Intel Northwood Pentium 4 CPU

Radified Guide to Intel's New 0.13-micron P4 Processor

The latest **Pentium 4 CPU** from **Intel**, code-named **Northwood**, (affectionately referred to as '*Northie*') was officially released 07jan2002. Its most significant design improvements are:

- Core die shrunk to **0.13-micron** [from 0.18 micron]
- L2 cache increased to **512KB** [from 256KB]
- Transistor count increased to **55 million** [from 42 million]
- Default voltage lowered to **1.5v** [from 1.75v]

The **Northwood P4** comes with socket-**478** packaging (478 pins), also referred to as mPGA478. A larger image of the Intel Northwood P4 CPU is posted here (760x624, 28KB). Notice how the chip itself is well protected beneath the hard shell casing, making is nearly impossible to damage. The casing design makes heatsink installations a snap.

Note that you can purchase two different socket-478 **P4**'s today. But one of them is *not* a **Northwood**. The **Northwood Pentium 4** is based on the new **.13-micron** die Tualatin core (smaller, 146mm² in size), with copper interconnects (which are tiny wires or 'traces' that connect transistors). By contrast, *previous* **P4**s are based on the (older) **.**18-micron Williamette core (larger, 217mm²), with aluminum interconnects. See here for an image (61KB) that illustrates the difference in size between the old & new P4 CPUs.

The **Northwood**'s smaller transistors are able to switch faster and generate less heat than previous, hotter-running **P4**s. This allows the **Northwood P4** to reach higher clock-rates than its larger, Williamette-based **P4** cousin. Note Chris' comments from his Northwood review at GamePC:

> Northwood runs extremely cool, considering its massive clock speeds. With the retail Pentium 4 cooler, at a default clock speed of 2000 MHz, the Northwood maxed out a temperature of **89.5**°F. In comparison, our Willamette P4 ran **well over 100**°F.

Northwood P4s overclock well, especially with their lower (**1.5**v default) voltage. Lower voltage means reduced power consumption and less heat generated, which translates into improved stability. The Williamette-based 2GHz P4 is rated at **75.3** watts. Far as I know, this is the highest-rated TDP (Thermal Design Power) of any CPU. The 2GHz **Northwood P4** is rated at **52.4** watts (see here). The 2.2GHz Northwood is rated at **55.1** watts. [You know that a 60-watt light bulb burns cooler than a 100-watt bulb.]

Preliminary reviews indicate that a **2.0**GHz **Northwood P4** has a good chance of reaching (being overclocked to) **2.5**GHz, which corresponds to an increase of **25%** over the default clockrate. The 1.6GHz denomination is virtually assured to reach 2.1GHz.

In terms of overclockability, this makes the **Northwood P4** (especially the **1.6A**) another Celeron 300a. The C300a was a legendary Intel CPU of yore, known for its ease of stable overclocking, rendering $500 performance for ~$125. People are already referring to the **1.6A** (~$140) at the new *Dancing Queen*, cuz it *does the dance* (overclocks) so reliably to speeds averaging **2.3**GHz. Note Chris' comment regarding overclocking a **2.0**GHz **Northwood P4** (3rd paragraph):

> "When we say stable, we mean it too. We were able to run through a set of benchmarks at 2.5 GHz without a single crash. In fact, our testbed is still running right now at 2.5 GHz. That's a 25% overclock without any external modification to the chip or motherboard!"

The first **Intel Northwood Pentium 4 CPU**s have been released in **2.0** and **2.2** GHz flavors. Rumor has it that Intel will also (later) release a 1.6 and 1.8GHz Northwood. It's looks like they're already available.

Intel is differentiating the **Northwood P4** from the it's older Williamette cousin by adding the letter '**A**'. Where the **P4** is concerned, that little '**A**' means **A**_lot. If you order a **2.2**GHz P4 CPU, you're **assured** that it's a **Northwood**, cuz there are no Williamette-based 2.2GHz P4s

Due to high introductory prices, most people will likely wait a month or two for price tags to drop to reasonable levels (below US$300, preferably less than $200). For example, I noticed that you can order a 2.2GHz Northwood P4 CPU at New Egg for $670. New Egg claims to have them in stock. [New Egg's impressive Resellerratings.] Atacom is offering the 2.2GHz Northwood for US$679, and the 2.0GHz flavor for $399 (note the 512K cache). Rumor has it that Intel will drop prices on January 27th.

Update 28jan2002 - Intel lowered prices yesterday, but only on non-Northwood CPUs running *below* 2.0GHz. That's disappointing. See here. Some speculate that this is because Northwood CPUs are selling better than expected (high demand, Economics 101). Looks like the next scheduled price drop is mid-April.

Intel is sneaky about the way they name their **CPU**s. The most obvious name changes rarely correspond to the most meaningful design changes. Rather, the most desirable design improvements (e.g. die size reductions) are often obscured by subtle name changes (like adding the letter '**a**', for example).

This means that you must do your homework if you want to select the CPU that represents the best combination of performance, stability, longevity & value. Gone are the days when buying the latest processor was a safe bet. For example, most people don't know that you can't directly compare clock-cycles (MHz) of the Pentium 3 with those of the **Pentium 4**. A **2**GHz **P4** does *not* process twice the number of instructions of a **1**GHz Pentium 3. If you think that Intel will ensure you know this, you're mistaken.

As if trying to determine which **CPU** represents the wisest choice weren't already challenging enough, you should know that you can also purchase a Pentium 4 with socket-423 packaging (**423** pins). CPUs with socket-**423** packaging are *not* compatible with socket-**478** systems. Since Intel is basing its foreseeable **P4** future on the new socket-**478** design, older socket-**423** CPUs represent a poor purchase option.

Key features of the **Intel Northwood Pentium 4 CPU** in a nutshell:

- **0.13**-micron die Tualatin core [old P4 = .18-micron Williamette]
- **146**mm² core size with copper interconnects [old P4 = 217mm² with aluminum interconnects]
- **512**KB L2 cache [old P4 = 256KB]
- socket-**478** (pin) packaging [old P4 = both socket-423 & -478 packaging]
- **1.5v** default core voltage [old P4 = 1.70v and 1.75v]
- Contains **55** million transistors [old P4 = 42 million]

- 8KB super-fast L1 cache [old P4 = same, P3 has 16KB, but not the super-fast stuff]
- 64-bit quad-pumped 100MHz FSB (effective **400MHz**) [old P4 = same]

- 2 **double-pumped** ALUs (**A**rithmetic **L**ogic **U**nits) do the work of four, running at twice the processor core speed [old P4 = 2 single-pumped ALUs]
- No support for dual-processor system configurations

- DDR-SDRAM chipset support scheduled for Q1 2002 [old P4 = same]
- uses Rambus DRAM [old P4 = same]

- 144 new SSE2 instructions [old P4 = SSE2, but not these 144 new ones]
- 20-stage pipeline [old P4 = same, P3 = 10-stage]

- uses NetBurst technology instructions [old P4 = same]
- new ATX 2.03 spec for mounting heatsink retention fittings [same]

- requires additional 12-volt 2x2 power supply connector [same]

You can purchase power supplies designed specifically for **Pentium 4** systems. I asked the folks at *PC Power & Cooling*, "What's different about **Pentium4** power supplies?" You can read their response, which is posted here. Intel discusses P4 power supply requirements here. Word on the street is that **not all** socket-**478** motherboards will require a new case or power supply unit (PSU). Some reviews claim that Asus includes an adapter kit so that you won't have to buy a new case or PSU, for system upgrades.

Most people who have already built **P4**-based systems claim that you don't need a new case, but that you should get an *ATX 2.03*-compliant **P4**-approved PSU. Enermax also makes a nice 430-watt P4-compatible power supply (slow site) you can buy for $82 [EG465P-VE (FCA)]. **Pentium 4** motherboards are larger than **P3** boards, so make sure your case is big enough to accept the larger **P4** boards.

I have a friend with a **P4** system (a home system, not a stripped-down benchmarking rig). He claims that it's "rock solid". When I heard the way Joshua said the words *rock solid*

(including unprintable, colorful adjectives), I knew that the **Northwood** would be my next **CPU**. Another review posted here echoes Joshua's sentiments.

Perhaps I should note that I'm not necessarily an **Intel** fan. Rather I'm a stability fan. And **Intel** chipsets rule the *stability* world. I'd gladly pay extra for a stable system (within reason, or course). My current system (**Intel**-based) is rock solid, even tho it's overclocked.

Kyle at [H]ard|OCP seems to agree by saying (next-to-last paragraph):

> Intel components still are **the pinnacle** when it comes to building a problem-free system that we can rely on.

Chris at GamePC seems to concur (first paragraph):

> Our particular market, the high-end / gamer segment, seems fairly split, many loving the raw speed and low price of the Athlon, while others love the well-endowed memory bandwidth and **ultra-stability** of the Pentium 4 platform.

To be clear, I seek maximum *stability*, with maximum *performance* at a minimum *price*. In that order. Speaking of **minimum price** ...

Until recently, the only way to run an **Intel Pentium 4 CPU** was with Rambus RAM. The release of **Intel's i845D chipset**, which supports **DDR** RAM (**D**ouble **D**ata **R**ate), has changed this. The problem with Rambus RAM used to be that it was significantly more expen$ive than DDR RAM, without providing a corresponding increase in performance. But all that has changed in recent weeks. Prices are now roughly equal.

It's rumored that Intel cut a deal with Rambus, which awarded Intel mega-buck$ if they helped Rambus sell a lot of their RAM (by manufacturing chipsets that require Rambus RAM). I haven't researched these rumors enough to know if they are true, but I *do* know many people dislike Rambus. For these people, it's a matter of principle *not* to buy Rambus RAM.

At least one article suggests that Rambus "*took unfair advantage of open JEDEC discussions, and patented concepts developed in industry committees.*" And the courts have recently found Rambus guilty of fraud. Personally, I'm too much of a capitalist to care about the details of techno-ethics. I merely want maximum performance for my buck, with rock-solid stability.

The price of Rambus RAM has dropped dramatically over the last few months, but is still significantly more expensive than DDR RAM, which performs comparatively to (and perhaps even *better than*) Rambus RAM, due to its lower latency.

You can get an idea of the relative prices of both Rambus & DDR RAM at either Mushkin or Crucial. At time of this writing, a single 256MB stick of non-ECC Mushkin 800MHz Rambus RAM cost $149. Crucial sells its 256MB stick of PC2100 DDR RAM for $88 (free shipping).

I searched Pricewatch and found 256MB sticks of PC800 Samsung Rambus RAM for $95 at New Egg (Cosair) .. better than Mushkin's $129. Others had better prices, but I refuse to purchase anything from a reseller with a poor resellerrating. New Egg's reseller rating is posted here. RJtech had some nice prices, too. Googlegear has Samsung PC800 here.

The best overclocking RDRAM RIMMs are reportedly the **single-density, double-sided** Samsung modules. You want what is called **16 device** (low density) memory for 256megs (**8 device** for 128megs). High density 8-device 256MB modules (4 device 128MB modules) do not overclock as well. I heard that GoogleGear carries this type, altho haven't verified this.

At least some (maybe all) of the *Corsair* modules use Samsung chips, but many feel that Samsung PCB is better than Corsair. (I think Samsung *invented* DRAM.) Newer single-sided, double-density modules do not overclock as well. **Note**: It seems that the prices of DDR RAM have spiked in the last few weeks, while the prices of Rambus DRAM have remained constant or dropped. I heard that this is due to the *increased demand* caused by Intel releasing their DDR-enabled chipset. This changes the decision-making dynamics. PC2100 transfers 2.1GB/s of data. Careful not to get GB/s confused with MHz or GHz.

Once you decide that you want a Northwood CPU, the first decision you'll have to make is: **which motherboard?** But before you decide "which motherboard," you need to decide whether you want to use Rambus or DDR RAM. I've researched this topic thoroughly, and still haven't come to a clear conclusion. We'll take a closer look at these questions, and find that there's no simple answer.

If you already have a bunch of DDR RAM, you'll likely want to go with a DDR-based mobo. Conversely, if you already own a few sticks of Rambus, you probably want to go with a RDRAM-based mobo. If you're like me, with nothing but regular SDRAM (PC133), the decision is more difficult. I am leaning toward going with an **RDRAM** solution cuz it benefits more from higher clock speeds than DDR RAM. .

The Asus P4B266 motherboard, for example, supports **DDR** RAM, and contains one more PCI slot (which I could use) than its Rambus-based cousin: the **P4T-E**. Xbit got the P4B266 to run at 172-FSB (wow). If you need USB 2.0, you could always purchase a separate PCI ad-on card for that (but it's better to save your PCI slots for things you can't get on the mobo itself).

The P4B266 comes with a 3:4 function that allows the CPU to run at 100-FSB with memory at 133-FSB .. thus maximizing memory bandwidth, without affecting the CPU. Most enthusiasts feel that this feature alone makes the P4B266 a better choice than other i845D boards.

Another favorite are the boards from MSI, which everyone seems to like. The 845 Ultra-ARU is the best DDR-based solution from MSI, cuz it offers **6** USB 2.0 connections. I've heard nothing but good things about MSI main boards, and this is the least-expensive of the DDR-based group.

The Gigabyte GA-8IRXP offers everything that the MSI boards has, but also comes with an extra PCI slot (**6** total). Personally, I find the extra PCI slot an attractive feature, especially if you have lots of PCI cards like I do. Gigabyte makes quality mobos, but it is considerably more expensive than the others. So it appears that (for DDR-based systems) the MSI board is best if **price** is your main concern. The Asus board is best if **overclocking potential** is what you're after, and Gigabyte offers the most **features**.

Looking at RDRAM-based solutions, the Asus P4T-E motherboard (not to be confused with the 423-pin P4T, without an '**E**' on the end), will support **Northwood P4 CPU**s with a

simple **BIOS flash upgrade** (see info listed under *Feature Summary* at bottom of the Asus page). Note that RDRAM-based systems benefits MORE from overclocking than do DDR-based systems. They ue the extra memory bandwidth better.

It contains the **Intel 850 chipset** (supports only Rambus DRAM). A large image of this board is posted here (122KB, 820x580). Notice how the Rambus RAM RIMM slots are perpendicular to each other. Some people feel that this perpendicular design limits overclocking potential (no hard evidence, debatable point).

Note that the older P4T-E BIOS does not recognize the Northwood CPU, and therefore can't set the clock/stepping settings. You will have to set these manually with the dipswitches, then boot, update the BIOS to a Northwood-recognizing version, shut down, and reconfigure dipswitches and jumpers back to "Jumper Free Mode".

The TH7-II from Abit uses a *parallel* design, which (some claim) offers superior overclocking potential. Abit motherboards are known for their overclockability, and are referred to as *the 'Ferrari' of motherboards*. I heard that all TH7-II mobos manufacturered after September, 2001 sport a memory clock generator that will run/support both PC1066 and PC1200 RDRAM. I heard this from someone who claims to have contacted Abit for verification.

But Abit does not have the reputation for stability and quality that Asus boards have, which are referred to as *the 'Mercedes' of motherboards*. Personally I prize **stability** above all other factors (performance, co$t). At such high clockrates, a few hundred mega-hertz aren't going to make a whole heck of a difference. I doubt you'll notice a difference between 2.0GHz and 2.3GHz. But stability problems can make your life downright miserable.

The Holy Grail of stable overclocking is achieved when you are able to reach the next default FSB speed, with a motherboard that supports the necessary AGP and PCI dividers, so that you can run those busses at DEFAULT speeds. Personally, I don't mind overclocking my CPUs, cuz chips come from a standard pie wafer, but I don't like running my AGP or PCI bus out of spec. This means that our CPU needs to be able to reach 533-FSB if we want to be able to run our AGP & PCI busses at DEFAULT clock speeds (provided our mobos offer the necessary AGP & PCI dividers already mentioned).

My current system (P3-700 @938MHz) is like this. The CPU is the only component being "overclocked" (which I feel is a misnomer, cuz the same pie wafer can yield chips sold at

the faster speed). So was my previous system: C300a @464MHz. The only difference is that today you'll also have to run your memory out-of-spec. I've never had to do that with current/previous systems.

As Chris illustrates in his review posted here (scroll down to the table near bottom), you have the best chance of getting there with a **1.6**GHz Northwood. (~US$140). He claims that your chances are "**very likely**". Some people claim that Northwoods stamped 'Made in Malaysia' are better than those stamped 'Made in Costa Rica', while most agree that it doesn't matter.

Overclockers.com set up up a CPU datbase query here, where you can search for typical results on any CPU you like. For the Northwood, scroll down to 'Northwood P4' near the bottom, listed under 'Select CPU type'. The **average** stable speed for the **1.6A** (40 entries) is **2.32**GHz. The average for the **1.8A** (26 entries) is **2.46**GHz.

I have read posts on various forums around the Net, and people seem to feel that your chances are **almost certain**, but you must make certain that you're getting a **Northwood**, and not a Williamette-based chip. A few notewothy coments from Chris' review:

> A friendly tip I was given is that many 128MB RDRAM modules will overclock better than 256MB RDRAM modules, due to the 128MBit technology being more mature than the 256MBit technology, as the 256MBit is still in it's infancy.. [**AND**] ..
>
> DDR SDRAM may have some compatibility issues at higher clock speeds .. [**AND**] ..
>
> it's clear that RDRAM at PC-1066 speeds offers better overall performance compared to DDR400 memory paired with the Pentium 4. The dual channel design of the i850 chipset helps RDRAM gain a major advantage in memory bandwidth that simply can't be beaten .. [**AND**] ..
>
> Asus's P4T-E motherboard also has these dividers, but failed to run at 533 MHz FSB due to an incompatibility with their clock generator chips.

Referring to the P4T-E's clock generator .. you can find more info about the ICS9250-37 clock generator here (12-page PDF file). If there is a problem, I'd expect Asus to replace them post haste. I'm not sure if these are modular units that's home users can replace

(unplug, replug). This thread contains more related info.

Received a note from a reader who claims that Outside Loop is selling the P4T-E motherboard with the **good** clock generator .. along with **pre-tested 1.6A**'s that are guaranteed for 2.13GHz. I would verify this with them, tho. I shot them an email and asked if they were familair with the clock generator issue. Their response:

> Yes, we're familiar with the situation. Typically, when we do get the 'good' boards in, they sell out in a matter of minutes. It would be best to give us a call and place a standing order, so that you can be guaranteed to get one.

If you get a motherboard with a BIOS that does not recognize the Northwood CPU, you will have to set the **dip switches** to the correct multiplier, so that the board can POST. Then **flash-update** the BIOS so that your Northwood is recognized. Then you'll be good to go.

A word about **voltage**: Most people feel that increasing CPU vCore voltage **10%** over manufacturers default spec is safe, but that anything more represents a gamble. If I can't get there with 10% extra, I don't go. People are having success overclocking the Northwood P4 with the stock heatsink & fan, but if you want to take it to the next level, I've heard god things about the AVC Sunflower.

A quick check at Pricewatch shows that Atacom is selling the Asus P4T-E for US$155. They have *two* versions: one with audio & one without. The one with audio sells for $7 more. I just got off the phone with a guy at Atacom (ext. 100) who swears that he has this board **in stock**. **[**Note: this is not an endorsement of Atacom. I'm merely showing that this board is available now. Atacom's resellerrating is posted here, and it's *not* very good.**]**

The Intel i850 chipset is configured for dual-channel Rambus DRAM RIMMs. Each channel contains **2** RIMM slots, for a total of **4** per motherboard. The dual-channel configuration means that you must install your Rambus memory modules in *matched pairs*. So you will need at least **2** sticks of RAM. All unpopulated RIMM slots must be filled with what are called Continuity RIMMs (because Rambus is a *serial* technology).

Update 22jan2002 - Received a note from Dylan Williams who writes to say he has both the Asus & Abit Rambus-based boards and prefers the Asus board:

> I can confirm that the P4T-E is rock solid at 140-FSB with PC800 RDRAM (1120). Benchmarks show a stock installation using 133-FSB with default voltage. The design of the P4T-E actually *helps* with RIMM overclocking. I also have a TH7II and it's nowhere as stable as the P4T-E .. altho it does have more overclocking options.

The full message is posted here. Worth reading. Despite what he says, I've heard a lot of good things about the Abit board. See here for benchmarks of related info. If you go with the Abit board, which a lot of people seem to like, make sure you get one with the **ICS 9212-13** memory clock generator, which is rated for **600**mhz. The older **ICS 9212-03** memory clock generators are only rated for **400**mhz (bad for you).

Update 04feb2002 - the Virtual Zone web site started a Northwood overclocking database (might take a while for the page to load, cuz it contains many images). You can download WCPUID v3.0f here. These types of images get the best quality/size ratios using **GIF** compression.

An article at Tom's Hardware, titled Pentium 4, Over 3GHz (dated 17jan2002), indicates that it might be easier to overclock DDR RAM (than RDRAM). A DDR-based Gigabyte 8IRXP motherboard was used to overclock a 2.2GHz Northwood to over 3GHz with water cooling. These types of articles do not excite me, cuz I'm never going to install a water-cooling unit in my PC. But I was interested by a comment that I noticed on the second page:

> "A motherboard with the Intel 850 chipset and Rambus memory was out of the question because RDRAM reacts very sensitively to increases in clock speed."

If that's true, that would be a significant reason to take the DDR route. I wish I could get some comparative data on relative system **stability** between Rambus and DDR-based systems.

Chris at GamePC seems to agree:

> On our P4T-E (i850/RDRAM) motherboard, we didn't have much luck with the Northwood. On this board, we were only able to go up to 2.20 GHz, even at the motherboard's highest allowed voltage levels ... On our second platform, the Asus P4B266 (i845-D/DDR SDRAM), our results were much better. Right off the bat, we were able to clock to 2.3 GHz with only a 0.05V vCore bump. With little voltage bumps here and there, we were able to get the chip completely stable at 2.5 GHz, running on a 500 MHz FSB (125 MHz x 4).

Far as RDRAM-based systems go, I heard that you have the best chance of successful over-clocking with RIMMs manufactured by **Samsung**. It should be noted that the P4 was **designed with RDRAM in mind** .. and later adapted to DDR. That would give an advantage to RDRAM.

Many people seem to feel that most **Samsung/Cosair** PC800 RDRAM can hit PC1066 speeds relaibly. Anecdotal reports claim that Samsung's PC800 RDRAM max'es out at ~PC1120 to PC1160 speeds. If you need 512MB, it might be better to get **4x128**, than 2x256 RDRAM sticks, as the 128MB sticks are more reliable overclockers. While we're discussing DDR RAM, you should probably know about SiS chipsets. If stability is your #1 priority, you probably want an **Intel** chipset.

Update 03nov2001: I've received a mailbox full of responses to my comments about Rambus RAM. Admittedly, I haven't researched RDRAM very much. All I know is that it provides performance comparable to that of DDR RAM, yet costs significantly more.

I posted one such response. This particular reader makes compelling points, and includes a brief history of RAM development. At the very end, he suggests that the (Rambus) RAM may be responsible for the **P4**-platform's superior stability over Athlon-based systems (which ran DDR RAM). Since I don't mind paying extra for stability, I found this especially interesting. I asked if he had any references or links to support his claims, but have not yet heard back from him. If you'd like to see what I'm talking about, see here => Rambus RAM.

These remainder of this page contains a folksy comparison (contrast) between Rambus and DDR RAM. If you have no need for this info, skip to the next (last) page for more info related to the **Intel Northwood P4 CPU**. The difference between the way that **Rambus** RAM & **DDR** RAM transfers **data** can be compared to the way **people** travel on a high-speed commuter *train* (on narrow rails) vs the way they travel in *cars* on a freeway (on a wide path, with many cars abreast).

The train (Rambus) is narrower, but moves along at a much faster rate (800MHz). Conversely, cars on the freeway (DDR) take up a much wider (data) path, but move along at a slower rate (266MHz). Both methods transfer roughly the same number of people (data) per unit time (bits/sec). Rambus RAM will transfer **3.2**GB/s of data (1.6GB/s per channel times **2** channels).

3.2GB/sec is equivalent to transferring the data contained in **5** full CDs (650MB per CD) every second. That's roughly *triple* the bandwidth performance of my current system. Like the narrow, high-speed commuter train, Rambus RAM is only **16**-bits (**2**-bytes) wide, but moves along at a higher clock-rate (800 MHz). DDR RAM is **64**-bits (**8** bytes) wide, but moves along more slowly (266MHz). Both methods accomplish roughly the same performance, but each goes about it in a different way. DDR RAM moves more data each step (Hz), but steps along at a slower rate.

Narrow bus data transfers are known as **serial**. Wide bus data transfers are known as **parallel**. Each has its own set of pro's & con's. Parallel is more established. Serial seems to be becoming increasingly popular, and is supposedly less expensive to manufacture. Perhaps it might be worth noting here that Rambus RAM modules, running at **800**MHz, run at exactly **twice** the (clock) rate of the front side bus (FSB), which runs at an effective clock-rate of **400**MHz. This is where the word *synchronous* comes in.

Intel is planning to raise the FSB (**F**ront **S**ide **B**us) to **533**MHz (quad-pumped **133**). The scheduled release date for FSB-533 chipsets is (reportedly) set for May 6th (this date keeps getting pushed back), at which time Rambus modules will run at 1066MHz (referred to as **PC1066** .. does your head hurt yet?) Notice that there is still a factor of *__2__* between FSB clock-rate and the speed/frequency of RDRAM modules.

People who are serious about performance seem more excited about the prospect of 533-FSB than the (overclockability of the) **Northwood CPU** itself. If you can hold off until

April, the performance available at that time should make the wait worthwhile. I also read that latency of PC1066 modules will be cut by 30% (lower is better/faster), making it roughly the same as DDR RAM .. which would be yet another reason to wait for 533-FSB. After the recent price increases of DDR RAM, latency (a measure of 'delay') is the only remaining advantage that DDR RAM holds over RDRAM.

Rambus is *demonstrating* 1200MHz RDRAM module on 23jan2002. Yahoo posted info here about the event. Note that a real-life demonstration is far more impressive than mere theory presented on paper ('vaporware'). Other incentives to wait until Spring would be:

- i845E chipset (Brookdale)
- 8X AGP
- USB 2.0
- ATA/133

Many enthusiasts feel that the **chipset** is the single most important system component, cuz it determines (limits) which components you can (and can't) use. The **chipset** determines which CPU you can use .. not the other way around. Most PC manufacturers tend to classify (primarily) their systems by the **CPU** it contains. This practice is misleading, if you agree that the CPU is not the system's single most important component. Choosing your **chipset first**, before you select a CPU, if often a wise strategy.

For this reason, I'm considering waiting until spring, even tho the **Northwood** will be here January. But you can also end up waiting forever. I heard that Intel will designate CPUs designed for the 533MHz FSB by replacing the letter '**A**' with the letter '**B**'.

Don't expect **Intel** to be very talkative about (marketing) the move to a **533**MHz bus speed, as this would give people a reason *not* to purchase the original-release **Northwood P4** (based on 400MHz FSB), and wait for spring. Word on the street is that Intel will release two new CPUs (2.26 and 2.4GHz) in the mid-April to end-of-May time frame that will be the first designed to run on the new 533-FSB chipsets.

I'm reluctant to address the volatile **Intel vs AMD** issue, but after receiving lots of mail

asking questions like, "What's wrong with AMD?" I'll briefly present my views: There's *nothing* wrong with AMD **CPU**s, especially for the average user. I'm all for AMD. I even recently purchased some of their stock (I'm sad to say). The competition helps keep **Intel** honest, and I readily admit that AMD chips **provide better value** than Intel's. But value is *not* my #**1** consideration.

I found that, when you try to cram a lot different hardware and software into a system, the potential for compatibility glitches grows proportionately with the installation of each additional component & application.

Personally, I'm far more interested in **stability** .. than saving a hundred bucks. The headaches aren't worth it (for me). Without engaging a debate about merits of relative platform stability, I'll simply reference a recent article posted at Tom's Hardware (dated 31oct2001). The article is titled **AMD vs Intel**. It begins here.

I call your attention to the Conclusion, posted here. Three paragraphs from the end, it says this <copy-n-paste>:

> *Another factor is the stability and product quality of a system: while all Athlon processors suffered from occasional instability in our tests, the Pentium 4 platform ran without a glitch.*
>
> *Reasons for this behavior might not lie in the processor itself, but rather in the motherboard design and the chipset used. Future driver updates might not just improve performance but also stability of a platform.* </paste>.

While you're there at Tom's, you might as well mosey on up two paragraphs and read where he says <copy-n-paste>:

> *But one thing should be made clear here - since Intel introduced its 0.13-micron processor, the **Northwood Pentium 4**, it can turn the MHz dial up higher than AMD can.*
>
> *High clock speeds are a real burr under AMD's saddle, as has been shown by the developments of the past several months. While Intel has already cleared the 2000 MHz hurdle, AMD has barely scraped over the 1533 MHz one from 1400 MHz.* </paste>

If these comments come from a guy who's known to be pro-AMD, what might that tell you about relative platform stability?

Update 04nov2001: I should've known that I'd get a mailbox full of responses to my comments regarding **AMD vs Intel**. (This is why I was reluctant to address the issue.) For example, one reader writes to say <copy-n-paste>:

> This quote: "*High clock speeds are a real burr under AMD's saddle, as has been shown by the developments of the past several months. While Intel has already cleared the 2000 MHz hurdle, AMD has barely scraped over the 1533 MHz one from 1400 MHz." .. is of dubious value, because MHz is not everything.*
>
> *CPU power depends on both MHz *and* instructions-per-cycle, and a few other things. Apple refers to this as the Megahertz Myth.* </paste>

This reader references an article posted here, titled *Pentium 4: In Depth*. I skimmed thru it, but it's too long & too technical for me to read in its entirety. It's blatantly pro-AMD & anti-**P4**. Here's a quote from the second paragraph:

> "*Despite a huge pavilion at COMDEX Las Vegas in November 2000 to launch the product, countless* annoying *blue guy commercials on television, and system prices that launched in the $3500 to $4000 price range, the **Pentium 4** has failed* miserably *to to outperform existing Pentium III and AMD Athlon system.*"

Articles like this are not surprising, since there is obviously much at $take. <sarcasm> The subtle way in which the author uses the words *annoying* & *miserably* </sarcasm> tells me that he is not even *trying* to appear unbiased. Note that this article addresses the original **Pentium 4**, and not the **Northwood**. Note also that the quote referenced comes from Tom, not me. Finally, note that I never claimed that AMD **CPU**s represent a poor purchase decision (they don't, especially for the average user).

I agree that the current **.18**-micron incarnation of the P4 has its shortcomings, especially

compared to the bang-for-your-back of Athlon-based system. I merely said that **P4**-based systems appear to offer **superior stability**, and that stability is my prime consideration. If a particular system has problems, it doesn't matter what kind of deal I may've gotten on it, or how well it performs. Again, I have no qualms about paying extra for a system if it will buy me a stable system. (I speak for no one but myself.)

It's not like I haven't been frustrated with many of **Intel**'s decisions. Their product roadmap has left me scratching my head on numerous occasions, making it downright difficult to purchase their products .. even when I *wanted* to Ideal configurations appear once in a blue moon. The last time the MHz planets were in alignment was when the P3-700 (cB0 stepping) & Asus CUSL2 arrived on the hardware scene. Hopefully the **Northwood Pentium 4** will again find the MHz planets aligned. My fingers are crossed. The next die-size drop will be to **.09**-micron (90 nanometers), but those chips won't aren't scheduled to until early 2003.

An article from ZDNet, titled *Look P4 you leap*, posted here says:

> "*As soon as Northwood shows up .. its small design architecture an larger cache will obsolete the Willamette chips faster than Malathion kills mosquitoes.*
>
> *The future is a **Northwood Pentium 4** with DDR SDRAM and that's where you're money is invested wisely for the long run. RDRAM systems, if they still exist after Intel's current contract with Rambus expires, will do better with MPEG content and video ..*"

Benchmarks for the **Northwood P4** are posted here (GamePC). I like that they used off-the-shelf chips, and not hand-picked engineering samples. These chips yield results similar to what we might expect. EETimes posted an article here claiming that motherboards with **Intel**'s DDR chipset will ship this December, altho the article mentions nothing specific about supporting the **Northwood P4**.

More **Northwood P4** info can be found here (A1 Electronics) & here (InQuest). CPU prices can be compared here (Sharkey's). A **P4** FAQ is posted here (Asus). DigiLife posted a single-page review of the **Northwood** here. Note that, for comparative purposes, DigiLife **over**clocked the Williamette, and **under**clocked the Northwood.

Here's another review from the folks at TargetPC, where they were able to overclock the Northwood to slightly better than 2.5GHz. Anand posted his version here, where he compares more different varieties of CPUs than anyone else. My favorite **Northwood P4 benchmark review** is from Kyle over at [H]ard|OCP. He includes an overclocked (**2.0**GHz) Northwood P4 in the mix, running at **2.5**GHz. This is closest to the setup that I'd use for myself. See here.

It's clear from these reviews that the average user is unlikely to notice any real-world difference between these CPUs. That leaves two factors as the deciding criteria from which to base your decisions:

1. Lowest **price** -> AMD
2. Maximum **compatibility & stability** -> Intel

I'll be watching closely to see how things go with Intel's DDR-enabled chipset, and will keep this page updated with pertinent info. If all goes well, we might have a new motherboard user's guide in a few months.

See Intel's support page for its socket-478 P4 processors for info about **CPU** packaging, heatsink/fan requirements, chassis/case & power supply requirements, retention mechanism installation, & other topics related to the 478-pin **Pentium 4 CPU**. Intel's gives instructions for assembling the P4 heat sink & fan in a 1.7MB PDF file.

If you want to know exactly what you receive when you purchase a retail boxed Intel Pentium 4 CPU, see here. See Intel's official press release for the 2.2GHz **Northwood P4** for more info. I find it rather curious that nowhere on the page do you find the word *Northwood* mentioned. Intel's **Pentium 4 home page** is posted here.

Before closing, I'd like to say that you'll find no advertising on this site. I therefore have no rea$on to parallax my views. I try to present things as I see them, and provide ample references to support my positions. I'm interested only in what's best for me. I couldn't care less about what anyone else might prefer to put in their system. This is an admittedly selfish position. Yet ironically, you might feel the same.

My first researched-CPU was the (now legendary) C300a, which offered (at the time) $600 performance (P2-450), when clocked to 464MHz, which they all did quite effortlessly .. yet cost only $125. I built two systems (one for myself & another for the wife). The money we saved paid for our SCSI sub-systems (SCSI controller & a single 10Krpm SCSI boot drive), which made a huge difference in real-world system performance. I got a similar bargain with my current CPU (P3-700 @938MHz). So there are good deals available if you do your homework.

I'd also like to mention <shameless plug> a few other Radified guides that you might find helpful. For example:

- The **[**Norton Ghost User's Guide**]** is the site's single most popular feature.
- The **[**ASPI Drivers Guide**]** is ranked #**2**, and is translated into more languages than any other site guide.
- My personal favorite is the **[**Guide to Booting from a SCSI hard drive**]**, which espouses a hybrid approach as the optimal disk storage solution.
- The **[**Guide to Ripping CD Audio & MP3 Encoding**]** receives more kudos than any other.
- **[**The Best Software Programs & Applications**]** is growing the fastest (in popularity).
- **[**Doc's Über FDISK Guide to Partitioning a hard drive**]** is referenced by two Universities.
- It comes with a companion guide called **[**Hard drive Partitioning Strategies**]**.
- A **[**PC Benchmarks**]** page contains a sample of benchmarks for making comparisons, including links to popular Benchmarking programs.
- And a **[**few others**]** </shameless plug>

The Referrals page contains a sample of the sites recommending this & other Radified guides. The Kudos page contains a sample of flattering comments from the Radified

mailbox.

The end.

Need more info? See here (107-page PDF) or search Google for: **[**Northwood Pentium**]**

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