PSR helps save on battery life by avoiding use of the video processor and associated circuitry on the transmitter device when an image is static, such as viewing a PDF page without scrolling.

- **Support for concurrent use.** Intel campuses have many conference rooms, many of which are used concurrently. Users must be confident that the content they share in one conference room is not inadvertently shared in other rooms. Intel Pro WiDi enables display privacy, alerting users when their display is being shared.

Table 3. Intel® Pro WiDi offers many user benefits to Intel employees, as well as IT security and manageability benefits that are required for our enterprise.

USER BENEFITS	
User Experience	<p>Connect quickly. Users are connected within 12 seconds.</p> <p>Present wirelessly. Panel self-refresh optimizes bandwidth usage and saves battery life.</p> <p>Easy handoff. The next waiting presenter connects quickly.</p> <p>Avoid exposure to sensitive content. "Now Projecting" provides visual confirmation before displaying content.</p>
IT BENEFITS	
Security	<p>Isolate wireless personal area networks (WPANs). Blocks bridging to the corporate WLAN.</p> <p>Restrict to Intel WiDi. Prevents PC-to-PC access to data through the WPAN.</p>
Manageability	<p>Manage remotely. Configures global policies on client and receiver devices.</p> <p>Control network utilization. Limits bandwidth allocation to WiDi to balance performance and traffic.</p> <p>Identify devices in the environment. Recognizes named receivers, customizable receivers, splash screens.</p>

- **Control bandwidth allocation.** Another concern with concurrent use of wireless display technology is bandwidth—user experience can degrade if many concurrent wireless display sessions are competing for bandwidth. Intel Pro WiDi is optimized so that bandwidth can be throttled to a level that supports typical conference room usages such as slide presentations and whiteboard use. This also helps extend client device battery life while using wireless display technology.
- **Flexible collaboration.** Our “The Way We Work” initiative is making the work environment at Intel more productive and enjoyable by creating flexible work areas, more conference rooms, and common areas to encourage creativity and collaboration. Intel Pro WiDi supports this goal, enabling greater user productivity through easier collaboration in non-traditional meeting areas. For example, employees gathered in a common area can easily video conference with a team on a different campus by making a video call on the PC, then sharing the video on a TV using Intel Pro WiDi.
- **Support for document editing.** Intel Pro WiDi is optimized for low latency. When a user moves the mouse on the transmitter device, that movement is quickly reflected on the display device. In addition, Intel Pro WiDi provides for bidirectional I/O; this means that users can use touch-enabled whiteboards and have their changes occur also on their tablet or laptop.
- **Standards-based connection.** The popular and widely available Miracast standard increases our ability to support a variety of transmitter and display devices. Intel Pro WiDi uses Miracast to provide interoperability, and then adds enterprise-level quality and performance on top of the standard to provide a premium wireless display experience.
- **Network manageability.** Intel Pro WiDi provides the ability to configure global policies on both client and receiver devices. We can also control wireless display network utilization. Because Intel is beginning to rely on wireless as the default corporate network, wireless display technology must coexist with the production network. Peer-to-peer connectivity using Wi-Fi Direct helps provide both a reliable connection to wireless display technology as well as interoperability with the enterprise Wi-Fi network. Other network manageability features of Intel Pro WiDi include the ability to uniquely identify wireless display devices and control security of the wireless personal area network.

IT Benefits

The following items, along with Table 3 on the previous page, summarize the enterprise IT benefits of Intel Pro WiDi.

- **Simplified infrastructure.** We envision a future where Intel's conference rooms are free from expensive cables and switch equipment. Centering on wireless display technology as the cornerstone for collaboration will help us achieve that vision.

In addition, Intel Pro WiDi aligns with the Intel IT strategy of providing cost-effective services because it enables us to reuse existing Wi-Fi infrastructure to provide new capabilities.

Intel® Wireless Display in Action

Within Intel, we have approximately 1,000 users configured with Intel® Wireless Display (Intel® WiDi). Some users are part of the product development team or have Intel WiDi installed as part of a proof of concept (PoC); however, most are early-adopters who have proactively installed Intel WiDi themselves. We are experiencing strong demand from users for formal IT support of Intel WiDi. While we allow the use of the consumer version of Intel's wireless display technology on a small scale, we are exploring the advantages of Intel® Pro Wireless Display (Intel® Pro WiDi) before starting production deployments on a larger scale and providing formal support.

In addition to having employees using Intel WiDi in conference rooms, labs, and at home, we also have demos set up in various showcase areas around the company. One such showcase is the IT Innovation Center in Folsom, California. Visitors enjoy witnessing Intel WiDi in action, and appreciate the display quality and responsiveness, as well as the ability to extend their Microsoft Windows* desktop, which enables them to share one screen while having other applications open on a private screen. One popular application is Intel® WiDi Media Share, which uses wireless display technology to enable the user to “flick” media from their PC to the wireless display screen.

Another area of wireless display technology that we exhibit at the IT Innovation Center is new receivers that are both Intel WiDi- and Miracast*-certified. These receivers allow content sharing from either a Windows PC or tablet or from a Miracast-capable tablet or smartphone. As the wireless display industry evolves, we expect to also be able to demonstrate that receivers can enable multiple devices to share content simultaneously.

CONCLUSION

Based on their experience with consumer devices, Intel employees expect to connect wirelessly to desired services whenever and wherever they want. Also, Intel IT is shifting away from a wired corporate network to making wireless the default access method. Wireless display technology enables client devices to create a peer-to-peer Wi-Fi Direct connection, without using the corporate Wi-Fi network. This allows wireless streaming of content directly to the connected display device, such as a projector, without using any cables.

Recognizing the significant benefits that wireless display technology can bring to the enterprise, Intel IT is collaborating with the Intel product development team to develop

a wireless display technology tailored for the enterprise environment—Intel Pro WiDi. Using feedback and recommendations from our technical evaluations and early PoCs, the product development team has developed a technology that incorporates those features that are most important to an enterprise. These features include improved usability, the ability to manage bandwidth competition during concurrent use as well as global policies for both transmitter and display devices, and interoperability with audio/visual equipment and the enterprise Wi-Fi network.

Based on our most recent technical evaluation, we plan to conduct a PoC in late 2013 and hope to start targeted deployments of Intel Pro WiDi in 2014. Our goal is to provide Intel employees with flexible collaboration opportunities and IT with the ability to cut costs by eliminating expensive cabling equipment.

FOR MORE INFORMATION

Visit www.intel.com/it to find white papers on related topics.

- “Enabling Global Collaboration with Intel®-based Infrastructure”

ACRONYMS

DFS	dynamic frequency selection
PoC	proof of concept
PSR	panel self-refresh
VGA	video graphics array
WPAN	wireless personal area network

Visit www.intel.com/p/en_US/support/detect/wireless-display for more in-depth information about Intel’s wireless display technology, including determining if a particular device is wireless display-ready.

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

Ultrabook™ products are offered in multiple models. Some models may not be available in your market. Consult your Ultrabook™ manufacturer.

THE INFORMATION PROVIDED IN THIS PAPER IS INTENDED TO BE GENERAL IN NATURE AND IS NOT SPECIFIC GUIDANCE. RECOMMENDATIONS (INCLUDING POTENTIAL COST SAVINGS) ARE BASED UPON INTEL’S EXPERIENCE AND ARE ESTIMATES ONLY. INTEL DOES NOT GUARANTEE OR WARRANT OTHERS WILL OBTAIN SIMILAR RESULTS.

INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL’S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

Intel, the Intel logo, Intel Core, Intel vPro, and Ultrabook are trademarks of Intel Corporation in the U.S. and other countries.

*Other names and brands may be claimed as the property of others.

