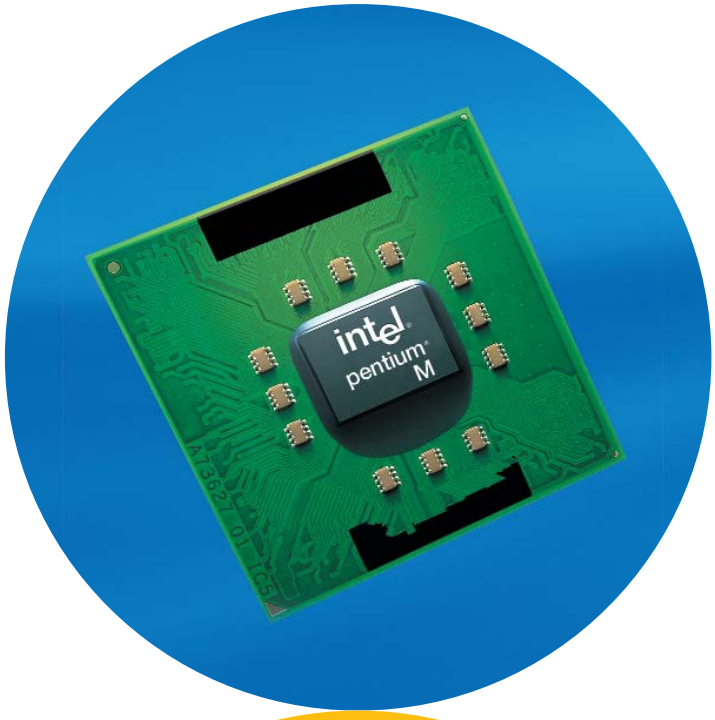
Intel® Pentium® M Processor in Embedded Applications

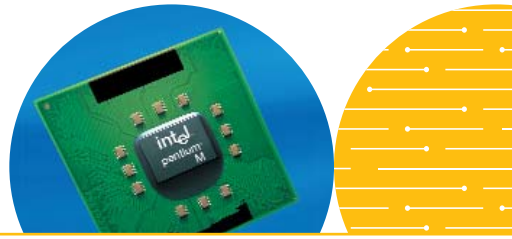
The Intel® Pentium® M processor is designed from the ground up with a new microarchitecture that delivers high performance with low power consumption.

Together with validated Intel® chipsets, it is an ideal building block for communications blades and space-constrained embedded designs that require highly efficient instruction execution, robust I/O and low thermals, while preserving software compatibility with other Intel® Architecture Processors.

Customer Studies



Intel® Pentium® M Processor in Embedded Applications

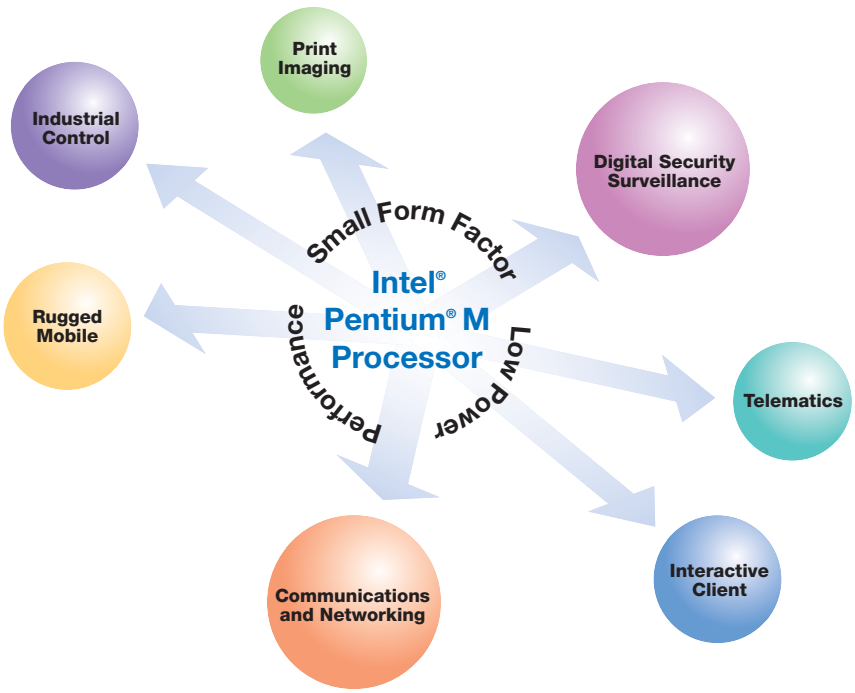


The Intel® Pentium® M processor can provide an optimal combination of strong compute performance and low power consumption for applications requiring dense form factors. While it incorporates advanced processor technology, the Intel Pentium M processor is fully compatible with previous-generation Intel® Architecture processors.

The processor utilizes a new microarchitecture to meet current and future demands for high mobile performance, low-power embedded computing, making it an excellent choice for a growing number of communications, transaction terminal, interactive client, and industrial control applications.

Learn why developers are choosing the Intel Pentium M processor

This brochure provides a series of summary case studies that describe embedded applications based on the Intel Pentium M processor, including boards and system solutions. The case studies include outlines of customer requirements, reasons why the Intel Pentium M processor was selected for their applications, and supporting customer experience data provided by the developers.



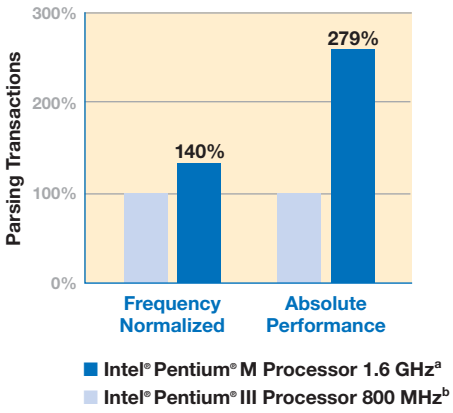
more performance per watt

Normalized Performance Benchmark Comparison:
Intel® Pentium® M processor and Intel® Pentium® III processor

Figure 1 shows the results of a benchmark test involving the parsing of H.248 (MEGACO) signaling transactions. The term "parsing" refers to the process of converting a message in H.248 compact text to a binary representation which can be used by the protocol software stack to execute the content of the message.

In this comparison, the results have been normalized by dividing the absolute measured performance by the processor frequency, which enables an approximate frequency-independent comparison of CPU architectures.

Based on this signal-parsing benchmark, an Intel Pentium M processor 1.6 GHz is 40 percent faster than an Intel® Pentium® III processor. In absolute terms, the Pentium M processor 1.6 GHz is 2.79 times faster than a Pentium III processor 800 MHz as measured by this benchmark.



Features	Benefits
Efficient Execution	
■ Advanced branch prediction	■ Faster program execution
■ Micro-op fusion	■ Excellent data manipulation: load, store
■ Hardware stack manager	■ Low context switching latency
Power Optimized	
■ Cache and processor bus power management	■ Low average power consumption
■ Intel SpeedStep® technology	■ Power consumption controlled by apps
Data Supply	
■ Large L1/L2 caches	■ Fast table look-ups

Benchmark configurations: a) Intel® Pentium® M processor 1.6 GHz, Intel® E7501 chipset, Linux*, 1 GB DDR200 SDRAM. b) Intel® Pentium® III processor 800 MHz, Intel® 815 chipset, Linux, 128 MB PC133 SDRAM. All tests performed with messages in "compact text" mode; UDP; no message piggybacking. **Disclaimer:** Data has been simulated and is provided for informational purposes only. Data was derived using simulations run on an architecture simulator. Any difference in system hardware or software design or configuration may affect actual performance. **Source:** Intel Corporation. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing.

Product Highlights

- Available in 1.6 GHz/24.5W[1] and 1.1 GHz/12W[1] low-voltage versions — both run at 600 MHz, 6W[1]
- 1 MB L2 cache
- Intel SpeedStep® technology
- Embedded lifecycle support

Chipset Support

- Intel® E7501 chipset with ECC, high I/O bandwidth
- Intel® 855GME chipset with ECC, on-chip graphics, dual display

[1]Thermal design power

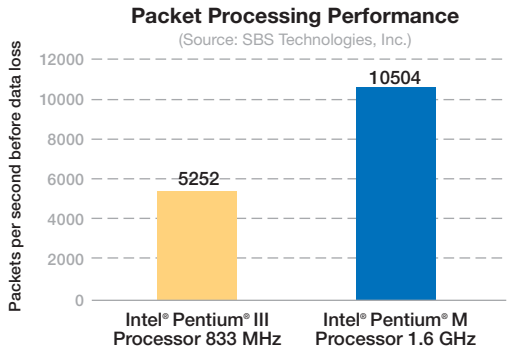
COMMUNICATIONS

SBS Technologies, Inc.

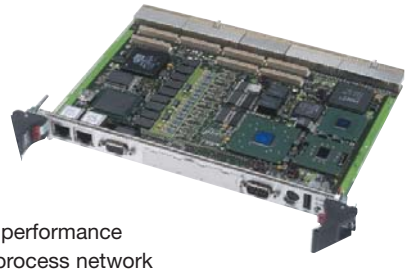
CT9 single-board computer*

Application

WAN monitoring solution



Customer Experience Data: SBS Technologies evaluated the performance gain provided by the Intel® Pentium® M processor 1.6 GHz and the Intel® E7501 chipset compared to an Intel® Pentium® III processor 833 MHz with a Serverworks* 3.0 LC chipset. WAN monitoring equipment based on the Intel Pentium M processor achieved a line utilization increase of over 200 percent for 50- and 90-byte packets, while providing the capability to handle higher-bandwidth protocols.



Customer requirements

WANs and LANs require sophisticated monitoring tools to ensure the security, reliability, and availability of the network infrastructure. In addition, monitoring solutions must be capable of overcoming performance bottlenecks as they gather and process network traffic at ever-faster line rates on WANs and LANs.

Intel® Pentium® M processor selection criteria

SBS Technologies based its previous WAN monitoring designs on the Intel® Pentium® III processor for processing multiple network streams at fully saturated T3 and E3 rates for both frame-based and cell-based protocols. SBS is now deploying WAN monitoring solutions based on the Intel® Pentium® M processor, which provides the additional performance needed to monitor OC-3, STM-1, and Gigabit Ethernet rates.

www.SBS.com/PentiumM

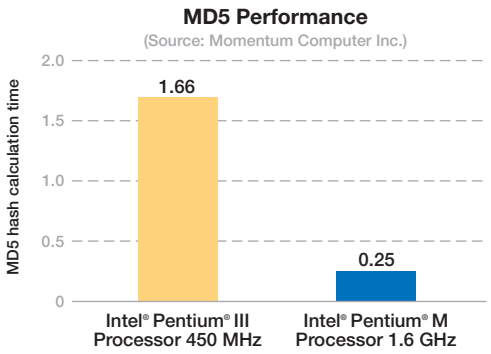
COMMUNICATIONS AND NETWORKING

Momentum Computer Inc.

Cheetah-Pr* processor PMC (PrPMC) board

Application

PrPMC mezzanine board for VME, CompactPCI,* and proprietary-based boards



Customer Experience Data: The Intel® Pentium® M processor at 1.6 GHz with the Intel® E7501 chipset was tested against an Intel® Pentium® III processor at 450 MHz, with both systems running the RedHat Linux* 9 operating system. The MD2sum utility (a standard component of Linux) was used to calculate the MD5 hash function in a test file of approximately 40 MB, selected because it exceeded the cache size of the processors. The Intel Pentium M processor completed the calculation in 0.250 seconds, compared to 1.656 seconds for the Intel Pentium III processor. As shown in the graph, this represents an approximate 6.6x performance improvement.

Customer requirements

The Cheetah-Pr is a solution for systems that require significant computing power in a small form factor. Power dissipation is another critical design issue. Many systems that require high levels of computing power use multiple processor boards, and the small form factor provided by the PrPMC enables highly scalable designs, based both on the number of processor boards and the clock rates of the processors.

Intel® Pentium® M processor selection criteria

In this application, processing power per Watt is the overriding design consideration. According to Momentum Computer Inc., its combination of high performance and low power consumption make the Intel® Pentium® M processor the ideal choice.

www.momenco.com

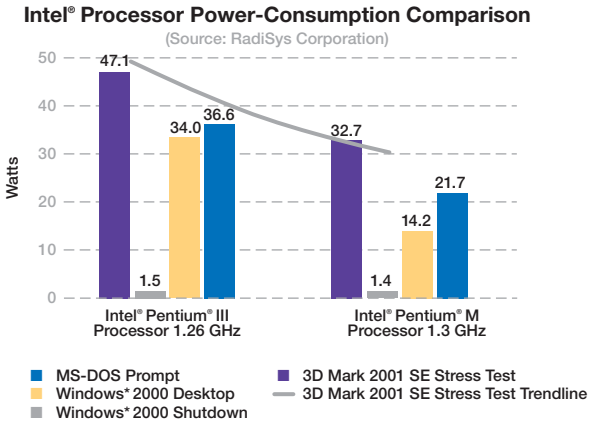
INDUSTRIAL CONTROL

RadiSys Corporation

LS855 microATX* board

Application

Industrial control, medical imaging and transaction terminals



Customer Experience Data: This graph shows power-consumption benchmarks, which compared the Intel® Pentium® M processor to other embedded processors. Power consumption was measured under Windows* 2000 for the Intel® Pentium® M 1.3 GHz and Intel® Pentium® III 1.26 GHz processors.

Customer requirements

Customers who develop industrial control and transaction terminal applications, including public kiosks and lottery terminals, are ready to upgrade their products to a next-generation platform capable of delivering higher performance. In many cases the small size of the enclosure required in these applications can impose thermal design challenges. The RadiSys LS855 board provides a low-power solution for systems that require passive cooling to achieve low noise with enhanced reliability. Dual independent display capability provides even greater integration and cost savings.

Intel® Pentium® M processor selection criteria

The key criterion for customers evaluating the LS855 board is the low-power solution provided by the Intel® Pentium® M processor. This enables customers to design a cooling solution based on either a low-noise fan or a passive heat sink for low noise with enhanced reliability. The integrated Low Voltage Differential Signaling (LVDS) display interface provides a dual-display solution for applications. Examples are kiosks using one display for customer interaction content and a second display with video advertising output. In medical applications, one screen can display patient records and a second screen can be used for diagnostic data.

www.radisys.com/oem_products/ds-page.cfm?productdatasheetsid=1158

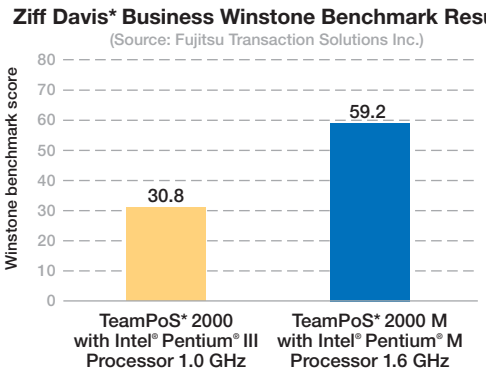
INTERACTIVE CLIENT

Fujitsu

TeamPoS* 2000 M

Application

Point-of-Sale (POS) systems



Customer Experience Data: In this Ziff Davis* Business Winstone benchmark test, moving the TeamPoS* 2000 design from the Intel® Pentium® III processor 1.0 GHz to the Intel® Pentium® M processor 1.6 GHz approximately doubled overall processing performance.

Customer requirements

Applications that were unheard of in a POS terminal just a few years ago are now expected by retailers and their customers. The expanding use of multi-media applications in POS terminals, for everything from employee training to advertising, requires the addition of more processing power. The amount of data involved in POS transactions is also growing, and the advent of Radio Frequency Identification (RFID) technology will increase the data volume even more. Transporting this data significantly increases the processing demand on POS terminals in both “fat” and “thin-client” environments.

Intel® Pentium® M processor selection criteria

POS terminals must be rugged, easy to maintain, and have the performance required to handle current and next-generation POS applications. These systems must have extended lifecycles that enable retailers to minimize their total cost of ownership. According to Fujitsu, the Intel® Pentium® M processor provides dramatically improved performance with lower power consumption, which reduces both energy costs and internal heat dissipation. Lower thermal dissipation can contribute to higher reliability.

www.ftxs.fujitsu.com

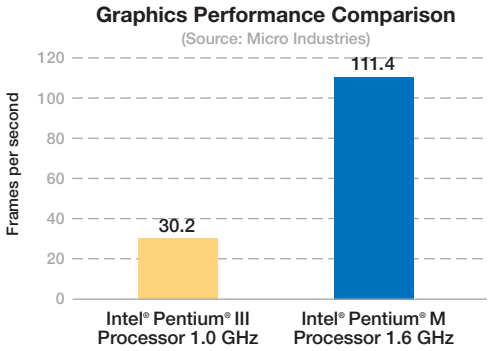
INTERACTIVE CLIENT

Micro Industries

Touch&Go* computer systems

Application

Point-of-Contact (POC) computer system



Customer Experience Data: This benchmark compared the Intel® Pentium® M processor 1.6 GHz to an Intel® Pentium® III processor 1.0 GHz. The system based on the Intel Pentium M processor rendered graphics approximately 4x faster than the system based on the Intel Pentium III processor.

Customer requirements

Retailers are constantly searching for new and better ways to manage inventory and sell products, while improving the consumer's shopping experience. Interactive client devices provide an effective way to deliver branding and promotional information to retail shoppers through Point-of-Contact (POC) systems. Since there is always a high premium on floor space, retailers also need POC solutions that can deliver maximum impact to customers through a centrally managed network of interactive clients. Today's advanced POC computer systems require the processing performance to drive eye-catching streaming video presentations, while simultaneously running sophisticated interactive software applications.

Intel® Pentium® M processor selection criteria

Touch&Go* computer systems from Micro Industries provide the processing performance, display options and I/O capabilities required by today's sophisticated retail applications, while minimizing total cost of ownership. High-performance rendered graphics are important to deliver effective POC messages. The Intel® Pentium® M processor delivers the enhanced graphics performance that Micro Industries needs in an advanced POC interactive client.

https://www.microindustries.com/products/syskiosks/messenger20.html

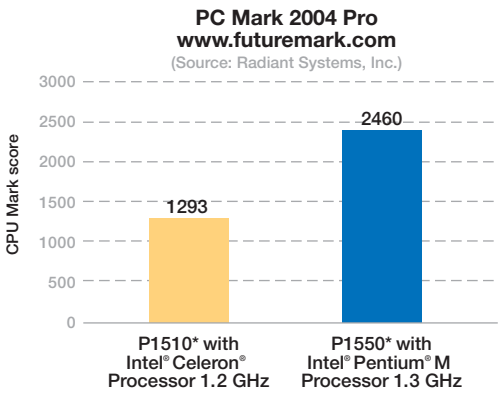
INTERACTIVE CLIENT

Radiant Systems, Inc.

P1550* Point-of-Sale (POS) Terminal

Application

Retail POS terminal



Customer Experience Data: Radiant measured 1.9 times greater performance for the Intel® Pentium® M processor 1.3 GHz platform compared to the Intel® Celeron® processor 1.2 GHz platform using PC Mark 2004 Pro, an application-based benchmark for measuring overall PC performance.

Customer requirements

Today's retailers face the triple challenge of intense competition, increasing consumer demands for more convenience and value, and high levels of employee turnover. Success in the retail segment can be defined by how rapidly retailers can serve their customers and respond to changing market conditions. To meet this challenge, POS technology must be high performance, reliable, flexible and easy to use.

Intel® Pentium® M processor selection criteria

The Radiant Systems P1550* POS terminal is based on the Intel® Pentium® M processor and validated chipsets to ensure fast transaction processing, while supporting an advanced 15-inch touch screen for enhanced ease of use. For optimal reliability, the terminal includes isolated cooling, solid-state storage, and Radiant's proprietary CableLock* system, enabling the device to operate in extreme retail environments. The use of industry-standard technologies and embedded Intel® Architecture enables the system to scale with changing end-user requirements.

www.radiantsystems.com/products/hardware/p1500.htm

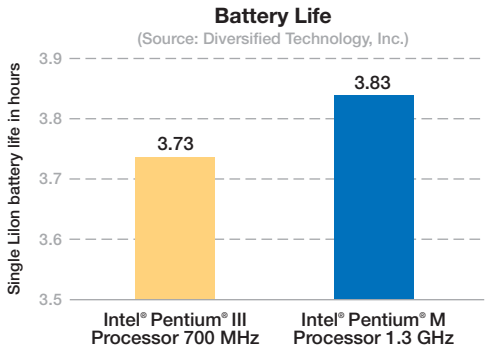
RUGGED MOBILE

Diversified Technology, Inc.

MIL855 Ruggedized Military Laptop* computer

Application

Mobile computer for battlefield use



Customer Experience Data: The benchmark evaluation showed that in terms of battery life, the Intel® Pentium® M processor at 1.3 GHz is three percent more efficient than an Intel® Pentium® III processor running at 700 MHz. This enables a solution that provides twice the speed of the previous design, with 2x the available cache, while providing superior battery life.

Customer requirements

In addition to specifying leading-edge hardware and software, the military imposes stringent criteria for ruggedized electronic equipment designed for battlefield use.

Intel® Pentium® M processor selection criteria

According to Diversified Technology Inc., the Intel® Pentium® M processor was a perfect fit for its new high-performance, ruggedized military laptop motherboard. The processor is capable of operating in more demanding thermal conditions than previous processors and is capable of intelligent thermal management, which enables maximum performance in a variety of operating conditions. The enhanced power efficiency of the Intel Pentium M processor is another key advantage in a military laptop platform.

www.dtims.com

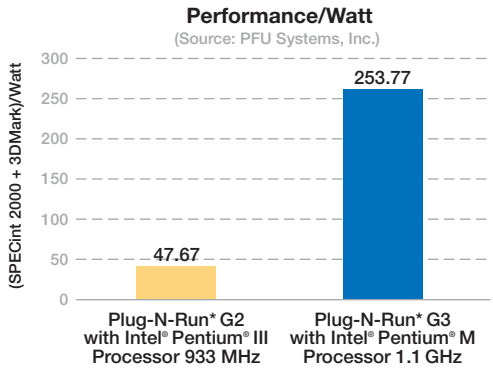
RUGGED MOBILE

PFU Systems, Inc.

Plug-N-Run* G3 System-on-Module

Application

Rugged mobile equipment for medical, industrial, test and measurement, transportation, and defense applications



Customer Experience Data: This benchmark compared performance/Watt between a module based on the Intel® Pentium® M processor 1.1 GHz and a similar module based on the Intel® Pentium® III processor 933 MHz. Performance per watt is equal to (SPECint 2000 + 3DMark)/Measured Watts – MAX.

Customer requirements

Manufacturers of mobile transaction terminals and other embedded computing products are turning to re-usable Commercial Off-the-Shelf (COTS) solutions to meet time-to-market challenges and boost productivity, while maintaining control over application-specific I/O configurations. Mobile equipment manufacturers must also meet the challenge of designing solutions to meet tight power budgets and thermal envelopes, while delivering higher levels of computing and graphics performance.

Intel® Pentium® M processor selection criteria

PFU Systems provides equipment manufacturers with "System-on-Module" (SOM) products that deliver scalable solutions in a component form factor. This approach makes PC/AT motherboard functionality available as an off-the-shelf building block, while the form, fit, and function required to implement application-specific I/O can be implemented by a custom system board. This enables PFU Systems customers to benefit from rapid advances in processor technology that meet their power budget and thermal envelope requirements. The PFU Systems Plug-N-Run* G3 package offers the functionality of a motherboard based on the Intel® Pentium® M processor and the Intel® 855GME chipset in a highly scalable COTS component. According to PFU Systems, the Intel Pentium M processor enables a significant improvement in power dissipation for its computational and graphics performance, compared to previous SOM designs.

www.pfusystems.com/g3pnr/index.html

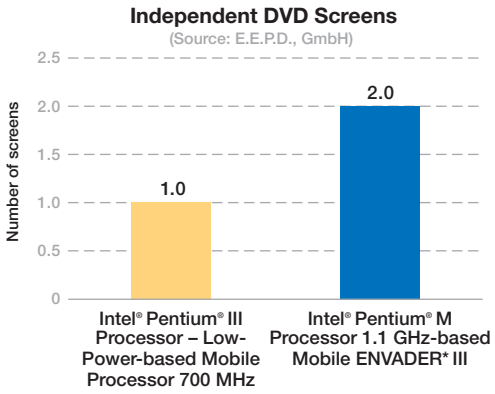
TELEMATICS

Electronic Equipment Produktion and Distribution (E.E.P.D. GmbH)

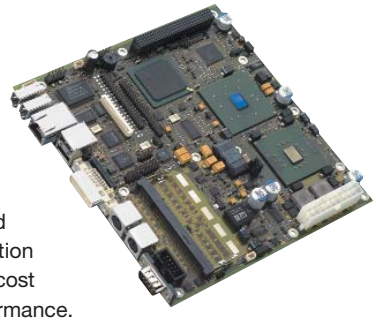
Mobile ENVADER* III

Application

Telematics (in-car computing)



Customer Experience Data: This benchmark involved an application driving dual screens and processing independent data streams. The system based on the Intel® Pentium® M processor 1.1 GHz and Intel® 855GME chipset delivered a significant performance improvement compared to the Intel® Pentium® III processor 700 MHz – Low Power. The Intel Pentium M processor-based system was capable of supporting dual screens without the addition of a second processor board.



Customer requirements

In telematics (in-car computing) applications, the demands of minimum form factor and maximum processing power often collide. Typical systems limit total board and processor power consumption to about 20 Watts, often at the cost of application processing performance. Today's telematics solutions require cost-effective and power-efficient solutions with the performance to handle applications including GPS navigation, Internet access, dual-screen DVD video, wireless networking, hands-free telephone communications, office productivity tools, camera interfaces, and combination CD/FM radio/MP3 players.

Intel® Pentium® M processor selection criteria

E.E.P.D. finds the Intel® Pentium® M processor and Intel® 855GME chipset an ideal platform for telematics applications. This processor/ chipset combination delivers the processing performance to handle simultaneous management and software encoding of multiple MPEG2 video streams while operating across a wide temperature range and providing dual independent display capability. In addition, the Intel Pentium M processor provides high efficiency with reduced power consumption and is compatible with the PC/104-Plus form factor.

www.eepd.de

Intel® Communications Alliance

A community of communications and embedded developers and solution providers

For more information visit: **www.intel.com/info/pentiumm**
or **www.intel.com/design/network/ica/index.htm**

UNITED STATES AND CANADA
Intel Corporation
Robert Noyce Bldg.
2200 Mission College Blvd.
P.O. Box 58119
Santa Clara, CA 95052-8119
USA

EUROPE
Intel Corporation (UK) Ltd.
Pipers Way
Swindon
Wiltshire SN3 1RJ
UK

ASIA-PACIFIC
Intel Semiconductor Ltd.
32/F Two Pacific Place
88 Queensway, Central
Hong Kong, SAR

JAPAN
Intel Kabushiki Kaisha
P.O. Box 115 Tsukuba-gakuen
5-6 Tokodai, Tsukuba-shi
Ibaraki-ken 305
Japan

SOUTH AMERICA
Intel Semicondutores do Brazil
Rue Florida, 1703-2 and CJ22
CEP 04565-001 Sao Paulo-SP
Brazil

Printed in USA. 0404/OC/DC/PP/8K ♻ Please Recycle 300947-003