Updated information on DAW performance & compatibility with motherboards/chipsets featuring PCIe

Intel chipsets

Intel 975X
The Intel 975X chipset is having the same Southbridge (ICH7R) as the 955X. The changes are primarily represented by a modified Northbridge (82975X) with support for 800/1066 MHz FSB (Extreme Edition) and technology to split the primary graphic card's connection into two x8 PCIe slots.

Intel is to release its new generation of single-core and dual-core CPUs based on 65 nm process technology, code names Cedar Mills (Intel 6xx) and Presler (Intel 9xx), in early 2006. While being new it is noted that this represents the last revision of the Pentium 4 architecture to be released. Approximately another 6 months down the road Intel will release its new CPU generation of single-core and dual-core CPUs, code names Woodcrest (server), Conroe (desktop), and Merom (mobile).

According to information the Presler and Cedar Mill CPUs will only be backward compatible with the Intel 955/945 chipsets and related motherboards. The Presler family of CPUs will have two independent processing engines on the same processing substrate whereas the Cedar Mills will feature one processing engine. The Presler clones will come with 2,8/3,0/3,2/3,4 GHz clock frequency, 800 MHz FSB (the Extreme Editions run at 1066 FSB and adds Hyper-Threading technology to the dual-core CPUs), and 2 x 2 MB cache. In fact, the increased cache size, up 2 x 1 MB, is the main architectural difference from Intel's previous dual-core CPU (Smithfield).

From a performance point of view it can be predicted that the Presler and Cedar Mill will mainly differ from previous Intel CPUs, of equivalent architecture and clock frequency, as to what extent the larger cache size has significant impacts (core-to-core latency and L2 cache latency can be disregarded as they are in the same ball park, Smithfield vs. Presler).

For DAW users it may be just as interesting to note that Intel's move to 65 nm processing technology means reduced power consumption and less capacity needed for CPU cooling and case ventilation. However, as long as the basic Pentium 4 CPU architecture is not changed the estimated thermal power dissipation, TDP, will not reach as low as with the current AMD 64 CPUs despite the reduced size.

For obvious reasons, as of this writing, it is too early to know how well the new Presler and Cedar Mill CPUs, will run in DAW configurations.

955X
This chipset as implemented by Asus (Asus P5WD2 Premium), Intel (D955) and Gigabyte (GA-8I955X Royal) is reported to work well with pro audio PCI/FW soundcards (Soundscape, RME HDSP PCI/Fireface 800, Lynx, etc.. There are also user reports confirming compatibility with UAD-1, Creamware Pulsar, Soundscape

Mixtreme and TC PowerCore DSP PCI cards. These mainboards are further reported to work well with PCI soundcard/DSP cards seated directly to on-board PCI slots.

Users with the Asus P5WD2 may have to adjust the Vcore setting in the BIOS as this mainboard is known to have relatively high Vcore settings by default which may result in high CPU temperatures under load and increased thermal risks. Users with dual-core Intel Pentium 4 CPUs (specifically the D830 and D840 series with high heat dissipation values under load) are further strongly advised to install heatsinks/fans with improved heat dissipation capacity compared to stock units (including the additional support of extra intake/outtake case fans).

Its is further recommended that users install the latest Intel Matrix Storage Manager with improved SATA/RAID/AHCI support if you are using Intel 9xx Express chipsets and experience pops/clicks in playback mode.

Stress test data:
The Asus P5WS2 Premium, in combination with Intel D830 @ 3.75 GHz and RME Fireface (using on-board TI FW controller), is by user reported to run the Thonex II stress test (Nuendo(Cubase) down to some 64 samples latency setting without pops/clicks and with 75-80% CPU idle/load usage. The Intel D820 @ 2.8 GHz is reported to run the same test down to 128 samples latency settings at approx. 90% CPU load with M-Audio FW 410 soundcard.

The Gigabyte GA-8I955X Royal is reported to make the original Thonex/Nuendo 3 stress test down to 128 samples latency setting at 53-62% CPU load without pops/clicks with D830 @ 3 GHz Pentium CPU, dual channel DDR RAM, Matrox P650 PCIe video card, and Presonus Firepod/RME Fireface 800 soundcards.

Thonex/Nuendo 3 stress test data with Pentium D820, Intel 955X chipset, and either M-audio 410 FW or RME MADI PCI soundcards, show similar performance irrespective if PCIe Geforce 6800 or ATI X300 video cards were used. This indicates that the PCI bus and its effective bandwidth on this 955X-featured mainboard were not affected by low- or high-end PCIe video installed.

The Intel D820 @ 2.8 GHz is reported to run the Sonar 3 stress test with Sonar ver. 4.04 down to some 2 ms latency setting at 70% CPU load with E-MU 0404 PCI soundcard/driver without pops/clicks.

915P/925/945X
These chipsets and related motherboards may work sufficiently well for DAW purposes (click-free Thonex stress test results down to 6 ms latency setting) if combined with low-powered PCIe video cards such as ATI X300 or Nvidia 6200. With increasingly more powerful PCIe cards installed, the PCI sub-system including Firewire, will be taxed at the expense of effective PCI bandwidth and streamed audio I/O.

It is recommended that users install the latest Intel Matrix Storage Manager Intel Matrix Storage Manager with improved SATA/RAID/AHCI support if you are using Intel 9xx Express chipsets and experience pops/clicks in playback mode.

There are user reports of "Task 330 errors" with Intel 915GAV/945 chipsets and Sydec soundcards.

915PM
Compatible laptops based on DAW user recommendations: Acer TravelMate 8104WLMi, Clevo M560, Toshiba Satellite M60-164, Toshiba Satellite M40x-126(129), Samsung X20 XVM 1600 III, Sony VAIO vgn-s3xp, etc. (check DAW hardware forums and the RME forums recurrently for latest users' inputs).

Stress test data:
The Intel 915 PM Express chipset (Sonoma) with 533 MHz FSB, PCI Express x16 and DDR2 support, Centrino @ o/c to 2.4 GHz, PCIe 6600 go video, and M-audio 410 FW soundcard, is reported to run the Sonar 3 test down to 1.5 ms at 55% CPU load. The same laptop and hardware configuration is stated to run the Thonex/Nuendo 3 stress test without pops/clicks down to 128 samples latency setting at 90% CPU load. This chipset with integrated PCIe support does not seem to differ in stress test performance whether high-end or low-end PCIe video cards are used or not.

945GM
This represents the latest mobile chipset from Intel. It adds 667 MHz FSB, DDR2-667 support, and improved power saving technology compared to the previous Sonoma chipset. It further adds support for the Yonah dual-core mobile CPU based on 65 nm process technology. For DAW users on the run or dependent on mobile solutions, the 945GM chipset plus Yonah dual-core CPU represents a very promising step forward in technology.

As of this writing, it is too early to elaborate on performance results and any compatibility-related issues as the first Intel Core Duo powered notebooks have just been released. Irrespective chipset and/or CPU technology it is principally recommended to search for notebooks featuring compatible CardBus technology (PCMCIA type II) if you use the RME Digiface, Multiface or RPM as there are no current plans by RME to support the ExpressCard interface.

Nvidia chipsets

Single-CPU nForce4 desktop (Ultra, SLI, SLI x16)
The single-CPU, desktop versions, of the nForce4 chipsets, in combination with single-core AMD 64 CPUs, are still reported to have the original PCI to PCIe interconnectivity issue by which minimum latency settings without pops/clicks in Thonex audio stress tests are significantly increased and/or number of VSTi/samples reduced compared to the nForce3 @ socket 939 chipset.

However, it has recently been demonstrated via audio stress tests that the single-CPU nForce4 chipsets perform almost as good down to some 256 samples latency setting (Thonex/Thonex II) when used in combination with dual-core AMD 64 X2 CPUs. At lower latency settings this combination still cannot run the Thonex test without pops/clicks and/or have higher CPU loads than the nForce3.

One way to eventually overcome the PCI to PCIe interconnectivity issue with present incarnations of single-CPU nForce4 chipsets would be to connect soundcard Firewire interfaces via a FW to PCIe card. By doing so, the Firewire soundcard is separated from the PCI bus and I/O streamed audio data is rather channeled via the PCIe bus. Some user reports indicate promising results (see here).

Stress test data:
The Gigabyte K8NXP-SLI, with AMD 64 4400+ X2 and RMD HDSP 9632 PCI soundcard, is reported[1] to not run the Thonex II/Cubase test below 256 samples latency setting without pops/clicks. Other user reports suggest that the desktop nForce4 plus AMD 64 X2 combination (e.g. Asus A8N-E, Asus A8N SLI, Gigabyte GA-8N-SLI, Tyan K8E S2865) can run the Thonex stress test equally well down to 256 sample latency settings but showing increased performance penalties at lower latency settings vs. the nForce3/VIA K8T800 chipsets.

It is noted that single-CPU nForce4-Sonar 3 stress test data, with less demand put on the DAWs sub-systems, show good latency setting vs. CPU load performance (see here).

nForce4, DSP PCI card, and AMD 64 X2 compatibility
Presently there are no known work arounds to issues with choppy audio and/or CPU spikes with the combination of UAD-1 PCI, AMD 64 X2 and nForce4 desktop chipsets.

However, there are a few user reports demonstrating good but not stellar performance down to some 6 ms latency setting, if the UAD-1 DSP host is moderately loaded and the mainboard's CPU is not maxed out. These reports are based on a combination of Asus A8N-E, AMD 64 4200+, 2x UAD-1s PCI and FW soundcard connected to the PCIe bus via a FW to PCIe card (to maintain audio I/O on the PCIe bus separated from the PCI bus).

The TC PowerCore mk II PCI does not have any compatibility issues with the combination of nForce4 desktop chipset and AMD 64 X2.

Dual-CPU nForce4 Professional (2200 + 2050 chipsets)
This dual chipset combination is used on dual-CPU (Opteron 2xx) mainboards targeted for the server-/workstation segment. Pro DAW users with high demands on simultaneous track counts at high sampling frequencies, VSTi/sampling capacity, video recording/rendering capacity, etc., are likely to find features such as dual dual-core CPUs, separate PCI/PCI-X/PCIe buses, NUMA support, etc. of great value.

DAW stress test data (Thonex, Thonex II) indicates that the nForce4 Professional chipset does not have the PCI-PCIe interconnectivity issue as reported with the nForce4 desktop chipsets.

[1] RME Forum; 2005-11-17

The following motherboards are recommended and known to be compatible with RME soundcards: Tyan Thunder K8WE (S2895) and Supermicro H8DCE. Supermicro has recently released a new series of motherboards featuring the new AMD 8132 PCI-X hub and separate 64-bit 100/133 MHz PCI-X buses/slots (H8DCi and H8DC8). Gigabyte has also released an AMD 8132-featured mainboard with similar PCI-X and PCI specs (GA-2CWEH). These new mainboards with AMD 8132 PCI-X hubs have though not yet been congruently tested for DAW usage.

It is not yet known if the new AMD 8132 PCI-X hub is compatible with UAD-1s. The new PCI-X hub though apparently does not have errata found on the 8131 – e.g. such that (1) the fairness algorithm does not function properly according to the HyperTransport I/O specs leading to uneven bandwidth distribution under specific conditions, and (2) that the PCI-X tunnel links do not function properly at 800 MHz.

The Tyan Thunder K8WE comes with 1x PCIe x16, 4x SATA II, 1x Gigabit LAN, 2x USB 2.0, 1x IEEE 1394a, 1x 32-bit PCI 33 MHz directly connected to the nForce 2200 chipset. Additionally, directly connected to the nForce 2050 chipset is 1x PCIe x16 and 1x Gigabit LAN. The mainboard also features a PCI-X hub (AMD 8131) with two separate PCI-X buses (64-bit/100 MHz [slots 4 & 5]/133 MHz [slot 6]) communicating via the primary CPU. It can also be ordered with integrated SCSI (connected to the PCI-X bridge B). There is a known AMD 8131-multiple UAD-1 issue such that CPU load may be high with multiple UAD-1s used with high host CPU loads – it is therefore recommended to run multiple UAD-1s via a Magma Expansion chassis. The extent of this issue varies according to user reports (see Nuendo's Harware Forum for more details).

The H8DCE has 8x USB 2.0, 4x SATA II, 3x PCI 33 MHz slots, 1x PCIe x4, 1x PCIe x16 and 1x Gigabit LAN directly connected to the nForce 2050 chipset. In addition, another set of 8x SATA II, PCIe x4, PCIe x16 and 1x Gigabit LAN are directly connected to the nForce 2200 chipset. It does neither feature any PCI-X buses/slots nor on-board IEEE 1394a/b controller. There is presently a PCI resource allocation issue reported with the PCI bus/PCI 33 MHz slots on the H8DCE in combination with specific PCI RAID and SCSI cards. This may be correlated with the finding that UAD-1s do not work with the on-board PCI slots whereas it works well via an add-on Magma expansion chassis. According to this user report, adjustments of PCI Bus timing via a utility tool may make the UAD-1s workable with the on-board PCI slots. TC PowerCore PCI mk I and II though seemingly work if directly connected to the on-board PCI slots at default PCI bus settings.

Stress test data:
The Tyan S2895 is reported to run the Thonex II test with 2x Opteron 275 (dual-core), 4 GB ECC RAM and 2x RME MADI down to 1,5 ms latency setting at 45-48% CPU load (play) without pops/clicks.

The combination of Supermicro H8DCE, 2x Opteron 270 (dual-core), 4 GB ECC RAM, 3x UAD-1, 1x TC PoCo PCI mk II, 1x RME MADI [all PCI DSPs and RME soundcard connected via a Magma Expansion chassis] is reported to run the Thonex II test with Nuendo 3.1 without pops/clicks down to 1,5 ms latency setting at 44-52% CPU load (play).

ATI Crossfire (ATI RD480) + ULi 1575 Southbridge
This chipset combination is used with the Asus A8R-MVP motherboard (MSI and Abit clones are to follow). Instead of being a single chipset solution as with the nForce4 incarnations, the chipset is based on a more traditional Northbridge (ATI RD480) plus Southbridge (ULi 1575) implementation. Four SATA II ports and 8x USB 2.0 ports are supported via the Southbridge. However, this motherboard only comes with 3 PCI slots and, based on tech reviews, there are reported question marks on sustained PCI I/O performance with the ULi M1575 SB (as with the SB450 used in combination with ATIs RDX200 chipset). Further, there are no native hooks to Gigabit Ethernet PCIe with this chipset. Users who need to transfer e.g. large audio/sample files via Ethernet in conjunction with other activities taxing the PCI bus may be affected by the comparatively low Ethernet throughput. At the bright side, USB throughput is though significantly better than with the SB450 and the mainboard shines in robust o/c capacity.

Stress test data:
Preliminary Thonex II stress test data (rme-audio.forum; 2005-12-20) with AMD X2 3800+, RME Multiface, but without DSP PCI cards, indicates that the Asus A8R-MVP performs not as well as the Asus A8N-SLI (more crackles and pops/clicks at low latency settings, ≤ 6 ms) with equivalent CPU, memory, video and pci soundcard configuration. There are though no principal compatibility issues reported with a PCI soundcard-ATI X300 PCIe-AMD 64 X2 combination.

VIA K8T890CE
Based on this Northbridge chipset, including the VT8237R Southbridge, Clevo has recently released an AMD 64 dual-core compatible notebook, the D900K. It comes equipped with a PCMCIA slot and is compatible with RMEs Digiface/Multiface.

As of this writing, it is too early to elaborate on performance results and any compatibility-related issues.

Stress test data:
Initial stress test results (Sonar 3, Thonex) shows that this notebook combined with AMD 64 X2 4800+, 2 GB DDR400 and RME FF800 performs with impressive numbers (down to 1,0 ms latency setting [Sonar 3] and 2,2 ms [Thonex] without pops/clicks).

CPU/Chipset drivers and OS hot fixes

Users with AMD 64 X2 (dual-core) or Intel dual-core CPUs are recommended to install the latest CPU/Chipset drivers and Microsoft Hot fixes.

Users with Intel-powered 9xx chipsets are recommended to install the latest Intel Matrix Storage Manager with improved SATA/RAID/AHCI support if you are using Intel 9xx Express chipsets and experience pops/clicks in playback mode.

In particular, the Microsoft dual-core hot fix is recommended to be installed by users with dual-core CPUs (not only in cases where Power Management schemes are enabled as per MS instructions, which in any case should be disabled on computers used for DAW work). Some users have reported that host–based cpu metering and hard disk performance inconsistencies have been eliminated with the dual-core hot fix as well as cases with stuttering mp3 playback and improved overall stability.

Notes on the complexity of measuring true performance differences with DAW stress tests

Different DAW stress tests & configurations will not throttle your system in the same way

The original and Thonex II stress tests are known to throttle the DAW system harder (specifically in terms of VSTi/sample capacity) than e.g. the Sonar 3 test which should be taken into consideration. Case in point – the nForce4 with a single-core AMD 64 cpu may not act differently than other DAWs lacking the PCI-PCIe interconnectivity issue under light stress (Sonar 3, Five Tower), whereas performance differences start to become real when the PCI bus is throttled harder (Thonex, Thonex II).

Even different versions of drivers, DAW software and VSTIs will yield different stress test data – other variables kept constant. Thonex stress test data based on Nuendo 2 generally results in lower CPU loads than if based on the Nuendo 3.x version – all other factors kept constant. Different host software versions, as well as unstable systems, are known to yield varying or inconsistent CPU read off results and thus likely to cause skewed interpretations of the actual variable to be tested.

Stress test results will primarily mirror the mode of the test design itself and thus vary across different test platforms. From a user perspective, the important thing is to identify a test design which is a relevant reflection of real-world conditions likely to represent your DAW work (i.e. are you a hard hitter dependent on hundreds of audio tracks including a multitude of VSTi/samples, or rather dealing with multimedia work based on a limited number of audio/midi tracks ?).

Host/menu read-off latency vs. true latency in audio stress tests

When comparing DAW stress test data across various soundcards used, the reader should interpret any performance differences at a specific buffer setting cautiously as the soundcard's menu latency setting may not reflect real I/O latency values. The German magazine, Keyboard (04/2005), measured the latency performance differences on seven Firewire soundcards and concluded that the discrepancies between indicated software latency values and real roundtrip latency ranged from 0 ms up to 7.1 ms. The RME Fireface 800 was the only tested device that did not differ (software indicated vs. real roundtrip values).

It is also important to note that Firewire soundcard interfaces usually include additional safety buffer latency in playback mode compared to PCI soundcards (this is needed as Firewire devices lack Direct Memory Access, DMA, as PCI devices). Thus, when comparing audio stress test data using playback mode with e.g. the RME Fireface it will add 64 samples latency via its safety buffer. If all other variables are kept constant the effective playback latency, RME HDSP PCI vs. RME Fireface 800, would actually add 1.5 ms (64 samples) at 44.1 kHz in the latter case. This effect is illustrated in the following figures:

Figure 1. Thonex II/Nuendo 3.1 stress test results: *CPU load vs. menu latency settings*. Average read off CPU load values (play). Input data based on user reports submitted to the Nuendo Hardware forum.

Figure 2. Thonex II/Nuendo 3.1 stress test results: *CPU load vs. adjusted playback latency settings.* Average read off CPU load values (play). Input data based on user reports submitted to the Nuendo Hardware forum. Average read off CPU load values (play).

Preferably, audio stress tests should be conducted with the same audio interface and driver version[2] across mainboard/chipset/CPU platforms as to reduce such latency artifacts.

Impacts of memory timing & bandwidth differences on DAW stress test results

CPU frequency and memory bandwidth/timings have significant impacts on audio stress test results – keeping other variables constant. The performance difference usually increases as latency setting values become smaller as illustrated by the following graphs:

Figure 3. Influence of *CPU frequency on CPU load (%)* as measured by the Sonar 3 test. All other BIOS/Host software settings and hardware configurations kept constant. Input data based on user reports submitted to the Sonar forum.

[2] buffer size information includes AD/DA conversion (1 + 1 ms) since RME Fireface driver 1.41 (11/2004); offset information increased by 1 sample since driver version 1.5 (12/2004). See http://www.rme-audio.com/.

Figure 4. Influence of *memory timings on CPU load (%)* as measured by the Sonar 3 test. All other BIOS/Software settings and hardware configuration kept constant. Input data based on user reports submitted to the Sonar forum.

Figure 5. Influence of *host multiprocessing mode on CPU load (%)* with AMD 64 X2 dual-core CPU as measured by the Sonar 3 test. All other BIOS/Software settings and hardware configuration kept constant. Input data based on user reports submitted to the Sonar forum.

Figure 6. Influence of *memory timings & bandwidth (1T vs. 2T command rate) on average number of Magneto plugins able to play* (1st test run without reload) as a function of latency settings. Input data based on user reports submitted to the Nuendo Hardware forum.

One of the conclusions made from the graphs presented (figures 4 and 6) is that memory timings and bandwidth have a comparatively larger influence on performance in low latency DAW work than in most other software usages. This indicates that in cases where the CPU-memory sub-systems are stressed there is a real-world advantage of being able to tweak memory performance and using memory modules capable of tight memory settings. Among adjustable parameters influencing memory timings and bandwidth, the command rate (or clock per cycle, CPC), which regulates how system clocks are allocating timings of a command to the system, is likely to have the greatest partial impact (disregarding the potential impacts of NUMA and 32-bit/64-bit NUMA OS support with Opteron CPUs). Users with AMD 64/X2/Opteron CPUs having high-demands on performance at low latencies may want to verify if their combination of memory, BIOS and mainboard is capable of running at 1T command rate instead of the default value (2T). Such a tweak must though be verified to run stable over time.

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and details on public forum about their DAW stress test results the audio community would be weaker in knowledge than presently found. Kudos to all involved ☺!

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