



# Intel® Centrino™ Mobile Technology Performance Brief



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## Executive Summary:

### Intel® Centrino™ Mobile Technology

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Intel is expanding its history of innovation with new notebook PC capabilities designed specifically for the mobile world. This technology allows users to work, play and connect without wires and choose from a whole new generation of thin and light notebook PCs that are designed to enable extended battery life.

This new innovative technology delivers breakthrough notebook PC performance and low-power enhancements to enable extended battery life in notebook PCs, combined with integrated wireless LAN connectivity and standards-based security support.

With Intel Centrino mobile technology, three components work together to deliver a breakthrough in freedom and capability— to work, learn and play on the go. These components include:

- Intel® Pentium® M Processor
- Intel® 855 chipset family
- Intel® PRO/Wireless 2100 Network Connection

The Intel Pentium M processor is available at speeds of 1.30 GHz, 1.40 GHz, 1.50 GHz, and 1.60 GHz. The Intel Pentium M processor is based on a high performance, low power micro-architecture and includes several innovative features like a high performance, power optimized 400 MHz System Bus, 32KB Level 1 instruction and data caches, 1MB Level 2 Advanced Transfer Cache, advanced branch prediction and data prefetching, Streaming SIMD Extensions 2 support, Enhanced Intel SpeedStep® Technology support, Intel MMX™ media enhancement technology support and advanced thermal monitoring capabilities. These features are offered in Micro-FCPGA and Micro-FCBGA package form factors.

The Intel Pentium M processor is the next step towards achieving high mobile performance at very low power. This exciting new processor supports Enhanced Intel SpeedStep technology at multiple operating points instead of two points support on existing processors. Real-time dynamic switching of the voltage and frequency between multiple performance modes is based on CPU demand. This occurs by switching the bus ratios, core operating voltage, and core processor speeds without resetting the system. Multiple Enhanced Intel SpeedStep technology operating points enable optimal performance at the lowest power.

The highly scalable Intel 855PM chipset has been designed specifically for mobile systems with enhancements in performance while reducing power consumption at the same time. The Intel 855PM chipset was designed in tandem with the Intel Pentium M processor. The Intel 855PM chipset was designed to maximize performance and enhance the PC user experience both on and off the Internet. Features such as a 400 MHz system bus offer a peak bandwidth of 3.2 GB/s, support of Double Data Rate (DDR) memory channels offer a peak bandwidth of 2.1 GB/s and the AGP 4X interface allows graphics controllers access to main memory at over 1 GB/s. The memory controller hub is connected to the I/O controller hub with the very efficient and high bandwidth Hub Interface. With dedicated data paths to fully optimize the additional bandwidth, the Intel 855PM chipset delivers high performance and support for future Intel Pentium M processors.

The Intel 855PM chipset has a lower core voltage in comparison to previous generations of memory controller hubs and utilizes innovative design features to reduce memory interface power during system idle conditions. Design enhancements like increased burst length size, timing improvements, shorter refresh cycles help improve the performance over previous generations of memory controller hubs.

The integrated Wi-Fi Certified Intel PRO/Wireless 2100 Network Connection has been designed and validated to work with all of the Intel Centrino mobile technology components and is able to connect to 802.11b Wi-Fi certified access points. It also supports advanced wireless LAN security including Cisco\* LEAP, 802.1X, and WEP in addition to providing software-upgradeable support for future security protocols, like WPA and full Cisco

compatible features. For comprehensive security support, the Intel PRO/Wireless 2100 Network Connection has been verified with leading VPN suppliers like Cisco\*, CheckPoint\*, Microsoft\* and Intel.

The Intel® PRO/Wireless 2100 Network Connection with Intel PROSet Software offers many ease-of-use features for users, including advanced profile management which allows multiple profiles to automate connection and switching between different wireless LANs, VPNs and wired networks at home, work, cafes, hotels and airports around the globe. Intel's special connection wizard provides a simple interface for setting up ad hoc networks. The Intel Wireless Coexistence System support enables reduced interference between the Intel PRO/Wireless network connection and Bluetooth\* devices. WLAN performance is further optimized by per-packet antenna selection. The Intel PRO/Wireless 2100 network connection also features a number of low power features to extend battery life including power saving capability that allows users to set power at five different settings to trade off performance for longer battery life and Intel Intelligent Scanning technology reduces power by controlling the frequency of scanning for access points when a link is lost.

Notebook PCs based on Intel Centrino™ mobile technology include the latest features to simplify system management, decrease power consumption, and lower the total cost of ownership for large and small business environments. Notebook PCs with Intel Centrino mobile technology offer great performance for today's and tomorrow's applications, as well as the quality, reliability, and compatibility that is expected from the world's leading microprocessor company.

This performance brief introduces the Intel Centrino mobile technology, explains the technologies that make it work, examines the purpose and methods behind the industry's most useful benchmarks, and shows how Intel Centrino mobile technology currently performs on each of the respective benchmarks. As new benchmarks are introduced, this performance brief will be updated as appropriate.

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# 1. Introduction

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Intel is expanding its history of innovation with new notebook PC capabilities designed specifically for the mobile world. This technology allows users to work, play and connect without wires and choose from a whole new generation of thin and light notebook PCs that are designed to enable extended battery life.

This new innovative technology delivers breakthrough mobile performance and low-power enhancements to enable extended battery life in notebook PCs, combined with integrated wireless LAN connectivity and standards-based security support.

With Intel® Centrino™ mobile technology, three components work together to deliver a breakthrough in freedom and capability—to work, learn and play on the go. These components include:

- Intel® Pentium® M Processor
- Intel® 855 chipset family
- Intel® PRO/Wireless network connection

The Intel Pentium M processor is offered at speeds of 1.30 GHz, 1.40 GHz, 1.50 GHz and 1.60 GHz. In the Highest Frequency Mode (HFM), the notebook PC can achieve high performance on the most complex business and Internet applications. The Lowest Frequency Mode (LFM) speed on all processors is 600 MHz which reduces power consumption and enables extended battery life. The on-demand performance switches between HFM, LFM and intermediate Enhanced Intel SpeedStep® technology operating points based on user needs, optimizing application performance and battery life.

When an Intel Pentium M processor is used in conjunction with the Intel 855 chipset family, the resulting platform provides reliable, balanced performance for today's mainstream notebook PCs, with headroom to remain productive as new applications emerge. The Intel 855 chipset family offers support for DDR memory technology and offers a system bus frequency of 400 MHz.

The integrated Wi-Fi\* Certified Intel PRO/Wireless 2100 Network Connection has been designed and validated to work with all of the Intel Centrino mobile technology components and is able to connect to 802.11b Wi-Fi certified access points. It also supports advanced wireless LAN security including Cisco\* LEAP, 802.1X, and WEP in addition to providing software-upgradeable support for future security protocols, like WPA and full Cisco compatible features. Finally, for comprehensive security support, the Intel PRO/Wireless 2100 Network Connection has been verified with leading VPN suppliers like Cisco\*, CheckPoint\*, Microsoft\* and Intel.

Notebook PC performance does not depend on the microprocessor alone. Hardware and software system components—such as the operating system, the graphics and I/O subsystems, application software, and memory—may significantly affect performance results. For this reason, this Performance Brief illustrates Intel Centrino mobile technology performance on a consistent notebook PC configuration. Details of the notebook PC configuration used for the performance scores throughout this brief can be found in Appendix A.

## 2. The Intel® Pentium® M Processor

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The Intel Pentium M processor is designed with a mobile optimized architecture that delivers advanced performance at very low power.

Highlights of the Intel Pentium M processor:

- Available at 1.30 GHz, 1.40 GHz, 1.50 GHz and 1.60 GHz
- Supported by the Intel 855 chipset family
- Featuring a high performance, low power mobile optimized micro-architecture
- On-die, primary 32 KB instruction cache and 32 KB write-back data cache
- On-die, 1MB Level 2 cache with Advanced Transfer Cache Architecture
- Advanced power management including Enhanced Intel SpeedStep® technology support with multiple operating points
- Fully compatible with existing Intel Architecture-based software
- Streaming SIMD Extensions 2
- Intel MMX™ media enhancement technology
- Memory cacheability up to 4 GB of addressable memory space and system memory scalability up to 64 GB of physical memory
- Available in Micro-FCPGA and Micro-FCBGA packages
- Based upon Intel's advanced 0.13µ manufacturing process

### 3. Intel® Pentium® M Processor Product Feature Highlights

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The Intel Pentium M processor micro-architecture is optimized for high performance and low power. It includes a number of features including Enhanced Intel SpeedStep® technology support, a high performance power optimized 400 MHz System Bus, 32KB Level 1 instruction and data caches, 1MB Level 2 Advanced Transfer Cache, Streaming SIMD Extensions 2 support and advanced thermal monitoring capabilities. These features and resulting benefits are described in more detail below:

- High Performance and Low Power Core

The Intel Pentium M processor features a high performance core architecture that uses techniques like micro-op fusion and Advanced Stack Management to maximize performance. Micro-op fusion combines micro-ops derived from the same macro-op. Advanced Stack Management reduces the number of micro-ops in stack related operations by tracking relative stack pointer changes locally. Reduction in number of micro-ops results in more efficient scheduling and better performance at lower power. The Intel Pentium M processor core can operate at very low voltages and uses advanced techniques to minimize clock and signal switching, resulting in very low power dissipation in the active state. The processor features dynamic power management states that consist of Stop Grant, Sleep, Deep Sleep, and Deeper Sleep Alert states that allow the processor to quickly enter and exit from these states to provide fast responsiveness and significant power savings.

- Enhanced Intel SpeedStep Technology Support

The Intel Pentium M processor features Enhanced Intel SpeedStep Technology support at multiple voltage and frequency operating points. Highlights of this technology include:

- Multiple performance modes ranging from the Lowest Frequency Mode (LFM) to Highest Frequency Mode (HFM) enable optimum performance at the lowest power
- Real-time dynamic switching of the voltage and frequency between multiple performance modes based on CPU demand. This occurs by switching the bus ratios, core operating voltage, and core processor speeds without resetting the notebook PC
- Software control of voltage and frequency operating points
- Very low transition latency

- 400 MHz System Bus with enhanced low power features

The Intel Pentium M processor supports Intel's highest performance mobile system bus by delivering 3.2 GB of data per second into and out of the processor. This is accomplished through a physical signaling scheme of quad pumping the data transfers over a 100-MHz clocked system bus and a buffering scheme allowing for sustained 400-MHz data transfers. The system bus features the following low power enhancements:

- Low voltage swing
- Intelligent disabling of data, address and control signal buffers
- Dynamic on-die termination disabling

- 32KB Level 1 Instruction and Data Caches

Both Instruction and Data Caches on the Intel Pentium M processor are 32KB in size. Large L1 caches provide fast access to critical instructions and data, resulting in very high performance.

- 1MB Level 2 Advanced Transfer Cache

The Level 2 Advanced Transfer Cache (ATC) is 1MB in size and delivers an extremely high data throughput channel between the Level 2 cache and the processor core. The Advanced Transfer Cache transfers data on each core clock. Features of the ATC include:

- Non-Blocking, full speed, on-die Level 2 cache
  - 8-way set associativity
  - Data clocked into and out of the cache every clock cycle
- Advanced Branch Prediction and Data Prefetching

The Intel® Pentium M processor features an advanced branch prediction architecture that combines three types of predictors – Global, Bi-Modal and Loop Detector. The processor automatically selects the most optimal algorithm to use, significantly reducing the number of mis-predicted branches. The processor also features an advanced data prefetcher that can track up to 8 upstream and 4 downstream operations simultaneously. Data is prefetched from main memory to the L2 cache in advance, resulting in higher performance by reducing the need to access system memory.

- Streaming SIMD Extensions 2 (SSE2)

The Intel Pentium M processor supports the complete SSE2 instruction set. These instructions include 128-bit SIMD integer arithmetic and 128-bit SIMD double-precision floating-point operations. These instructions reduce the overall number of instructions required to execute a particular program task and as a result can contribute to an overall performance increase.

- Features used for Test and Performance / Thermal Monitoring:
  - Built-in Self Test (BIST) provides single stuck-at fault coverage of the microcode and large logic arrays, as well as testing of the instruction cache, data cache, Translation Lookaside Buffers (TLBs), and ROMs.
  - IEEE 1149.1 Standard Test Access Port and Boundary Scan mechanism enables testing of the Intel Pentium M processor and system connections through a standard interface.
  - Internal performance counters can be used for performance monitoring and event counting.
  - Includes an on-die thermal diode and the Intel Thermal Monitor feature for thermal management purposes. The Intel Pentium M processor features a new Thermal Monitor mode which uses Enhanced Intel SpeedStep technology instead of clock control. This technique achieves efficient thermal management with minimal performance impact.
  - The Intel Pentium M processor has a maximum junction temperature ( $T_J$ ) specification of 100°C.

## 4. Intel® 855PM Chipset Product Feature Highlights

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As the next step in the evolution of the Intel Hub Architecture for the notebook PCs using Intel® Centrino™ mobile technology, the Intel 855PM chipset was designed in tandem with the Intel Pentium® M processor.

The Intel 855PM Memory Controller Hub (MCH) delivers support for either PC1600 and PC2100 DDR memory technology and a 400 MHz system bus, providing the latest graphics support through 1.5V AGP4X technology. Together these features deliver the highest total bandwidth capabilities to the PC platform. The enhanced 82801DBM I/O Controller Hub 4 (ICH4-M) delivers twice the I/O bandwidth over traditional bridge architecture and provides dedicated data paths to fully optimize the additional bandwidth. The ICH4-M has reduced core voltage from previous generation of I/O hub architecture chipsets. The ICH4-M makes a direct connection from the graphics and memory for faster access to peripherals and provides the features and bandwidth required for a high performance notebook PC.

In addition to advanced application support, the Intel 855PM chipset was designed with the following features to enhance the end-user experience:

- 400 MHz system bus delivers a high bandwidth connection between the Intel Pentium M processor and the platform
- The DDR memory channel delivers up to 2.1 GB/s of memory bandwidth to the processor. High memory bandwidth, coupled with an efficient protocol, deliver balanced platform support and provide the memory bandwidth necessary to extract the highest performance from the Intel Pentium M processor.
- The AGP4X interface allows graphics controllers to access main memory at over 1 GB/s, twice that of previous AGP platforms
- Support for Hi-Speed Universal Serial Bus (USB 2.0) with backward compatibility with USB 1.1
- AC97 2.2 Interface with support for a third codec to provide 20 bit resolution. The latest AC97 audio delivers six channels of audio for enhanced sound quality and full surround sound capability for live broadcast and other Digital Dashboard programming
- LAN Connect Interface (LCI) provides flexible network solutions such as home phone line, 10/100 Mbps Ethernet, and 10/100 Mbps Ethernet with LAN manageability
- Dual Ultra ATA-100 controllers support the fastest IDE interface for transfers to storage devices
- Support for ACPI-defined power states C1-C4, S1, S3-S5
- Support for Enhanced Intel SpeedStep® Technology
- Support for "Deeper Sleep" power state
- Allows wake-up from sleep states S1-S4

The 855PM chipset is designed for low power and great performance supporting architectural features for power reduction techniques including:

- Chipset MCH core voltage reduced to 1.2V for reduced power consumption
- Management of DDR SO-DIMM (platform) power by using aggressive use of CKE Power-Down when memory interface is idle and enhancement of per-bank page-closing policy for the memory interface
- Management of Intel® 855PM MCH DDR I/O power with aggressive tri-stating of control signals when not needed and partial drive of command signals when possible and including during idle cycles and reducing toggle rates of control line
- Support for DDR Read Throttling via External Thermal Sensor to prevent memory overheating, disabling of I/O buffers and DLLs when possible, turning off Hub Interface and Host PLLs also add to increased power savings for the 855PM chipset

Some of the features added to the Intel 855PM chipset design to boost MCH performance include:

- Significant timing improvements to allow a robust DDR266 channel with a combination of significant logic changes and I/O changes
- Shorter memory refresh sequence with shorter memory controller queues provides additional bandwidth improvement by reducing CPU access latencies
- Reduction in page-miss occurrences due to significant improvements in page closing algorithms

## 5. Intel® PRO/Wireless 2100 Network Connection Product Feature Highlights

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The Intel PRO/Wireless 2100 network connection is the integrated Wireless LAN (WLAN) solution for Intel® Centrino™ mobile technology. The Intel PRO/Wireless 2100 network connection works in concert with the other Intel Centrino mobile technology components to provide freedom and flexibility to work and play on the go without searching for a phone jack, network cable, or plugging in a special card. The Intel Centrino mobile technology is based upon four major categories: Security, Performance, Ease-of-use, and Verification.

- **Security**  
Intel Centrino mobile technology has been Intel tested to support advanced, standard and industry enhancement-based wireless security solutions including WEP, 802.1X and Cisco\* LEAP. For more information read our [Intel® Building Blocks for Wireless LAN Security](http://www.intel.com/network/connectivity/resources/doc_library/white_papers/WLAN_Security_WP.pdf) White Paper ([http://www.intel.com/network/connectivity/resources/doc\\_library/white\\_papers/WLAN\\_Security\\_WP.pdf](http://www.intel.com/network/connectivity/resources/doc_library/white_papers/WLAN_Security_WP.pdf)) and read the [Enterprise Solutions for Wireless LAN Security](http://www.wi-fi.org/OpenSection/pdf/Whitepaper_Wi-Fi_Enterprise2-6-03.pdf) ([http://www.wi-fi.org/OpenSection/pdf/Whitepaper\\_Wi-Fi\\_Enterprise2-6-03.pdf](http://www.wi-fi.org/OpenSection/pdf/Whitepaper_Wi-Fi_Enterprise2-6-03.pdf)) on the Wi-Fi Alliance website.
- **Performance**  
With 802.11b support and speeds up to 11Mbps, Intel PRO/Wireless 2100 network connection enables fast network connections. It includes per-packet antenna selection to enable optimized WLAN performance. The Intel® Wireless Coexistence System helps reduce interference between Intel PRO/Wireless and certain Bluetooth\* devices. For more information about 802.11b read the [IEEE 802.11b High Rate Wireless Local Area Networks](http://www.intel.com/network/connectivity/resources/doc_library/documents/pdf/NP1692-01.pdf) White Paper ([http://www.intel.com/network/connectivity/resources/doc\\_library/documents/pdf/NP1692-01.pdf](http://www.intel.com/network/connectivity/resources/doc_library/documents/pdf/NP1692-01.pdf)).
- **Ease-of-use**  
Intel PROSet software enables easy configuration and management of wireless network connections with the automated profile wizard.
- **Verification**  
Intel Centrino mobile technology is verified with leading VPN infrastructure products. Intel is working with hardware and software developers and wireless service providers to deliver a reliable and integrated wireless mobile computing experience.

Additional highlights of the Intel PRO/Wireless 2100 Network Connection include:

- Single band support, providing the ability to connect to 802.11b networks
- Industry standard and extended wireless security support (WEP, 802.1X and Cisco LEAP)
- Intel PROSet software with advanced profile management support, allows multiple setup profiles to connect to different WLAN networks
- Intel PROSet software with automatic WLAN switching support enables automatic switching between wired and wireless LAN connections
- Intel PROSet software supports Cisco\*, CheckPoint\*, Microsoft\* and Intel VPN connections

- Intel PROSet software with ad hoc connection wizard support provides a simple interface for setting up ad hoc networks
- Intel® Wireless Coexistence System support enables reduced interference between Intel PRO/Wireless and certain Bluetooth\* devices
- Per-packet antenna selection enables optimized WLAN performance
- Intel Intelligent Scanning Technology, reduces power by controlling the frequency of scanning for access points
- Power saving capability with five different power settings allows users to trade off performance and battery life

## 6. Performance Summary

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### Mobile Experience - MobileMark\* 2002

MobileMark\*2002 is used to evaluate notebook PC user experience by measuring both performance and battery life at the same time on the same workload. MobileMark 2002 is a tool that measures notebook PC performance on popular business-oriented applications in the Microsoft\* Windows\* operating environment. The productivity usage model provides computations representing today's business users using popular office productivity and content creation applications. This usage model reports a performance score and a battery life score.

The productivity workload of MobileMark 2002 consists of emerging usage models and popular productivity applications including:

- Adobe\* Photoshop\* 6.0.1
- Macromedia\* Flash\* 5.0
- McAfee\* VirusScan\* 5.13
- Microsoft\* Excel\* 2002
- Microsoft\* Outlook\* 2002
- Microsoft\* PowerPoint\* 2002
- Microsoft\* Word\* 2002
- Netscape\* Communicator\* 6.0
- WinZip\* 8.0

## Mobile Experience

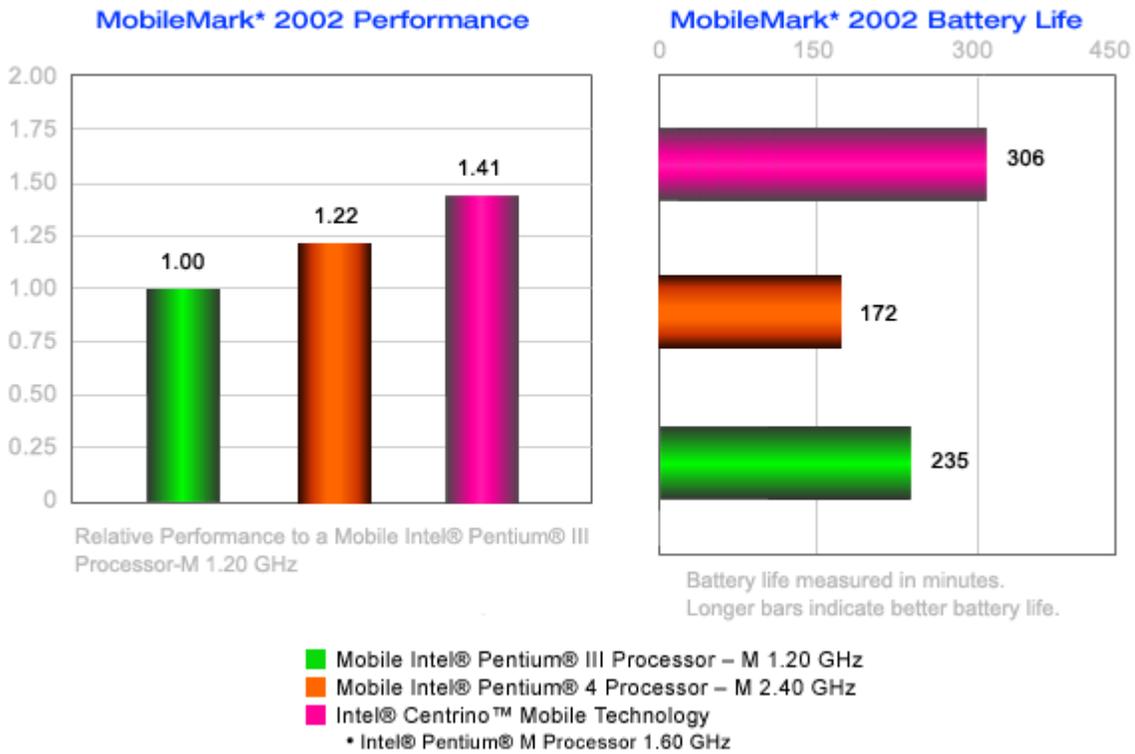


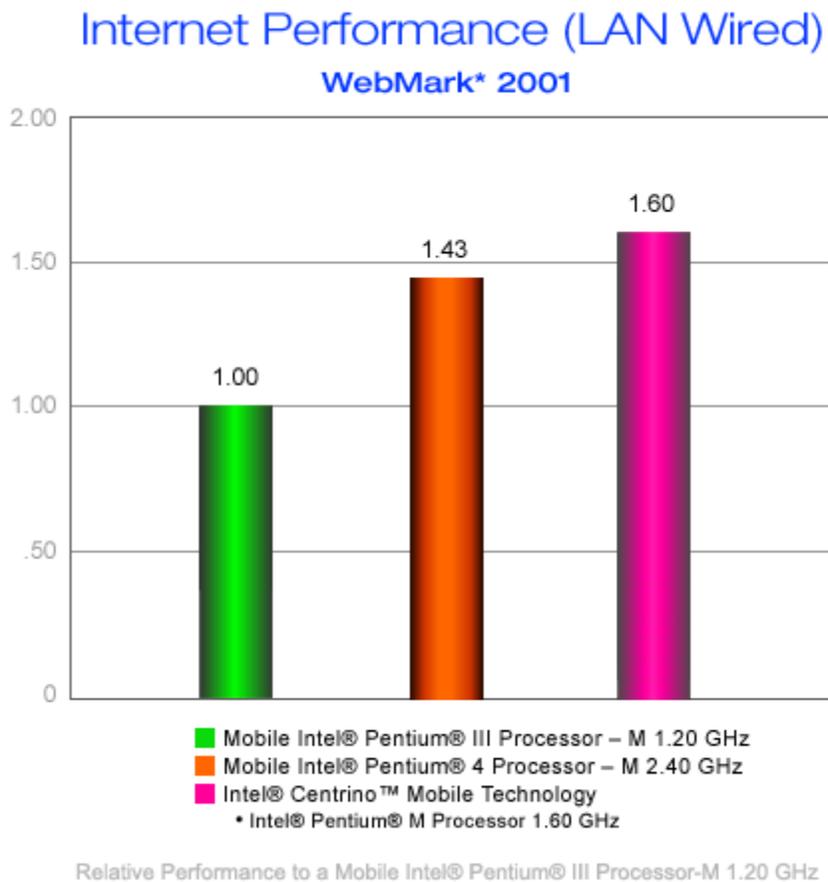
Figure 1. Intel® Centrino™ Mobile Technology Performance and Battery Life on MobileMark\* 2002



## Internet Performance - WebMark\* 2001

WebMark\* 2001 is an Internet client benchmark designed to measure Internet performance with respect to the client computer and the speed of the connection. WebMark 2001 measures the performance of the PC client on various technologies that are used within the benchmark, such as Flash\* (operations per second), Java\* (operations per second), XML (operations per second), and Video performance (frames per second).

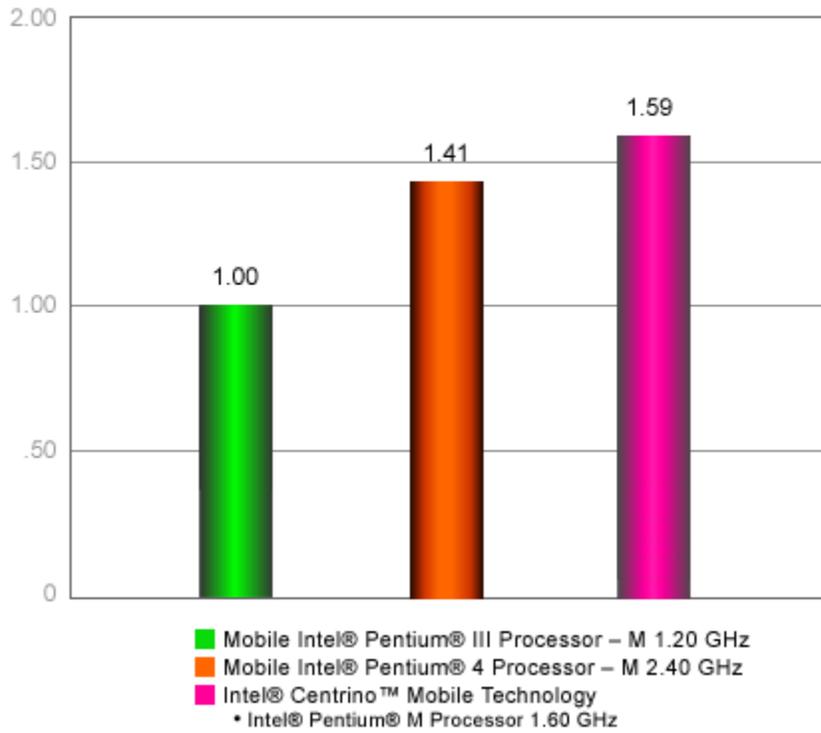
WebMark 2001 can be measured over different network connections. Figure 2 and Figure 3 below showcase WebMark 2001 performance over a 100Mbps LAN wired connection and an 802.11b wireless connection.



**Figure 2. Intel® Centrino™ Mobile Technology Performance on WebMark\* 2001 (LAN Wired)**

## Internet Performance (802.11b Wireless)

WebMark\* 2001



Relative Performance to a Mobile Intel® Pentium® III Processor-M 1.20 GHz

Figure 3. Intel® Centrino™ Mobile Technology Performance on WebMark\* 2001 (802.11b Wireless)

## 7. Summary of Results

Table 1 and Table 2 summarize the benchmark performance of Intel® Centrino™ Mobile Technology, the Mobile Intel® Pentium® 4 Processor-M and the Mobile Intel® Pentium® III Processor-M on Windows\* XP.

**Table 1. Raw Performance Data**

Benchmarks	Mobile Intel Pentium III Processor-M	Mobile Intel Pentium 4 Processor-M	Intel Centrino Mobile Technology
MobileMark* 2002 – Performance	134	164	189
MobileMark* 2002 – Battery Life (minutes)	235	172	306
WebMark* 2001 (LAN Wired)	206	294	329
WebMark* 2001 (802.11b Wireless)	179	253	285

**Table 2. Normalized Performance Results**

Benchmarks	Mobile Intel Pentium III Processor-M	Mobile Intel Pentium 4 Processor-M	Intel Centrino Mobile Technology
MobileMark* 2002 – Performance	1.00	1.22	1.41
MobileMark* 2002 – Battery Life (minutes)	235	172	306
WebMark* 2001 (LAN Wired)	1.00	1.43	1.60
WebMark* 2001 (802.11b Wireless)	1.00	1.41	1.59

## Appendix A: Notebook PC Configuration

**Table 3. Notebook PC Configuration Used for Performance Measurement**

Intel Mobile System	Mobile Intel® Pentium® III Processor-M	Mobile Intel Pentium 4 Processor-M	Intel Centrino™ Mobile Technology
Processor	Mobile Intel® Pentium® III Processor-M 1.20 GHz	Mobile Intel Pentium 4 Processor-M 2.40 GHz	Intel Pentium M Processor 1.60 GHz
Motherboard Chipset	Intel 830M	Intel 845MP	Intel 855PM
Network Card	Intel AnyPoint II PCMCIA (Wireless transmitter disabled for MobileMark* 2002)	Intel Pro/Wireless 2011B LAN 3A mini-PCI adaptor (Wireless transmitter disabled for MobileMark* 2002)	Intel Pro/Wireless LAN 2100 3B mini-PCI Adapter (Wireless transmitter enabled and associated with an Access Point for MobileMark* 2002)
Vendor and Model	IBM* T23	IBM T30	IBM T40
Bios Version	1.15	2.01	1.00
Memory Type	512 MB PC133 SDRAM	512 MB PC2100 DDR	512 MB PC2100 DDR
Hard Disk Controller / Bus	Integrated ATA-100 controller	Integrated ATA-100 controller	Integrated ATA-100 controller
Hard Disk-Make/Model/size	IBM IC25N04ATCS05-0 Travelstar 40 GB	IBM IC25N04ATCS05-0 Travelstar 40 GB	IBM IC25N04ATCS05-0 Travelstar 40 GB
Hard Drive speed	5400 RPM	5400 RPM	5400 RPM
Operating System Type & Version (MobileMark* 2002 only)	Windows* XP Professional, Build 2600, Service Pack 1 on FAT32	Windows XP Professional, Build 2600, Service Pack 1 on FAT32	Windows XP Professional, Build 2600, Service Pack 1 on FAT32
Operating System Type & Version (WebMark 2001 only)	Windows XP Professional, Build 2600	Windows XP Professional, Build 2600	Windows XP Professional, Build 2600
Graphics Controller Name	S3* SuperSavage/IXC 1014	ATI* Mobility 7500	ATI Mobility 9000
Graphics Memory Size/Type	16MB	16MB	32 MB
Graphics Resolution/Color	1024x768 x 32bit Color	1024x768 x 32bit Color	1024x768 x 32bit Color
Graphics Driver: WinXP	S3 Graphics, Inc. 6.13.10.1277	ATI Mobility 7500 6.13.10.6114	ATI Mobility 9500 6.13.10.6269
Chipset INF and Disk Driver: WinXP	Intel® Chipset Software Installation Utility V4.00.1013	Intel Chipset Software Installation Utility V4.00.1013	Intel Chipset Software Installation Utility V4.20.1009
Sound Card	Intel Integrated Audio	Intel Integrated Audio	Intel Sound MAX Digital Audio

Monitor/type & refresh	Plug and Play @ 60Hz.	Plug and Play @ 60Hz.	Plug and Play @ 60Hz.
Battery capacity	10.8V X 4.04 AH = 43 WHr	10.8V X 4.4 AH = 48 WHr	10.8V X 4.4 AH = 48 WHr
Screen size	14.1"	14.1"	14.1"
Screen brightness	~15 nits	~15 nits	~15 nits
Power Management Mode for MobileMark* 2002	Portable/laptop	Portable/laptop	Portable/laptop
Power Management Mode for WebMark* 2001	Always On	Always On	Always On









**UNITED STATES, Intel Corporation**  
2200 Mission College Blvd., P.O. Box 58119, Santa Clara, CA 95052-8119  
Tel: +1 408 765-8080

**JAPAN, Intel Japan K.K.**  
5-6 Tokodai, Tsukuba-shi, Ibaraki-ken 300-26  
Tel: + 81-29847-8522

**FRANCE, Intel Corporation S.A.R.L.**  
1, Quai de Grenelle, 75015 Paris  
Tel: +33 1-45717171

**UNITED KINGDOM, Intel Corporation (U.K.) Ltd.**  
Pipers Way, Swindon, Wiltshire, England SN3 1RJ  
Tel: +44 1-793-641440

**GERMANY, Intel GmbH**  
Dornacher Strasse 1  
85622 Feldkirchen/ Muenchen  
Tel: +49 89/99143-0

**HONG KONG, Intel Semiconductor Ltd.**  
32/F Two Pacific Place, 88 Queensway, Central  
Tel: +852 2844-4555

**CANADA, Intel Semiconductor of Canada, Ltd.**  
190 Attwell Drive, Suite 500  
Rexdale, Ontario M9W 6H8  
Tel: +416 675-2438

**BRAZIL, Intel Semicondutores do Brasil**  
Centro Empresarial Nações Unidas - Edifício Torre Oeste  
Av. das Nações Unidas, 12.901 - 18o. andar - Brooklin Novo  
04578.000 São Paulo - S.P. - Brasil  
Tel: +55-11-5505-2296