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The Dual-Core Challenge

A Dual-Core processor benchmark study and the advantages of Dual-Core AdvancedMC processor modules over DSP modules to power multimedia messaging services

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Executive Summary

This paper intends to validate two major points: one is to demonstrate via a benchmarking study that Dual-Core Intel processing technology for mobile multimedia network systems can achieve the best performance / cost-efficiency ratio over other CPU platforms; and, as a result of the test findings, that Dual-Core-based Advanced-MC processor platforms are more advantageous than DSP (Digital Signal Processing) modules with respect to building media servers that support new subscriber services such as multimedia messaging, among others. The benchmark study consists of multimedia performance tests conducted by Kontron partner, VoiceAge Networks, whereby Dual-Core Intel CPU technology was measured against other CPU platforms in the processing of audio/video RTP streams using MPEG4, H263 and AMR-NB codecs.

The Dual-Core Challenge

By Sven Freudenfeld

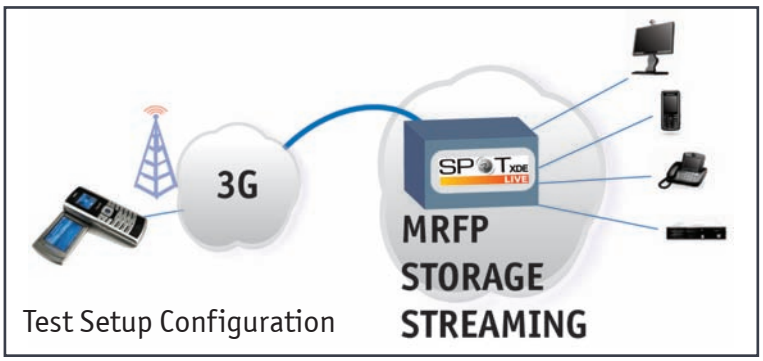
For mobile network operators and content service providers, real-time multimedia applications such as audio and video streaming, video telephony, video mail, video conferencing, video ringback tone, and mobile TV, among many others, offer attractive new market opportunities.

Media server vendors and video application developers are at the other end, looking for a real-time transcoding engine that can be easily integrated as a building block into their product portfolio. No matter which end they are on, their revenue will be positively impacted by a real-time content adaptation engine that ensures an optimal subscriber experience.

With growing subscriber bases, network deployments need to include new processing systems at the Media Server level that can handle the compute-intensive processing of a high number of multimedia streams in the smallest footprint, while minimizing any thermal issues.

What is very encouraging for design engineers is the arrival of Dual-Core Intel® technology, which provides increasingly better performance per watt ratios than what is currently available on the market today.

VoiceAge Networks, a solution provider in the emerging rich media content adaptation market, has conducted a benchmark study of the performance of an Intel CPU platform that consists of two Dual-Core Intel® Xeon® processors, pitted against two other CPU platforms – a Dual Intel Xeon® (single-core) platform and a Dual AMD Dual Core Opteron. The following is an overview of this study.



Test Setup Configuration

Dual Core Performance Test

The performance statements herein measure the maximum number of streams that can be transcoded and streamed live. Whereas performance tests can often serve as a good metric for comparing systems, it is important to note that several variables—even if slightly changed—may impact the results. For transcoding, these include:

- Input media type, format, codec, and size (bit rate, frame rate, etc.);
- Output media type, format, codec, and size (bit rate, frame rate, etc.);
- Interface used, if this is included in the duration of the measure;
- Hardware.

Test Setup

The tests were conducted with a streaming server application called SPOTxde Live® supplied by VoiceAge Networks, and a client application that can request multiple streams. The streams are requested by the client to SPOTxde Live which asks a Streaming Server to start the feed, then SPOTxde Live transcodes/streams the audio/video.

A preface to live multimedia content adaptation for mobile networks

The SPOTxde Live content adaptation module is a rich-media content adaptation engine providing real-time transcoding capabilities for audio and video streams. The real-time throughput, low latency, speed, flexibility, scalability, compatibility, and effectiveness of the real-time content adaptation engine provides subscribers a live, rich-media experience.

Real-time content adaptation is a key technology for realizing the adaptation of rich media audio and video streams in real time. The proliferation of video streaming-based services requires transcoding technology to adapt the bit rates and formats of the video streams to the end-users' devices. For instance, a Content Provider who streams a simple video clip from a newly-released movie to devices with different video capabilities will need to convert both the audio and video format and the bit rate for each device, ensuring that the converted stream fits both network and device requirements.

Test Hardware

Hardware used includes:

Dual-Core Intel® Xeon® processors
CPU : 2 x Dual-Core Intel Xeon @ 2 GHz each
Chipset: 667MHz Bus Intel E7520
Memory : 1GB

Dual Intel Xeon®
Server Type : HP Proliant G4 DL360
CPU: 2 x Xeon @ 3.4 Ghz
Memory: 2GB

Dual Opteron
Server Type : IBM Blade LS20 8850
CPU: 2 x Dual Core Opteron @ 2.2Ghz
Memory : 4GB

To calculate the maximum number of streams we examined the stability of the stream dataflow and the load (as in the Linux system load) of the machine. If the dataflow became unstable or the load started to increase in a sustained manner we rejected this maximum. So the maximum number of streams detailed here represents a stable dataflow and a stable load so we can be confident that these numbers represent what the system could do in a real case scenario. — VoiceAge Networks

Test Results

The table below illustrates the maximum number of streams supported for each platform. Note that in the far-right columns, the numbers represent the maximum audio/video streams supported (1 stream contains both audio and video unless there is only video or audio), and even if the streams have the same input and output codec, they are decoded and encoded.

Table 1: Test results comparative table

Media Type	Input	Output	2 x Dual-Core Intel® Xeon®	Dual Xeon	2 x Dual-Core Opteron
Config. No. 1 Audio/Video	Audio: • AMR-NB • 12.2 kbps Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	Audio: • AMR-NB • 12.2 kbps Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	43	30	30
Config. No. 2 Audio/Video	Audio: • AMR-NB • 12.2 kbps Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	Audio: • AMR-NB • 12.2 kbps Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	38	26	31
Config. No. 3 Audio/Video	Audio: • AMR-NB • 12.2 kbps Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	Audio: • AMR-NB • 12.2 kbps Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	40	32	37
Config. No. 4 Audio/Video	Audio: • AMR-NB • 12.2 kbps Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	Audio: • AMR-NB • 12.2 kbps Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	42	32	40
Config. No. 5 Video	Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	58	51	59
Config. No. 6 Video	Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	60	44	42
Config. No. 7 Video	Video : • H263 • QCIF (176x144) • 15 fps • 64 kbps	Video : • MPEG-4 • QCIF (176x144) • 15 fps • 64 kbps	55	50	49

VoiceAge Networks' SPOTxde LIVE addresses the barriers to seamless real-time delivery of mobile rich-media data services. It ensures interoperability between the source of the live feed and the receiving devices (mobile phones, PDAs, and IP terminals), as well as across networks that adhere to different standards. It provides real-time, high-density transcoding capabilities for an ever expanding set of audio and video codecs.

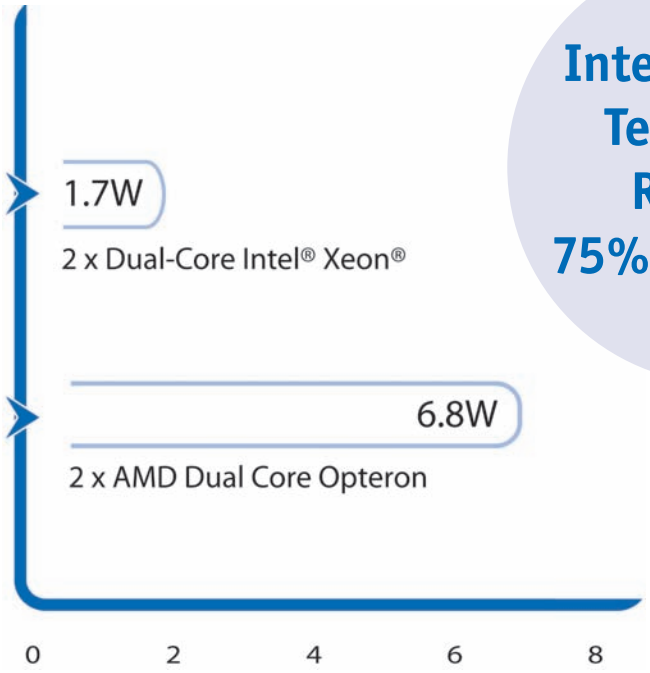
It enables a multitude of simultaneous sessions to be run in parallel, unprecedented rapid session setup, minimal latency, real-time throughput, and error resilience while maintaining the fidelity and integrity of the original media, ensuring that each end-user's experience is notably enhanced.

When Mobile Network Operators and Content Providers deploy the SPOTxde Live content adaptation module, it relieves them from the painstaking manual editing process for hundreds – if not thousands – of devices who can now have access in real-time to video streams, as the risks arising from interoperability issues are automatically neutralized by the platform.

Test Analysis

If we extrapolate from the test results, we can see that even with a minimum hardware configuration of only 1 GB of memory compared with 2 GB and 4 GB of memory respectively for other two platforms, then the Intel Dual-Core Xeon CPU platform simply outperforms in

Figure 1: Average Watts per Stream



Intel Dual Core Technology Requires 75% Less Power

Table 2: Total Power Consumption

	2 x Dual-Core Intel Xeon	Dual Xeon	2 x Dual Core Opteron
	1GB	2GB	4GB
CPU Power	31W/CPU	55W/CPU	95W/CPU
Chipset*	12W	12W	-
Memory**	4.33W	8.66W	78W
Total power	78W	131W	268W

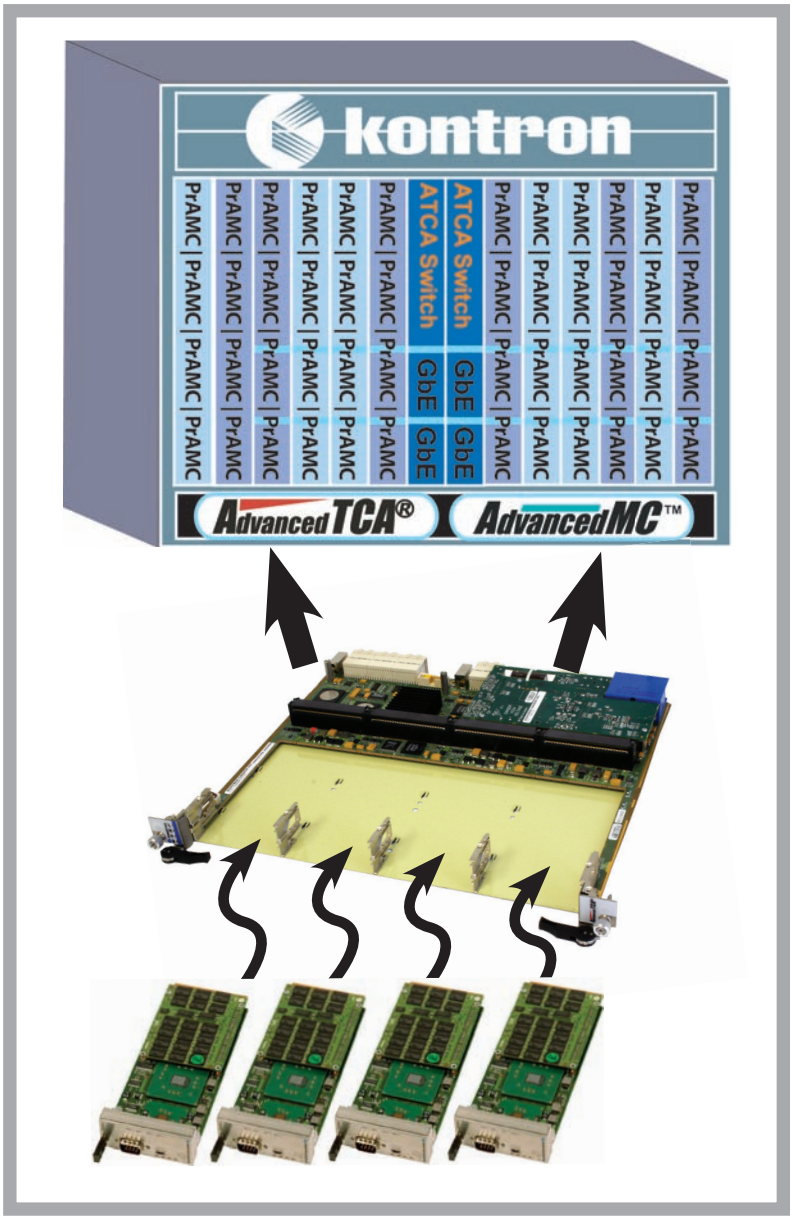
* Based on Intel MCH E7520 Server Chipset chipset for Dual Core Intel Xeon and Xeon CPUs; AMD Opteron integrates its memory chipset.
** Features DDR2 for Intel-based platforms and DDR for AMD platform.

Table 3: Total Watts / Stream — Less is more

	2 x Intel Dual Core Xeon	Dual Xeon	2 x Dual Core Opteron	Intel DC Xeon vs. Opteron
	1GB	2GB	4GB	
Config. No. 1	1.8	4.4	8.9	80%
Config. No. 2	2.1	5.0	8.6	76%
Config. No. 3	2.0	4.1	7.2	73%
Config. No. 4	1.9	4.1	6.7	72%
Config. No. 5	1.4	2.6	4.5	70%
Config. No. 6	1.3	3.0	6.4	74%
Config. No. 7	1.4	2.6	5.5	75%

the case of streaming both video and audio.

In the first audio/video test, as an example, we see that the Dual-Core Intel® Xeon® platform processed 43 concurrent streams, a 30 percent increase in performance over the Dual Xeon and the AMD Dual Core Opteron. One could transfer this kind of performance onto an AdvancedTCA processing node and possibly integrate 12 such nodes in a 14-slot AdvancedTCA system. This would result in a total of 516 concurrent streams or channels per system, realizing a highly dense processing system within a 12U footprint.



Power consumption per stream

Equally critical to MNOs is how much power is needed for various performance hungry applications, which essentially has a direct effect on operating costs.

In comparing the average amount of wattage required (Table 2) for these three CPU platforms plus the wattage of memory and chipsets, we see that the two Dual-Core Intel® Xeon® processors each have a typical power consumption of 31W, compared to 55W for the Intel Xeon, and 95W for each of the AMD Dual Core Opterons. Looking at the benchmarking study, the results show that in nearly every testing scenario, the Dual-Core Intel® Xeon® processors required 70 percent to 80 percent less wattage per transcoded stream than the two Dual AMD Dual Core Opterons.

This has tremendous ramifications with respect to keeping power costs down for operators who want to deploy many of today's new mobile applications. Convert that kind of savings over the course of a year, and MNOs can expect an optimal return on investment.

If designed on an AdvancedTCA system, Dual-Core Intel® Xeon® processors would successfully contribute towards the requirement for each node to maintain a power envelope of 200W. This has recently been achieved with the launch of the Kontron AT8020 AdvancedTCA node board.

Porting Intel Dual-Core onto AdvancedMC modules

However, one could further increase the processing density and cost efficiencies by taking an AdvancedMC processor module approach. This would entail using an AdvancedTCA carrier that supports four (4) single-width, full (or mid-) -size AdvancedMC processor modules, each one populated with one Dual-Core Intel 64-bit processor and up to 4 GB of memory. The potential result is essentially a doubling of performance per node, from 43 to 86 or more, concurrent streams processed. Going back to our 14-slot AdvancedTCA system, this could conceivably equate into 1,032 concurrent audio/video channels streamed across 12 slots.

Dual Core AdvancedMC versus DSP modules

Examining the design options available in the development of a transcoding platform, say a Media Resource Function Platform (MRFP), designers will look at performance/cost ratios, among other criteria, to make a final selection.

An open standard solution based on AdvancedMC

Expanded Mobile Services
Powered by Open Modular AdvancedMCs

Person to person (P2P)

Video telephony:	Enables mobile end-users to instantly add video to their phone calls – across different networks and to any device
Video mail:	Enables voice mail with video capabilities
Video conferencing:	Allows multi-user wireless video conferencing on mobile phones and landline video phones
Video ringback:	Video content that incoming callers see while they wait for their calls to be answered
Push To Talk/Share:	Allows users to call people or exchange media by pressing just a single button on their device

Application to person (A2P)

Mobile radio:	Listen to your favorite radio channel in real time on your mobile device
Broadcast news/ weather reports:	Watch real-time streamed special news reports, weather warning alerts, etc.
Live TV:	Watch your favorite TV program in real time on your mobile device

processor modules designed with Intel Dual Core CPUs, bundled with transcoding software such as that provided by VoiceAge Networks, would be much more cost-effective, while still achieving the same performance if not better than proprietary-based systems fully loaded with DSP modules used to achieve the same or similar functionality.

The hardware costs alone are quite different. A DSP module is three times the cost of an AdvancedMC processor module. And, as the benchmark study illustrates, less memory is needed for the Dual-Core Xeon to process streaming video which further helps reduce costs.

More importantly, an open standard AdvancedMC processor module is much more flexible in that it can be re-used for other compute-intensive applications. Conversely, a DSP module is used for all sorts of media processing but is essentially tied to its own DSP functionality and its limited support of codecs.

So in comparison, an AdvancedMC processor module will generate a quicker and better return on investment, plus give mobile network operators the much needed flexibility to swap-in or swap-out any subscriber service with negligible risk.

The ancillary benefits of the AdvancedMC open standard cannot be ignored – ease of manageability through IPMI; High Availability (hot-swap; hot-plug); low-power, ultra-dense processing; lower operating costs; and most significantly, enables greater equipment consolidation to dramatically reduce the need for surplus network 'real estate'.

To replicate the above example of the live transcoding application without open modular building blocks, one would need to deploy both a DSP farm of Media Gateways and a separate set of application servers to approximately achieve the same result. The general costs to deploy this as a carrier-grade solution are prohibitive.

An Intel-based Solution

Intel dual-core processors have closed the performance gap, as more applications are being designed to take advantage of hyperthreading and the new Intel microarchitecture technology. Going back to the AdvancedMC processor module, a proposed product would be to design one with either the Intel® Core™ Duo processor T2400/T2500 or the Intel® Core™2 Duo processor T7400, in conjunction with the space saving Intel 3100 chipset which integrates memory and I/O controller hub in one chip.

One of the new advances of the Core Duo offering is smart cache technology, where each of the two CPU cores can intelligently access the same cache. It increases performance and saves on power compared to conventional architectures which would require having to go out the front side BUS. Other enhancements include additional power savings by ensuring there is a dynamic and independent power control over each core.

As for the Core 2 Duo, there are other new features on top of what Core Duo offers, such as extending the cache out to a full 4MB at 64 bits, and a new feature called wide dynamic execution, basically consisting of wider pipes and deeper buffers for a greater increase of

instructions.

Summary

Mobile network operators (MNOs) typically concern themselves with obtaining the most performance and the greatest flexibility at the lowest cost. While DSP products are widely mainstream, they are becoming less attractive to newer general purpose processors that provide support for new multimedia, mobile applications. New ground is being broken with Dual-Core Intel development — either as single or dual processors — which are being incorporated with the roll-out of new open modular systems based on AdvancedTCA and AdvancedMC hardware configurations.

With more software applications taking advantage of open standard, off-the-shelf platforms, MNOs will enjoy exceptional operating savings, faster ROI on equipment expenditures, and exercise the option to reuse equipment for other purposes while still maintaining more space-efficient networks. K

About VoiceAge Networks

VoiceAge Networks is a leading solution provider in the rich media content adaptation market, addressing the impediments to the seamless delivery of mobile messaging and content downloads. Its SPOTxde Media Platform provides an ideal combination of software applications that bridge the widening gap created by a proliferation of devices, protocols, and formats, and between the Internet and mobile networks. Already deployed by leading content providers and mobile operators worldwide, SPOTxde Server can be implemented as a Single Point of Transcoding to address all possible content adaptation needs, allowing virtually all devices (including legacy models) to participate in revenue generating value-added services while providing an optimized user experience. VoiceAge Networks is based in Montreal, Canada with points of presence in the U.S., Europe, and Asia, and has proudly chaired the OMA sub-committee for the Standard Transcoding Interface (STI) since 2004. For more information, visit www.voiceagenetworks.com.

About Kontron

Kontron shortens the application design process by ensuring that each open modular building block is fully interoperable and designed to be both the right technology and the right architecture in mind to suit any development needs. Kontron pre-integrated open modular solutions are customizable and also feature options for best-in-class carrier-grade OS and middleware software solutions. Kontron offers a diverse selection of AdvancedTCA processor, switch and carrier platforms, plus complementary field-replaceable AdvancedMC processor, storage, and I/O modules.

Kontron employs more than 2,300 people worldwide and has manufacturing facilities in Europe, North America, and Asia-Pacific. The company is listed on the German TecDAX 30 stock exchange under the symbol "KBC". Kontron is a Premier member in the Intel® Communications Alliance. For additional information on Kontron, please visit www.kontron.com/atca.

About the Intel® Communications Alliance:

The Intel Communications Alliance is a community of communications and embedded developers and solutions providers who share a common vision on the convergence of computing technologies. The member companies within the Alliance are committed to the development of modular, standards based building blocks, platforms, and solutions based on Intel technologies, processors, products, and services. The availability of these standards-based modular building blocks and solutions offer the market greater choice, faster time to profit, and the opportunity to innovate using modular building blocks from multiple levels of integration - silicon, software, boards and complete systems. For additional information on the Intel Communications Alliance, visit : www.intel.com/go/ica

AUTHOR'S BIO

Sven Freudenfeld is responsible for North American Business Development for the Kontron AG line of AdvancedTCA, AdvancedMC, MicroTCA, and Pre-Integrated Solutions. Sven possesses more than 15 years of experience with voice, data, and wireless communications, having worked extensively with Nortel Networks in Systems Engineering, Sanmina-SCI in Test Engineering, and Deutsche Telekom in Network engineering. Sven holds an electrical engineering degree from Germany, and is also Chair of the CP-TA marketing workgroup focusing on the interoperability of COTS standard building blocks.