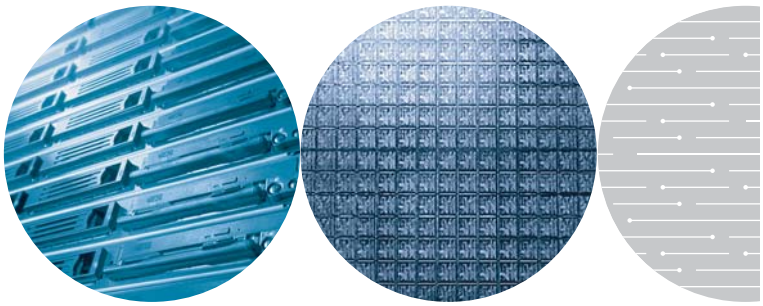
Application Note

HMP Software Performance Characteristics: Intel® NetStructure™ Host Media Processing Software Running on Intel® Processors

Intel in Communications



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Introduction

This application note shows the price/performance of Intel® NetStructure™ Host Media Processing Software (HMP Software) Release 1.1 for Windows*. It compares the software model and the cost advantages over implementing media processing solutions with conventional board-based systems. The computing platforms chosen for benchmarking purposes were off-the-shelf PCs and standard telecom computing platforms.

This publication is written for:

- Distributors
- System integrators
- Toolkit developers
- Value-added resellers (VARs)
- Original equipment manufacturers (OEMs)
- Telephony equipment manufacturers (TEMs)
- Service providers (SPs)

Executive Summary

HMP Software performs media processing tasks in general-purpose host processors in servers based on Intel® architecture without the need for special digital signal processors (DSPs). This application note describes tests conducted by Intel engineers to illustrate the performance characteristics of this software running in a Microsoft Windows operating system environment with Intel® Pentium® Processors. These tests show that for low- to medium-density installations, HMP Software offers significant cost advantages over traditional media processing boards without sacrificing performance.

Host Media Processing

Host media processing is a new way to deliver voice media processing in telephony applications by using the media processing capabilities of the host processors in off-the-shelf servers, eliminating the need for special telephony hardware based on DSPs.

HMP Software implements host media processing in a way that is optimized for Intel Pentium Processors. As a result, HMP Software can supply media services for building flexible, scalable, cost-effective, next-generation Internet Protocol (IP) media servers. Developers can more rapidly create advanced voice processing applications, while VARs and end users can significantly reduce the costs associated with installing, configuring, and maintaining these applications.

Intel Architecture

Intel has developed advanced features that make Intel architecture an ideal price/performance fit for advanced media processing. These include:

- **Streaming SMID Extensions 2 (SSE2) instruction set**, which allows software developers to have maximum flexibility to implement algorithms and provide performance enhancements when running software such as MPEG-2, MP3, and 3D graphics.
- **Intel® Integrated Performance Primitives (IPP)**, a highly optimized Intel software library for audio, video, imaging, cryptography, speech recognition, and signal processing functions and codecs.
- **Hyper-Threading Technology**, available on Intel Pentium 4 processors, is a form of simultaneous multithreading (SMT) that makes a single processor look like multiple processors to the operating system.

HMP Software Features

HMP Software provides a number of features and capabilities that enable quick, efficient, and cost-effective delivery of applications such as interactive voice response (IVR) and announcements voice mail and unified messaging servers, conferencing servers, and speech-enabled media server applications:

- **Uses built-in network interface card (NIC)** for IP connectivity.
- **Industry-standard H.323 and SIP protocol support** for call control.
- **H.450.2 supplementary services protocol support** for call transfer capability.
- **IP multicast (transmit only)**, which facilitates implementation of features such as announcements and listen-only conferences with large numbers of participants.
- **Low-bit-rate-coders** including support for G.711, G.723 and G.729.
- **Intel® Dialogic® Continuous Speech Processing Technology**, which allows easy migration from public switched telephone network (PSTN)-based speech recognition solutions on telephony boards to an HMP Software environment. Continuous Speech Processing Technology enhances existing speech technologies by providing real-time access to voice signals, allowing identification of human speech input and presentation of it to the speech recognition engine. The real-time functions include both echo cancellation and voice activity detection (VAD).

- **Scalability,** with up to 120 concurrent user sessions including a mix of voice, speech recognition, T.38 fax, and conferencing media processing resources per system. At least 50% of CPU and memory is available to an application.
- **Dual CPU configurations and Hyper-Threading Technology** enable greater densities per footprint of rack mount space.
- **High densities,** with up to 120 ports of IVR or conferencing per system.
- **T.38 fax support,** for compatibility with the most popular fax protocol for voice over IP (VoIP) networks.
- **Real-time media processing performance,** with HMP Software implemented as a Windows operating system kernel-mode driver running at real-time priority. HMP Software is also optimized for Intel Pentium 4 Processors.

Test Objectives

Traditionally, there has been no way to determine how HMP Software would perform in relation to on-board, DSP-type voice processing implementations. Intel conducted the performance tests described in this document to provide a guideline to the performance that can be expected of typical applications.

Intel engineers took standard voice coders and performed high-density call flow testing while taking detailed measurements of CPU utilization. Standard host platforms were used in the different tests.

The tests used standard voice coders (HMP Software supports G.711, G,723, and G.729), while measuring CPU utilization to determine how many channels of voice processing are possible while leaving 50% overhead available for developers' software applications.

The results of these tests should enable developers or solution providers to determine which types of systems they should develop or deploy, depending upon the number of channels desired. The results include a per-port pricing analysis based on standard pricing.

The market price fluctuations for the static priced platforms described in this publication will affect the conclusions drawn. However, the ratios and performance characteristics should remain valid.

Where noted, there was an assumption made to leave 50% of the CPU overhead for running real world applications. Developers should run their own benchmark testing with their applications loaded on top of HMP Software.

Test Results

Figures 1, 3, and 4 show the price/performance over different channel densities of configurations based on HMP Software as well as of a hardware-based configuration. Figure 2 shows the itemized price per port.

The HMP system pricings use HMP Software Release 1.1 on either a standard PC server or a blade server.

The hardware-based configuration shows the price per port of systems built and tested using configurations based only on voice boards installed in standard PC servers.

In all cases, the software model out-performed the hardware-based configuration. The key findings are illustrated in the different channel densities, showing that a standard 1U PCI server was the most economical up to the 960-port range, where HMP Software installed on blade servers could become more desirable.

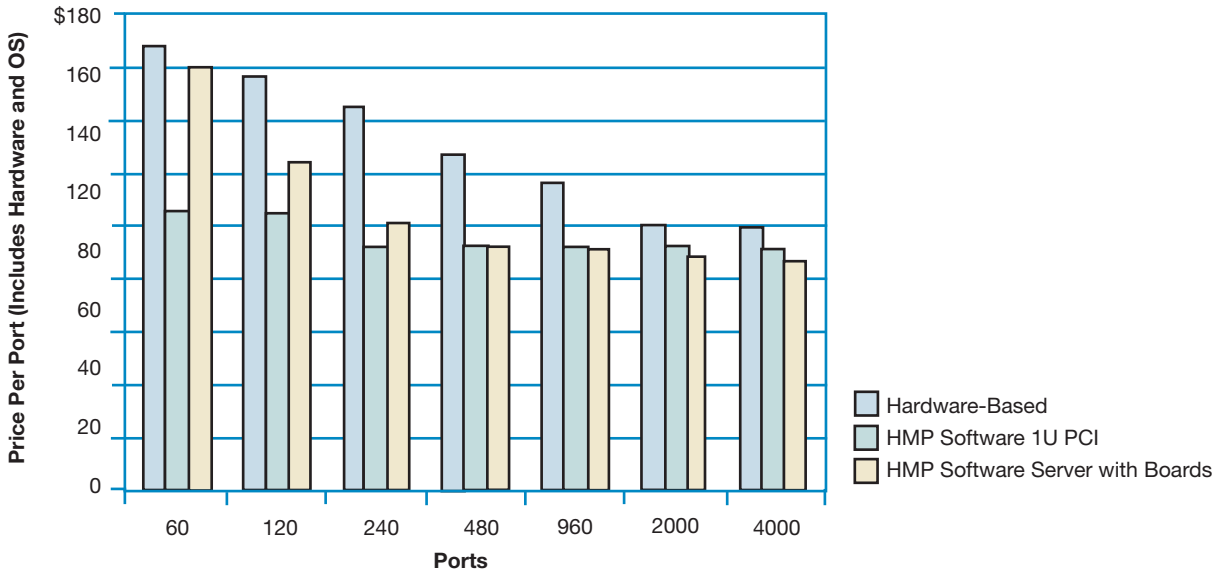

Figure 1. Price per Port

Price Per Port

Ports	Hardware-Based	HMP Software, 1U PCI	HMP Software Server with Boards
60	$169	$105	$159
120	$157	$104	$124
240	$144	$92	$102
480	$126	$93	$93
960	$117	$93	$91
2000	$100	$92	$89
4000	$100	$92	$88

Figure 2. Itemized Price per Port

Intel® Pentium® III Processor

Processor Speed	Bus Speed	Memory	OS	NIC Speed
1.3 GHz	133 MHz	512 Mb	Windows* 2000 Pro, Sp4	100

1 RTP channel of G.711 @ 30ms: 5.11 MHz	64 channels = 26.95% CPU load
1 RTP channel of G.711 @ 20ms: 6.16 MHz	64 channels = 31.71% CPU load
1 RTP channel of G.711 @ 10ms: 9.92 MHz	64 channels = 51% CPU load
1 RTP channel of G.723.1 @ 30ms: 23.41 MHz	16 channels = 31.21% CPU load
1 RTP channel of G.723.1 @ 20ms: 23.87 MHz	16 channels = 31.79% CPU load
1 RTP channel of G.723.1 @ 10ms: 25.25 MHz	16 channels = 33.45% CPU load
1 RTP channel of G.729 @ 40ms: 20.03 MHz	16 channels = 27.53% CPU load
1 RTP channel of G.729 @ 30ms: 20.57 MHz	16 channels = 28.05% CPU load
1 RTP channel of G.729 @ 20ms: 21.86 MHz	16 channels = 29.66% CPU load
1 RTP channel of G.729 @ 10ms: 25.30 MHz	16 channels = 33.39% CPU load
1 voice channel @ 30ms: 1.06 MHz	84 channels = 31.63% CPU load

All data was collected using HMP Software Release 1.1.

Figure 3. Pentium III Processor Performance of HMP Software Release 1.1 with Varied Sample Sizes

Figure 3 shows how different sample sizes of digitized voice influence port density using HMP Software. This scenario uses voice samples of three different sizes (10 ms, 20 ms, and 30 ms). Depending on the size of the G.711 sample being fed to the processor, there could be a fluctuation of anywhere between 27% and 51% CPU utilization based on 64 simultaneous channels.

Please note that this data is provided only to illustrate performance fluctuations based on the sample size. Also, since Hyper-Threading is not available on the Pentium III Processor, results are better using a Pentium 4 Processor with Hyper-Threading as shown in Figure 4. All data was collected using HMP Software Release 1.1.

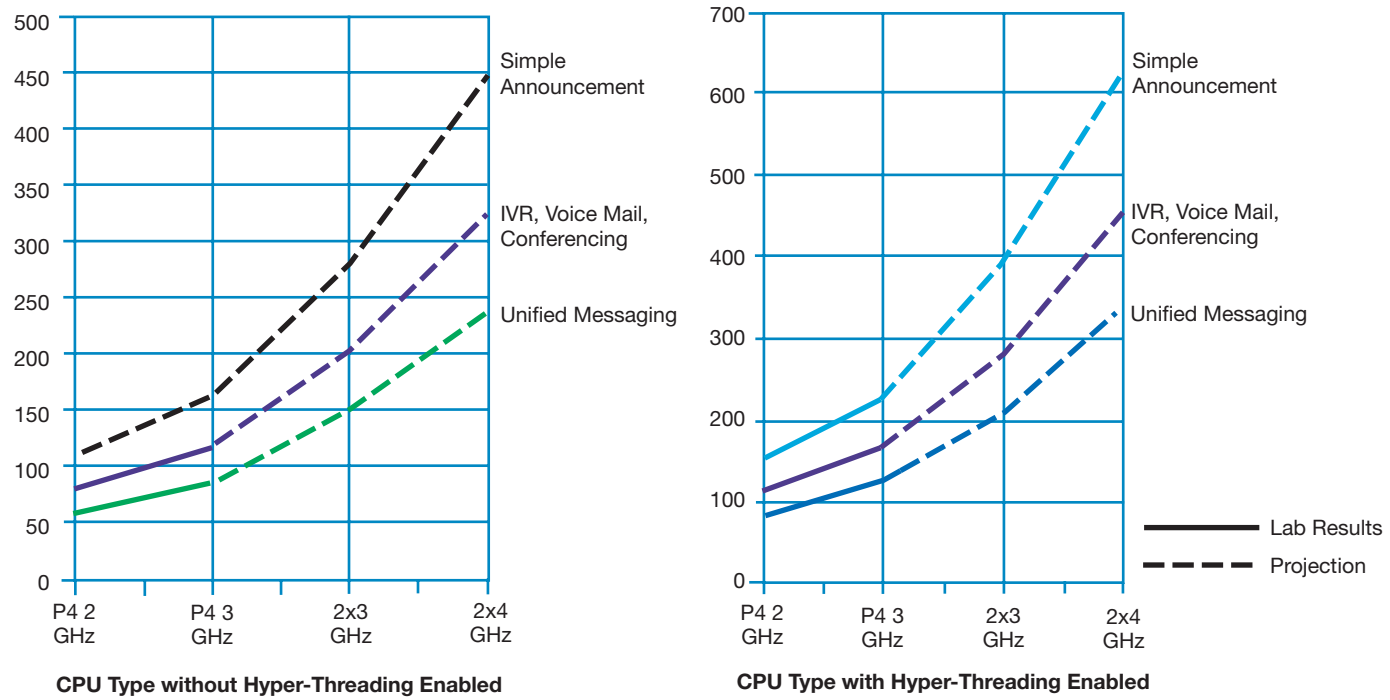

Figure 4. Projected Performance

Solution: IP Media Server, 60 Ports of Voice, Fax and Speech

Expense Item	Hardware-Based				
	Explanation	Cost	Explanation	Cost	Savings
Purchase of Building Blocks	DMIP6012E1P100($12563), D41JCT($1425) +PC($1300)	$15,288.00	HMP Software: 60 RTP, 20 transcoding, 60 call control, 60 voice, 32 CSP, 8 Fax PC @ $2400	$12.096.00	-$3192.00
Development System Inventory	10% of deployed ports 25% volume	$1,528.80 $3,497.00	Can scale down development system to 5% of deployed ports None	$604.00 $0.00	-$924.00 -$3497.00
Product Shipment	Ships boards from distributor to customer	$150.00	None HMP Software license sent electronically	$0.00	-$150.00
Installation and Configuration	3 Hrs @ $100.00	$300.00	1 hr @ $100.00	100.00	-$200.00
Spares	30% of cards buy DMIP301 board ($8921), ship and install ($250)	$4,196.40	None	$0.00	-$4196.40
Field Upgrade	Install ($250)	$9,171.00	Add 16 more HMP Software Ports	$1,400.00	-$7771.00
Total		$34,131.20		$14,200.00	**58.39%**

Figure 5. Cost of Ownership with IP Unified Messaging Example

Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing.

For more information on performance tests and on the performance of Intel products, visit http://www.intel.com/performance/ or call 1-800-628-8686 (in the U.S.).

Cost of Ownership for Multi-Technology Servers

Figure 5 shows how an IP unified messaging server could be cost-effectively deployed in an HMP Software model. The software model not only eases the burden of hardware-based upgrades, it also shows subatantial savings in the cost of ownership.

Please note that this is an illustration only. All examples use manufacturer's suggested retail price (MSRP).

Part Numbers and Pricing Used in Examples:

Item Market Name	MM#	Type of Resource	MSRP	Description
DMIPS10V11W	856585	Voice	$48.00	Runtime license for single port of Voice Resource for Intel NetStructure Host Media Processing Software for Windows Version 1.1
DMIPS10F11W	856587	T.38 Fax Termination	$112.00	Runtime license for single port of T.38 Fax termination resource for Intel Netstructure Host Media Processing Software for Windows Version 1.1
DMIPS10C11W	856591	Conferencing	$40.00	Runtime license for single port of Conferencing Resource for Intel NetStructure Host Media Processing Software for Windows Version 1.1
DMIPS10S11W	856590	Speech Integration	$40.00	Runtime license for single port of Speech (CSP) Resource for Intel NetStructure Host Media Processing Software for Windows Version 1.1
DMIPS10R11W	856589	RTP G.711	$40.00	Runtime license for single port of RTP G.711 Resource for Intel NetStructure Host Media Processing Software for Windows Version 1.1
DMIPS10E11W	856588	Enhanced RTP	$52.00	Runtime license for single port of Enhanced RTP (G.729a/b, G.723a) Coding Resrouce for Intel NetStructure Host Media Processing Software for Windows Version 1.1
DMIPS10I11W	856584	IP Call Control	$20.00	Runtime license for single port of H.323 and SIP Protocols for Intel NetStructure Host Media Processing Software for Windows Version 1.1

Figure 6. Part Numbers and Pricing Used in Examples

Echo Cancellation and CPU Bandwidth Implications

Some typical applications require the added use of echo cancellation. Typical applications that require this capability are speech recognition applications that use the echo-cancelled stream for feeding a pure speech stream to the processor for analysis. Such applications will likely consume additional CPU overhead, and performance results would be particular to that application. We have found in our labs that sample application overhead required an additional 30 MHz for echo cancellation.

Conclusions

HMP Software provides cost advantages in purchase, development, deployment, and post-deployment:

- **Purchase:** Developers pay only for the media resources they need.
- **Development:** Systems are more cost effective to develop and test.
- **Deployment:** No need to keep inventory and no need for physical installation. Shipping and import/export fees and regulatory approvals are all reduced.

- **Post-deployment:** Sparing costs are reduced or eliminated and systems require less space and power. Because the system is software-based, field upgrades are easier and can even be handled remotely. Gateways in the architecture help to offload customer issues. And overall system availability improves, since the hardware of deployed systems "softens" as software "hardens" over time.

As the benchmark results show, software-based media processing using HMP Software Release 1.1 is more cost effective than hardware-only configurations, both on a cost-per-port basis and in the cost of deployment and maintenance.

At 480 ports, the costs are the same for standard 1U PCI servers. Above 960 ports, is becomes more cost effective to move toward specialized telecom servers.

Moore's law will also produce more cost-effective standard CPU price/performance. With this in mind, HMP Software becomes a compelling development and deployment platform.

For More Information

Intel Telecom Products:
http://www.intel.com/design/network/products/telecom/index.htm

HMP Software Reference Guide:
http://resource.intel.com/telecom/support/appnotes/an03002/1931-01.pdf

Definitions and Acronyms

HMP	Host media processing
IP	Internet Protocol
IPP	Intel Integrated Performance Primitives
IVR	Interactive voice response
NIC	Network interface card
OEM	Original equipment manufacturers
PSTN	Public switched telephone network
SMT	Simultaneous multithreading
SP	Service providers
SSE2	Streaming SMID Extensions 2
TEM	Telephony equipment manufacturers
VAD	Voice activity detection
VAR	Value-added resellers
VoIP	Voice over Internet Protocol

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