

Hardware Innovation for Windows

Platform and component design for Microsoft® Windows® Operating Systems

Windows Home Concept

Abstract

Microsoft is working with industry partners to research compelling innovations for PCs that substantially change computing experiences. A new concept prototype that exemplifies these innovations for home computing is the Microsoft® Windows® Home Concept. The Windows Home Concept design embodies a convergence of future capabilities to provide compelling home entertainment, media management, and communication experiences, making the PC the ideal technology hub for the home.

This white paper provides PC manufacturers and hardware vendors with an overview of the Windows Home Concept, including high-level information about features and technologies included in the concept prototype.

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Introduction

Microsoft is working with industry partners to research compelling innovations for PCs that substantially change computing experiences. A new concept prototype that exemplifies these innovations for home computing is the Microsoft® Windows® Home Concept. The Windows Home Concept design embodies a convergence of future capabilities to provide compelling home entertainment, media management, and communication experiences, making the PC the ideal technology hub for the home.

Microsoft and HP worked together to develop the concept prototype. This work defined the critical features of the concept, which create a compelling, end-to-end hardware and software user experience. The result is this innovative new design that incorporates features and technologies closely aligned with the Windows family of operating systems: the Windows Home Concept.

This white paper provides PC manufacturers and hardware vendors with an overview of the Windows Home Concept, including high-level information about features and technologies included in the concept prototype. Additional resources and links to more information are provided at the end of this paper.

Microsoft hopes that the Windows Home Concept will spark the imagination of the PC industry, creating excitement and future opportunities for Windows and PCs—throughout the home and beyond.

The Windows Home Concept

Continued advances in hardware and software innovation are sparking a new era of growth for the technology industry, including an evolution of form and system design that encourages acceptance of PCs beyond the den or home office. Other advances in fast, wireless Internet connectivity are leading to a new wave of Web services, as well as changing in how people use, store, and manage digital media.

As PC manufacturers and developers take advantage of these innovations to create new hardware and software solutions that mirror the way the real world works, the solutions can transcend the boundaries among people, and between people and the technology they use. These new experiences will drive customer demand for systems with these capabilities, opening new business opportunities for the PC industry.

Many of these innovations have been incorporated into the Windows Home Concept. They work together to deeply enhance the role of the PC in the home, making it a more powerful tool than ever before. The Windows Home Concept focuses on the following four areas to provide high-fidelity entertainment and integrated communication experiences:

- **System fundamentals.** A simple-to-use system that is quiet, energy efficient, and available to respond to requests—even when the PC appears “off” to the user.
- **Entertainment experiences and media management.** The Windows Home Concept is designed to provide leading-edge entertainment and media management capabilities throughout and beyond the home with help from a wide range of supported devices.
- **Integrated communications.** The Windows Home Concept is the center of home communication, including telephony, e-mail, and messaging.
- **Connectivity to and throughout the home.** The Home Center PC includes a broadband connection to the Internet, and a home network using both wired and wireless technologies.

Windows Home Concept: An Example Implementation

The Windows Home Concept showcases just one example of how to integrate future technologies into exciting new PCs and PC devices.

The Windows Home Concept consists of three primary components:

- Home Center Concept PC
- Home Center Concept Remote
- Home Tablet Concept PC

The Windows Home Concept also utilizes a 50-inch plasma high-resolution display with high-definition TV capabilities.



Figure 1. The Windows Home Concept: Home Center Remote, Home Center PC, and Home Tablet PC

Home Center Concept PC

The Home Center Concept PC shows how systems can be fundamentally appropriate for peoples' lives by placing computing capabilities in context. Technology and design work together to integrate the system into living spaces beyond the den or home office, and can facilitate interactions with content management.

By integrating multiple components, the Home Center PC simplifies system setup and reduces clutter and uses a single, coaxial cable connection for cable TV, broadband internet, and voice-over-IP (VoIP). The cable also integrates wireless access point (WAP) functionality. This integration simplifies system and network set-up by reducing device and connector management and improving the user experience.



Figure 2. Home Center Concept PC

The Home Center PC shown in Figure 2 includes the following features and technologies:

- Always Ready technology. A Microsoft Power Sense™ technology, called “Always Ready,” allows the system appear off to the user while continuing to function in a limited capacity.
- Auxiliary display. The Home Center PC includes a two-line alpha-numeric auxiliary display to provide “glanceable” information in a way that doesn’t interrupt the primary experience and that can be read from across the room.
- User-friendly expansion capabilities. The Home Center PC includes a number of simplified expansion capabilities hidden behind a dampened door, including a Server I/O Module (SIOM) bay and PCI Express connections.
- Residential gateway. The Home Center PC includes an integrated cable modem and cable TV capabilities. It also includes a WAP that provides IEEE 802.11a/g/n for media and data streaming.

- High-definition video and audio output. The Home Center PC supports standard high-definition TV and higher resolutions, including 720p and 1080p. The Home Center PC uses UAA to incorporate 7.1 surround sound audio. The Home Center PC supports decoding and processing of all popular formats.

In addition to the free-standing form factor, a second version of the Home Center PC demonstrates a horizontal form factor that complements standard A/V and CE equipment. Where the first version emphasizes simplicity and common capabilities, the second version, shown in Figure 3, emphasizes the importance of offering a wide range of external connection options and integration capabilities.



Figure 3. Home Center Concept PC—Horizontal Form Factor, Front and Back Panels

Home Center Concept Remote

The Home Center Remote connects with the Home Center PC using two-way Bluetooth wireless technology communication. A color LCD auxiliary display extends the UI of the Home Center PC, providing an easy way to receive information and manage content on the PC without disrupting the main display.



Figure 4. Home Center Concept Remote

The Home Center Remote shown in Figure 4 includes the following features and technologies:

- **Biometric sensor.** A biometric sensor on the side of the Home Center Remote provides user identification and authentication.
- **Voice-command button and microphone.** The Home Center Remote includes a microphone that makes possible voice commands and speech-based search. This speech functionality is embedded in the Home Center PC and is integrated with the content guide, enabling efficient content navigation and selection.
- **LCD Auxiliary display.** The Home Center Remote also includes a color auxiliary display capable of rendering high-quality user interface (UI), so the remote can replicate the UI playing on the 50-inch plasma display.
- **Bluetooth wireless technology.** The Home Center Remote connects to the Home Center PC using Bluetooth wireless technology.

Home Tablet Concept PC

The Home Tablet PC is a fully-functional mobile PC with Tablet functionality that includes Windows Media Center Edition capabilities. In addition to standard mobile PC capabilities, the Home Tablet PC is optimized to synchronize and stream live or recorded content from the Home Center PC and to provide a wide range of communications functionality employing high-quality audio, high-resolution video, and rich ink input.

The Home Tablet PC and Home Center PC can be used together to enhance entertainment experiences, such as viewing online content, browsing a content guide on a mobile PC while watching broadcasts on the display, or controlling the home center with the Home Tablet PC. Either PC can be used to manage voice calls or other communications.

Because of the portable nature of the Home Tablet PC, this functionality can be enjoyed in a wide variety of locations and situations both inside and beyond the home.



Figure 5. Home Tablet Concept PC

The Home Tablet PC shown in Figure 5 includes the following features and technologies:

- Pen-enabled digitizer and touch screen. A pen digitizer allows inking input for handwriting; a touch screen provides easy navigation through the Windows Media Center Edition UI.
- Media Center START button and controls. These controls, along with the touch screen capabilities, enable simple navigation of the Windows Media Center Edition UI.
- Biometric sensor. A biometric sensor is also included on the Home Tablet PC for identification and authentication purposes.
- Microphone array. A multi-dimensional microphone array supports high-quality voice capture when the user holds the Home Tablet PC in either portrait or landscape orientation.
- Integrated USB Camera. This integrated video camera is used for video conferencing, as well as presence detection.

Communications Dock

The Home Tablet PC's communication functionality is augmented with a Communications Dock. The Communications Dock demonstrates how future mobile PC docks can evolve and innovate to offer enhanced value and convenience to consumers. The Communications Dock includes message indicators, a large auxiliary display, and a wireless VoIP handset. The physical interface between the dock and the Home Tablet PC is designed to streamline the physical effort required to dock and connect the Home Tablet PC for power and battery charging.

Designed specifically with the understanding of home life flow, the Communications Dock is designed to be located in a high-traffic area where the family naturally congregates, while serving as a logical docking station for one family member's mobile PC.



Figure 6. Home Tablet Concept PC and Communications Dock

The Communications Dock shown in Figure 6 includes the following features and technologies:

- Mobile PC dock. Connects the Home Tablet PC to provide power and battery charging.
- Auxiliary display. This display supplements the Home Tablet PC when docked. When the tablet is gone, it can display message indicators, such as caller ID, alerts, or status information.
- Wireless handset. The handset takes advantage of VoIP for telephony communications.

Windows Home Concept Scenarios

These scenarios illustrate possible experiences made possible with the features, technologies, and devices included in the Windows Home Concept.

Entertainment and communications integration. Jeff is watching the big game and the score is tied—there are less than two minutes to go—when a call comes in. It's his good friend Jay, and they haven't spoken in months. Because he has personal video recording (PVR) capabilities, Jeff chooses to select "answer" rather than "ignore." After Jeff finishes the call, he resumes the game broadcast right where he paused it, and he doesn't miss a single second of the critical last plays.

System provides services throughout the day, even when it appears off. Denise has always turned off the PC when she wasn't using it. But with her new Windows Media Center Extender and capabilities provided with the Always Ready technology, she leaves her PC powered on so she can use the music and content that is stored on her PC. Even though her PC is on, it's quiet and appears off because it's running in a lower-powered state. Now she always leaves her PC on so it can perform tasks such as recording late-night re-runs of her favorite TV show.

Playing live and recorded TV on a mobile PC. Denise wirelessly streams live TV from her Home Center PC to her Home Tablet PC to watch TV anywhere in the house. Denise can also record TV content for her daughter to watch while they run errands.

Program search using voice commands. Just as he's leaving the house to meet friends, Jeff sees a commercial for a program that will be broadcast later that week—but it will be broadcast when he's at work. He knows he doesn't have time to search through the content guide to find the broadcast, so he picks up the remote and says "Record Channel 7 on Wednesday at 7 p.m." The guide moves to Wednesday and shows that the program will be recorded.

Communications to the right people on the best device. Denise uses ink technology to scribble "Dinner is at 7:00 p.m." on her Home Tablet PC and sends it to a Group she's created for her family. Her husband gets the message on his convertible notebook PC while he's taking notes during a meeting. Her son gets it as an MMS on his cell phone. Her daughter gets an e-mail alert while she's working on her homework upstairs. The message also appears on Denise's tablet as an ink sticky note, and is displayed when she docks it in the Communications Center.

Relaxed computing throughout the home. Denise is using her Home Tablet PC to manage finances while she and her husband are lying in bed. When she's finished, she streams TV from the Home Center PC, using wireless headphones so she doesn't wake her husband, who has fallen asleep.

Trends Influencing PCs in the Home

Microsoft conducted usability and market research in the Windows Home Concept's early development stages to better understand how people want to use technology to enhance their lives, and to identify what technology trends affect PCs in the home.

Results from this usability research showed that the participant families were first looking for ways to improve their home-life flow through rich, integrated communications, as well as through shared and personal entertainment experiences. Technology trends, such as broadband adoption and price projections for large-screen LCD and plasma displays, all pointed to an opportunity to create and provide natural entertainment and media experiences.

Based on this assessment, the Windows Home Concept was designed to enable these experiences in ways that are simple to use, simple to set up, and integrate into home-life flow.

Why Move to the Living Room?

The PC continues to evolve into the premiere entertainment device in the home. As digital media becomes the standard for media experiences, the PC's unparalleled power, rich UI, convenience, and flexibility will play an increasingly-important role for consumers. Given the growth in digital media and the PC's role in managing and playing that media, the "living room" (the space that a family uses for the common gathering location in the home, which could be a room such as a family room or media room) is a natural location for this PC; it is the most common location for TVs in U.S. households, and it is where most of the TV is watched: an average of 79% of all TV is watched in that room. Because of these factors, it is often the location of the largest, and the highest-definition or best-quality display in the house. (*Source: Gartner Dataquest: PC Forecast 2002-2003, March 2004*)

Why Connect the PC to the TV?

The TV typically provides the largest, highest-quality display in the house, and home theater system usually includes the best audio capabilities. When a PC is connected to the TV, the entire digital media collection—music, digital video archives, movies, and pictures—is connected and available. Everything is in one place, searchable and ready for instant use, and located in the best room for relaxed viewing alone or with others.

Connecting the PC to the TV also provides these benefits:

- Remote controls can manage content and media.
- Mobile PCs and auxiliary displays allow the user to search metadata and manage content without interrupting what's playing on the main display.
- Shared entertainment experiences, such as gaming, benefit from large displays; mixed media experiences are enabled, such as playing music while viewing pictures, or receiving Messenger notifications while watching TV.
- Broadband connection to the Internet provides information and data that enhances user's viewing experience such as using picture-in-picture windows and mobile PCs during a movie or show to find related content online, participating in live broadcasts through online voting or messaging, or downloading movies or pay-per-view events through service offerings.

Why Create a Home Communications Center?

The Microsoft usability research discussed above strongly pointed to a “family messaging center,” which Microsoft translated to the Home Communications Center (the Home Tablet PC and Communications Dock). Microsoft selected this form factor specifically because it is new, and because it allows for differentiation and expansion in the marketplace. The Home Communications Center is just one possible implementation of how to integrate new and future software capabilities and technologies to provide messaging-center type experiences.

Design Philosophy of the Windows Home Concept

Harmonious form factors. The Windows Home Center was intentionally designed with a “calm aesthetic,” which focuses on a refined visual design that is harmonious with its surroundings. This can result in a system case or device design that is discreet and recedes into the background, or that intentionally blends with or enhances a specific room or location. The system or device should be designed to draw the user’s attention to what the device does, rather than to its visual appearance.

Technology that blends into the surroundings. Design and appropriate technologies should weave together to enable the system and devices to blend into their physical environment. For example, placing expansion bays and controls behind a dampened door hides them when they are not in use. These elements all lead to a system that exists in context with its surroundings.

Backdrop for content. When designs take advantage of these environmentally-appropriate hardware and software form factors and intentionally integrate technology, information and media content become visually dominant over physical form. The user’s focus remains on the content, rather than shifting to the system or device. When this happens, the experience becomes:

- **Personalized.** Function can be tailored to the preferences of unique users. Incorporating hardware and software capabilities such as biometrics, colored LED indicators, and subtle UI cues enhance personalization.
- **Consistent.** Physical and software UIs are uniform across the system and devices, allowing users to transfer their learning and behavior from one element of the system to another. Integrating components and taking advantage of a consistent UI contribute to a consistent user experience.
- **Content-centric.** Rich displays enable content to be available and accessible across the system, from auxiliary displays to large, high-definition displays. Including features and hardware such as speech-search capabilities, auxiliary displays, and incoming call identification, increase a user’s ability to access and interact with content.

Technologies Influencing the Windows Home Center

This section describes technologies and innovations that influenced the design and development process, or that are included in the Windows Home Center.

Home Center Concept PC

Windows Media Center Edition

Adding a networked PC running Windows Media Center Edition instantly adds value to connected systems and devices, enabling experiences and capabilities that can't exist in a stand-alone workstation, desktop PC, or CE device. The Windows Media Center Edition UI is an ideal interface for users to interact with and control a wide range of PCs and devices in the home. This UI's simple and easy-to-use design makes it appropriate for managing content services with a remote control, working on a mobile PC using touch screen capabilities, or enjoying a Portable Media Center on the bus to work.

Windows Media Center Edition provides a rich developer platform that enables a large and growing range of value-added software and service offerings. The following list includes examples of software and services that can take advantage of components available in Windows Media Center Edition:

- Entertainment on-demand, including music and music videos, big-name and independent movies, and targeted news and sports programming.
- Enhanced entertainment experiences on the TV, such as interactive DVDs and TV broadcasts.
- New classes of collaborative and single-user applications, including photo-sharing between users all over the world, karaoke, and even dance-step education and entertainment titles.
- Personalization and identification using biometrics for simplified logon, eliminating the need for users to constantly enter their information. Using the logon information, the system can provide applications and services that are personalized for individual users in the home.
- Home automation and security, such as applications that allow a home user to monitor security cameras or control HVAC systems.

Always Ready Technology

Many experiences enabled in the Windows Home Concept rely on the PC being available 24-hours-a-day, seven days a week. This includes tasks such as recording TV with a PVR, sharing media to other PCs and devices connected to the home network, and communication services management and notification.

A Microsoft Power Sense™ technology, called "Always Ready," allows the system to appear off to the user, while continuing to function in a limited capacity. When the user presses the power button on the PC or remote control, instead of the PC going into Standby, the PC goes into a lower-power On state, called the "Rest" state of the Always Ready technology. In this Rest state, the PC appears off to the user, but is actually still available to respond to requests. When the system is in the Rest state, Always Ready technology does the following:

- Blanks the display
- Mutes the audio
- Filters specific keyboard and mouse events
- Turns off LEDs

Low power use. The Always Ready technology uses power management capabilities in Windows and hardware to lower power consumption. Many consumers turn off their desktop PC when not in use, to save power and reduce noise. Energy-conscious designs are a key consideration, especially with rising CPU and GPU power requirements. Combining better in-use system power management with the Always Ready technology modes enables significantly lower rates of power consumption.

Quiet operation. Acoustic emissions are significantly reduced because of lower power consumption by the CPU and GPU. This can allow the system to reduce fan speed, or even to turn off the fan and let the system passively cool. When the fans are off, the system is silent, which helps to make it appear off.

The Home Center PC incorporates quiet components, alternative cooling technologies, and other sound-dampening techniques to reduce acoustic emissions. The design goals for such PCs should target acoustic emissions of 30 dB or less in A-weighted sound pressure (as defined in ISO 7779 and ISO 9296) while all components except the optical drive are operating. These lowered-power levels help systems be appropriate for living spaces where PCs have not traditionally been incorporated.

Auxiliary Displays and System Indicators

Auxiliary displays. Auxiliary displays are an efficient, low-cost method to provide simple and quick access to system status and media information without requiring the user to power-on the system or display. It also allows the system to provide “glanceable” information in a way that doesn’t interrupt the primary viewing experience, especially when the main display is being used for viewing items such as movies, TV, or pictures. This information can include displaying the time, channel number, volume level, audio track title, or background recording confirmation.

Future implementations of auxiliary displays could range from simple alphanumeric displays to high-resolution panels. Some may offer local interaction specific to the display.

Message indicators. The Home Center PC and Home Tablet PC support integrated messaging indicators. These indicators let the user quickly determine if the system has waiting information, such as e-mail or voice messages, and can be personalized to provide per-user status information. Message indicators can range from low-cost and simple LEDs, to information-rich auxiliary displays.

User-friendly Expansion Capabilities

Expandability is enhanced by easy-to-access expansion bays for capabilities such as removable media storage for digital media or TV tuners for high-definition TV.

Four types of expansion are relevant to consumer systems:

- SIOM, a hot-pluggable storage module, defined by the PCI SIG industry standard. Availability targeted for the second half of 2004.
- ExpressCard, an evolution of the PCMCIA standard, which supports one lane of PCI Express and one USB 2.0 connection.

- PCI Express, expected to replace conventional PCI and graphics expansion cards. PCI Express will be integrated into most chipsets by 2006.
- PCI Express Mini Card, expected to replace Mini PCI. It is targeted for factory-built configurations, such as wireless radios or modems, and is not expected to be exposed for end-user expansion capabilities.

Residential Gateways

A persistent connection to the Internet provides Web access throughout the home and enables a wide range of experiences, services, and functionality.

The Home Center PC includes an integrated broadband cable modem and cable TV capabilities. The Home Center PC can provide additional value to broadband subscribers with new services, as well as sharing access to other devices throughout the home.

A digital subscriber line (DSL) and digital satellite could also be accommodated, and require only a coaxial connection and telephone line connection. This solution also is one that provides a simplified user experience, allowing users to plug in a single cable to receive cable TV programming, wireless capabilities within the home, a broadband Internet connection, and communications.

Slightly more than one-third of all world-wide and U.S. households have a broadband Internet connection; adoption is expected to be approximately 60% of all U.S. online households by 2007. Two-thirds of current U.S. broadband users have cable modems. (Source: IDC: *Worldwide Broadband Access Service, 2004-2008 Forecast, March 2004*)

Wireless access points. An integrated WAP and broadband DOCSIS cable modem permits the Home Center PC to function as a gateway to the Internet. It also provides capabilities such as Dynamic Host Configuration Protocol (DHCP), prioritized IP routing, firewall protection, and even parental control functions. When another router performs these functions, the PC can automatically configure itself to extend access to the wireless home network.

Both software and hardware access points integrated into PCs and external wireless routers will be used in the home. These devices should support IEEE 802.11a/b/g technologies simultaneously and be optimized for multimedia traffic.

Broadband modems. The most popular type of connections today are DSL and cable modems, but new technologies such as IEEE 802.16, WiMAX, Ethernet to the home, and fibre to the home will become increasingly popular options.

VoIP gateways. A VoIP gateway provides access to voice and video to multiple communication endpoints in the home. These endpoints range from a Bluetooth headset, VoIP wireless handset, or a PC running “soft phone” software. A “soft phone” provides a rich, intuitive UI because the PC can both adapt its UI to the user’s needs and situation, and can access information such as e-mail, calendar, and shared documents.

The Home Center PC can be configured with a POTS gateway either as an internal component on the motherboard, or on a peripheral adaptor or external peripheral using USB. The POTS gateway allows the PC to communicate on the PSTN network.

Wireless Connectivity and Peripherals

The majority of homes will be networked with wireless technologies. Wireless home networks are the best way to provide simple-to-use configuration capabilities that reduce manual setup. They also provide extensibility over wire solutions.

IEEE 802.11 wireless networking. The Home Center PC is optimized for wireless technologies, and acts as the hub within the home for a variety of devices using a range of wired and wireless technologies; IEEE 802.11 variants enable wireless networked communications, with IEEE 802.11a for multimedia streaming and IEEE 802.11g for data streaming.

IEEE 802.11n is a promising, high-speed replacement for IEEE 802.11a and IEEE 802.11g.

Bluetooth wireless technology. Bluetooth is a compelling wireless option for devices and communications. The Home Center PC uses the Bluetooth technology to enable devices such as handsets or headsets to be used for communication. For example, if a call comes in on a cell phone, the Home Center PC can use the cell phone as communication gateway; if the call comes in on another transport, such as VoIP, a cell phone supporting the proper Bluetooth wireless technology profile or running the appropriate software can act as a handset.

Ultra wideband (UWB). UWB is a promising, short-range, high-bandwidth connectivity technology that will likely begin to replace wired connectivity between home entertainment devices. It is expected to work alongside, not as an alternative to, whole-home networking solutions such as the IEEE 802.11 variants. UWB is expected to become popular for digital cameras and camcorder connections, as a wireless alternative to USB in hand-held, battery operated devices that require downloading hundreds of megabits or several gigabits of data.

Large, High-resolution Displays

Current PCs are able to support resolutions that are higher than current capabilities of the best high-definition TVs. The richest entertainment experiences will be obtained with a larger digital display that has a minimum native resolution of 1280x720,60Hz, and an optimal resolution of 1920x1080,60Hz. A wide display should have an aspect ratio of 16x9 or 19x10 to enable the best media experiences.

As large, flat-screen, high-definition TVs become cost-accessible over the next few years it's likely they will see greatly-increased market penetration, creating an opportunity for the PC to provide improved viewing experiences:

- Prices for plasma and LCD displays are projected to drop by half in approximately 18 months.
- Cost-crossing point for 42-inch LCD and plasma displays is projected for 2006.

Large, Flat-screen TV Projections for 2004-2007

Year	37" Plasma	42" Plasma	50" Plasma	37" LCD	42" LCD
2004 (today)	\$935	\$1207	\$1807	\$1590	\$2894
2007	\$575	\$890	\$1190	\$611	\$845

Source: DisplaySearch, March 2004

High-definition TV Tuners

Entertainment PCs should include multiple TV tuners to allow a user to simultaneously record and view multiple TV programs. This also allows for live TV broadcasts to multiple TVs in the home. The Home Center PC includes two tuners capable of receiving both digital high-definition TV and analog standard definition programming. To enable a live TV buffer for each program stream, the PC system must have sufficient HDD IO to simultaneously read and write multiple high-definition streams (which can be up to 20Mbps in the case of MPEG-2). These throughput levels can be accomplished by SATA RAID 0 striping.

Consumer trends point to significant projected growth of more than 33% for high-definition TV adoption over the next four years.

Media Storage and Management

The ability to manage, search, and archive massive amounts of content is an important component of a rich media experience. Many users today keep their entire digital image and music collections on their PC and use it as a primary playback device. In the future, consumers will also archive and manage video collections and recorded TV.

Media and content storage. This capability becomes critical as storage needs move beyond lower-volume media, such as music and images, to the high-volume storage capacity needed for an entire digital media collection—which could include an entire library of movies and whole seasons of TV shows.

Hard disk storage in PCs sold during the Windows Home Concept timeframe should be sufficient to store hundreds of hours of high-definition TV, hundreds of music albums, and an entire collection of photos and home videos. Additional removable storage can provide backup and expansion capabilities. It is likely that hard disk drives larger than one terabyte in size will be available to consumers in the next few years.

Managing media on the PC. A compelling feature of the Windows Home Concept is that users can access their licensed media from any device in the home or transfer their media to a portable device to take it with them wherever they go.

Online content services can take advantage of rich UI capabilities to enhance their related content offerings. Searching for and accessing content is simplified by speech technologies and the ability to use traditional two-foot UIs to manage content. Media management is also made simple because the Windows Media Center UI can be extended to other displays anywhere in the home using Media Center Extender technology.

High-definition Video and Audio Output

High-quality video and audio capabilities are a critical element of entertainment experiences.

High-definition video and PVR. Currently-available PCs can decode and display the 1080p video encoded in Microsoft Windows Media® 9 and delivered on some DVDs, producing digital-cinema quality video that far exceeds what is possible from a traditional progressive-scan DVD player.

The PC is capable of decoding high-definition video and audio using a wide variety of codecs. WMV and WMApro formats provide efficient mechanisms for encoding content at many bit rates. For example, an entire movie can be encoded on a single DVD at 1080p with 5.1 surround sound audio. The best experiences will be with content with the following or higher resolutions: 720p, 1080i, or 1080p.

These experiences are already available in the form of high-definition TV broadcasting, WMV-HD supporting DVDs, and online video services.

High-definition audio. The evolution in PC audio provides a high-quality audio experience, surpassing the capabilities of today's integrated audio.

The Home Center PC incorporates 7.1 surround sound audio, and decoding and processing of all popular formats (high-definition 2, 5.1, and 7.1 audio formats). Integrated 7.1 high-definition digital audio hardware provides the richest audio experiences possible, and connecting devices to the home network allow audio experiences throughout the home.

The next generation integrated PC audio solution is high-definition audio, supported by the Microsoft Universal Audio Architecture (UAA) initiative. The UAA initiative supports high-definition audio, including USB and IEEE 1394 audio devices, through a Microsoft audio-class driver included in Windows XP and in the next version of Windows, codenamed "Longhorn."

Gaming

The Home Center PC highlights changes in the world of gaming enabled by moving the PC into the living room. The living room is a great space for gaming; the shared space encourages participation and creates new gaming experience opportunities.

Split screen for multi-person gaming. Game developers can now offer head-to-head gaming experiences in their PC game titles because the PC is connected to the largest, highest-resolution display in the home.

Wireless game controllers. Wireless technologies can make game controllers appropriate for relaxed and mobile game play.

Microsoft XNA. The XNA platform includes interchangeable, interoperable software tools and technologies. Microsoft will develop a common controller interface and unify input APIs and button standards across multiple platforms. The result will be a family of common controllers for Windows and Microsoft Xbox® video game system users.

In graphics and audio, many tools such as PIX (an analysis tool) and XACT (an audio authoring tool) will be available on Windows as part of the XNA development platform. Likewise, innovations from Windows such as High-Level Shader Language (HLSL) will come to Xbox. The Microsoft DirectX® API and the Microsoft Visual Studio® development system will continue to be the baseline environment for both platforms. Collectively, these tools and technologies will enable movie-quality graphics while driving the need for new software that will help developers cope with the challenges of high-definition video and audio.

Front and Back Panel Components

PCs targeted for entertainment and media should incorporate designs and functionality that is similar to consumer electronics equipment, rather than the traditional "beige-box" PC.

Front playback controls, I/O connectors, and visual feedback (such as indicator lights and auxiliary displays), should all be designed for simple use and harmonious integration with existing A/V equipment, such as using standard transport controls and indicators that represent individual functions.

The free-standing form factor of the Home Center PC takes advantage of integrated wireless technologies, a broadband modem, and multiple TV tuners, to offer a design with only four cables: power, cable in, digital audio out, and digital video out to the display. For an "all-in-one" system, this offers the extreme simplicity.

Back panel designs must balance providing a wide range of options with simplified user options. For example, the horizontal form factor of the Home Center PC is designed to offer range of connectivity options using CE-style connectors whenever possible. Providing a variety of designs allows customers to select the options that best fit their needs.

Extending Media beyond the Home Center Concept PC

In addition to providing media to the connected primary display and stereo system in the living room, the Home Center PC can provide content to other devices throughout the home and beyond.

Windows Media Center Extender technologies. Windows Media Center Extender technologies deliver Media Center experiences to any TV or audio system in the home, turning the PC and home network into a platform of integrated content, applications, and services. Windows Media Center Extender devices are a cost-effective solution for expanding Media Center access to multiple simultaneous users, seamlessly and efficiently. Windows Media Center Extender devices remotely access the entire Media Center experience, not just media files. Media Center software extensions, hosted on the Media Center PC, are available on any device using the same UI and remote control navigation. As a result, the same consistent, up-to-date Media Center experience is available in every networked room in the house.

Windows Media Connect. Windows Media Connect makes it easy to share media such as music, pictures, and video with an emerging class of devices known as Digital Media Receivers (DMR). With Windows Media Connect, content on systems running Windows XP can be consumed anywhere in the home. Windows Media Connect is standards-based, allowing hardware manufacturers to easily develop compatible DMRs, which have rich functionality for playing digital media files.

Future Windows Media Player synch technology. Technologies incorporated into future versions of Media Player will simplify the process of synchronizing audio and video media with other devices, such as digital still image and video cameras, portable media centers, and Pocket PCs.

Digital Rights Management (DRM). Services can use DRM to enforce flexible usage scenarios such as a 48-hour viewing timeframe or three-plays-for-free. Content provided by these services is accessed from devices using Windows Media Center Extender, Windows Media Connect devices, or portable media players, and is regulated by the service provider's requirements. Rights are checked and enforced before content is sent, encrypted with the appropriate license, to the device.

Media Transfer Protocol (MTP). MTP is a new protocol designed to enable driver-less connectivity for portable media devices. MTP provides object-based enumeration and transfer functionality that yields a rapid and rich remote view of the contents of a connected device, and also includes simple device control and easy extensibility. Initially, MTP is targeted at portable media-creation and playback devices, such as portable media players and multi-media enabled digital still cameras, but in the future it will be offered as a generic solution to any storage-based multimedia enabled device.

Home Center Concept Remote

LCD Auxiliary Display

The Home Center Remote's color LCD auxiliary display allows the Windows Media Center Edition UI to be replicated on the small display, providing the benefits of the rich UI experience, even when the main display appears off.

The display provides a powerful method of accessing content and receiving information without disrupting media playing on the main display. For example, caller ID information, image or album cover thumbnails, playlist titles, and content metadata can all be displayed and managed using the remote.

Voice Command Button and Microphone

The Home Center PC includes support for both voice and touch input, ideally suited for other input technologies.

Push-to-talk functionality. The Home Center Remote includes a microphone that allows voice commands and speech-based search from the comfort of the couch. The user has only to say "play jazz" and the Home Center PC will begin playing jazz music from the media library.

Because this speech recognition functionality is included in the Home Center PC, it is integrated with the content guide, and can be used for meaningful searches within the guide that result in efficient content navigation and selection. Voice commands can streamline navigation tasks that can't possibly be implemented on a standard remote. The voice command "Next Tuesday evening" allows simpler and more natural navigation and selection within a content guide.

Biometric Sensors

The Windows Home Concept uses biometric sensors on both the Home Tablet PC and the Home Center Remote for identity and authentication purposes. The sensor allows the user to access personalized information, such as playlists and favorites. Although biometric algorithms are not yet mature enough for secure access (such as domain logon), fingerprint readers can establish identity among a limited number of people, such as the members of a household, and it can offer parental controls.

A biometric fingerprint reader is especially suited for gaining identity on devices, such as a remote control, that don't require login; for these types of devices, identity is established through the login process. Current cost of goods for fingerprint readers are under \$10, averaging approximately \$5 per unit.

Bluetooth Wireless Connectivity

The Home Center Remote communicates with the Home Center PC using Bluetooth wireless technology, with two way communications to synchronize items between the remote and the PC. The remote does not require line of sight to the receiver, allowing for more relaxed and natural interaction between the remote and the system.

Do Not Disturb Button

This button ensures that no audible or modal alerts occur that force the user's attention from primary entertainment or communications experiences. When the user presses this button, the system disables audible notifications and updates presence state to indicate when busy. Notification thresholds and presence may also be adjusted when the Do Not Disturb state is in effect.

Home Tablet Concept PC

Pen-enabled Digitizer and Touch Screen

Input technologies such as pen digitizers allow ink input for handwriting and touch screens for easy navigation on appropriate UI designs. The Home Tablet PC display allows for both high-resolution pen input for and finger input for casual use.

Media Center Button and Controls

The Media Center button, included on the Home Tablet PC and the Home Center Remote, bring up the Windows Media Center UI on these devices, providing full Media Center functionality.

Biometric Sensors

See "Biometric Sensors" in the Home Center Concept Remote section above.

Microphone Arrays

On the Home Tablet PC, a non-linear microphone array supports high-quality voice capture when the user holds the Home Tablet PC in either portrait or landscape orientation. High-quality speakers and a non-linear microphone array integrated in the Home Tablet PC enable good voice communications and media playback and enable better sound quality than conventional telephones and speakerphone.

Integrated Cameras

The Home Tablet PC includes one USB camera. This integrated video camera is used for video conferencing, as well as presence detection. Integrated cameras can also be used for capturing photos.

Communications Dock

The Communications Dock supports integrated wireless telephone handset and an auxiliary display for message indicators, such as caller ID, alerts, or status information.

Shared and Group Communications

The Home Communications Center uses future Microsoft MSN® shared calendar and Microsoft Outlook® capabilities, allowing users to view and work with calendars for a whole group, such as a family. Users can have personal and group calendars displayed next to each other, so all information is available in one glance. MSN calendaring also allows you to place live calendar information into Web pages, or to authorize other services and applications to access the calendar to enable more integrated experiences.

Opportunities for Partners

Innovations such as those included in the Windows Home Concept create new product and service opportunities for hardware manufactures, software developers, and service providers.

Hardware manufacturers:

- New form factors and technologies such as Windows Media Connect and Windows Media Center Extender create markets for PCs for new locations in the home.
- Households become multi-PC households as mobile PC sales increase.
- PC systems can integrate hardware otherwise sold through other channels, such as cable modems, WAPs, and VoIP gateways.
- System manufacturers can offer after-market capabilities such as add-on high-definition TV tuners; scalable remote controls with features such as auxiliary displays, biometrics for authentication, or telephony capabilities; and microphone arrays.
- System and device manufacturers should utilize Windows UAA class drivers to support their audio devices.

Software developers:

- Because services can be provided throughout beyond the home, software developers can create targeted applications for particular locations and experiences, including those tailored for more relaxed and social environments.
- Interoperability between multiple PCs in the home offers exciting new software platform opportunities, such as using a mobile PC to manage networked content and controlling any display in the home.
- Using Microsoft XNA, software developers can use one toolset to create gaming applications for multiple system platforms.
- Large displays and Windows Media Center Edition UIs enable new gaming experiences, including split-screen applications where two gamers use one screen in a comfortable, relaxed, shared space.
- Voice input capabilities add value through streamlined search capabilities, command and controls, and video conferencing content annotations.
- Developers can add value to their products by offering personalized and shared content capabilities: phone contact lists, music playlists, browser "Favorites" links, or family or group information (such as calendaring applications).

Service providers:

- Internet connectivity and broadband access enable a new wave of Web and broadband services such as:
 - Media, including music, videos, photos, art collections, and TV
 - Entertainment, including sports programming enhancements, and movies
 - Telephony, including voice and messaging communications
- Because Windows Media Center Edition is accessible throughout the home and beyond, content providers can create targeted content for a wider range of locations, including more relaxed and social experiences in the living room, bedroom, front porch, or even the coffee shop.

Resources for More Information

Windows Hardware and Driver Central

Includes Windows Driver Development Kits [DDK], Windows Hardware Compatibility Test [HCT] Kits, and Windows Logo Program requirements.

<http://www.microsoft.com/whdc/>

Microsoft Developer Network (MSDN) Online

MSDN subscriptions provide product downloads, DVDs or CDs, with the latest Windows tools, platform, and server technologies.

<http://msdn.microsoft.com/>

Technologies Influencing the Windows Home Concept Design

Many WinHEC 2004 presentations provide additional information about technologies and innovations influencing the Windows Home Concept.

<http://www.microsoft.com/whdc/winhec/>

General WinHEC 2004 Presentations:

Auxiliary Displays for Mobile PCs

Building a Great Media Center PC

Display Technology Advancements for Tablet PCs

Emerging Trends in Technology Usage

PC Trends in the Home - User, Market and Design Opportunities

Web Services for Devices

Web Services Implementation for Devices

Windows Client Media Standards and Strategy Overview

Windows for Mobile PCs and Tablet PCs - CY05 and Beyond

Understanding the Hardware Landscape

Always Ready Technology

Using Microsoft Power Sense Technologies - Windows Media Center PC

<http://http://www.microsoft.com/whdc/winhec/>

Power Management on WHDC:

<http://www.microsoft.com/whdc/system/pnppwr/powermgmt/>

Auxiliary Displays and System Indicators

Hardware Design Guidelines

<http://http://www.microsoft.com/whdc/system/platform/pcdesign/>

Biometric Sensors

Biometric Devices on WHDC

<http://www.microsoft.com/whdc/device/input/smartcard/default.aspx>

Digital Rights Management

WinHEC 2004 Presentations:

Business Opportunities with Next Generation Windows Media DRM

Building Secure DRM-Enabled Devices

Digital Rights Management and the Home Media Ecosystem

Digital Rights Management

<http://www.microsoft.com/windows/windowsmedia/drm.aspx>

Do Not Disturb Button

Hardware Design Guidelines

<http://www.microsoft.com/whdc/system/platform/pcdesign/>

Front and Back Panel Components

WinHEC 2004 Presentation: *Media Center Driver for Front Panel Displays*
Living Room PC Considerations
<http://www.microsoft.com/whdc/system/platform/pcdesign/>

High-definition TV Tuners

WinHEC 2004 Presentation: *TV Tuners and Windows Media Center*

High-definition Video and Audio Output

WinHEC 2004 Presentations:
AV Quality and Windows Media Center
Complexity of Designing Streaming Media Systems
Universal Audio Architecture - State of the Union
Windows XP Audio Architecture Overview

Audio and Video Technologies on MSDN
<http://msdn.microsoft.com/library/default.asp?url=/nhp/default.asp?contentid=28000411>

Audio on WHDC, including UAA
<http://www.microsoft.com/whdc/device/audio/default.mspx>
uaa@microsoft.com

Graphics Hardware and Driver Support on WHDC
<http://www.microsoft.com/whdc/device/display/aero/default.mspx>

Integrated Cameras

Still Imaging / WIA Technologies on WHDC
<http://www.microsoft.com/whdc/device/StillImage/default.mspx>

Streaming Devices on WHDC
<http://www.microsoft.com/whdc/device/stream/default.mspx>

Large, High-resolution Displays

Display and Graphics on WHDC
<http://www.microsoft.com/whdc/device/display/default.mspx>

Media Center Button and Controls

Hardware Design Guidelines
<http://http://www.microsoft.com/whdc/system/platform/pcdesign/>

Input and HID on WHDC
<http://www.microsoft.com/whdc/device/input/default.mspx>

Media Center Controls on MSDN
http://msdn.microsoft.com/library/en-us/dnwm/html/remote_control.asp

Media Storage and Management

WinHEC 2004 Presentations:
Portable Storage - Overcoming Legacy
Simplified Storage, Storage Directions and Trends

Storage on WHDC:
<http://www.microsoft.com/whdc/device/storage/default.mspx>

Media Transfer Protocol

WinHEC 2004 Presentations:
Designing Portable Media Players for Windows
Media Transfer Protocol

Microphone Arrays

Audio and Speech Input on WHDC
<http://www.microsoft.com/whdc/device/audio/default.mspx>

Microsoft XNA

Microsoft XNA Overview
<http://www.microsoft.com/xna/>

Residential Gateways

WinHEC 2004 Presentations

Communications in Longhorn: Telephony, Mobile devices and HW/SW integration

Windows APIs for A/V Home Networking Quality of Service

Networking and Communications on WHDC:

<http://www.microsoft.com/whdc/device/network/default.msp>

VoIP Devices on MSDN

<http://msdn.microsoft.com/embedded/devplat/VoIP/>

WAP Architecture: pcasap@microsoft.com

User-Friendly Expansion Capabilities

WinHEC 2004 Presentation: *PCI Express - Future Form Factors*

Voice Command Button and Microphones

Audio and Speech Input on WHDC

<http://www.microsoft.com/whdc/device/audio/default.msp>

Microsoft Voice Command for Windows Mobile,

Windows Mobile Developer Tools and Resources

<http://www.microsoft.com/windowsmobile/information/devprograms/>

Windows Media Center Edition

WinHEC 2004 Presentation: *Media Center - Success Through Innovation*

Windows Media Center Extender Technologies

WinHEC 2004 Presentation: *Network Media Devices - Media Center Extender*

Windows Media Center Extender:

<http://www.microsoft.com/windowsxp/mediacenter/evaluation/devices/extender.asp>

Windows Media Connect

WinHEC 2004 Presentations:

Windows Media Connect - Connectivity Solution for Networked Media Players

Windows Media Connect - Key Asset for Networked Devices

Windows Media Connect Device Design Considerations

<http://www.microsoft.com/whdc/>

Wireless Connectivity and Peripherals

WinHEC 2004 Presentation: *Network Connected Devices - Architectural Overview*

Networking and Communications on WHDC

<http://www.microsoft.com/whdc/device/network/default.msp>