Multiplier Changing Overclocking Method for CPU Intensive Applications

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Abstract

Overclocking method is the most popular method used by the users who want to perform the processing speed beyond the manufacturer's limit. When client server computing becomes useful for all environments in order to reduce the resource usages of the clients, this method is applied to reduce and remove huge amounts of server energy usage. The applications today can't escape from consuming more processor power than in the past. The more intensive tasks the processor runs, the less lifetime of the machine becomes. So, overclocking method is reintroduced in the place of obsolete server based computing environment. Server based speed up method with the aid of benchmark tests are supported to proof the increased processor performance. The reintroduced method is tested on changing multiplier values of the CPU. The highest multiplier values with x34 are used at testbed i7 3770 processor type which provides the greatest performance for intensive applications.

Main points: overclocking, multiplier values, intensive tasks, obsolete server based computing

1. Introduction

Overclocking is a technique where the CPU's performance is increased, by ramping the processor's frequency beyond the design specification. Overclocking is not a new idea for all kinds of computer users and it is very useful for resource intensive application users. The CPU of a computer can be overclocked by various methods but when the clients are overclocked from another server becomes a big challenge.

Sasikal,D. et al., [8] presented dynamic overclocking mechanism which leads to appear to increase under longer duration of time and so this issue is solved with the help of throttling mechanism at some instances. This technique is used to maintain the system's energy with light workload. Subramanian,V. et al.,[10] showed various benchmark applications to overclock superscalar processors and the overheads of extra hardware and penalty of error recovery by adjusting the clock frequency dynamically.

Hikmat,A. and Abdullah,A. [4] introduced the Genetic algorithm performance with CPU overclocking technique. The voltage and temperature is used with normal processing conditions with the use of active feedback to maximize the overclocking preformance. Active feedback is used to ensure the current status of operating condition is placed under safe and secure. They used Intel core2 duo E6420 for CPU with original frequency and finally they have been boost 50% besides 3.20 GHz. Colwell.B [1] introduced that overclocking is better-than-worst case design as any computing system is a conglomeration of components, operating within frequencies, power supply

voltages and temperature ranges. Then they were set simultaneously to accommodate these worst-case values of each component.

Ramesh,P.K [7] presented pairs of existing redefining voltage-frequency to novel power level switching mechanism, in addition to achieve up to 40% speed-up compared to a base scheme without overclocking. Maekinen,S [6] covered the CPU overclocking to increase overall system performance including system memory and graphics processor. The results of CPU overclocking showed significant performance than others. Cuillinan,C et al., [2] conducted a total of 66 benchmarks were evaluated on CPUs, GPUs and FPGAs platforms. CPUs outperformed in overall execution combined with transfer time. FPGAs outperformed for fixed algorithms using streaming while CPUs outperformed in overall execution in addition to transfer time.

Srinivasan,J et al., [9] scaled the processor lifetime reliability of microarchitects as a manufacturing problem. The current processor manufacturers guaranteed lifetime reliability, device design, circuit layout and chip test manufacturing. Kraja,F and Acher,G [5] proposed the High Performance Computing (HPC) architecture with the comparison of suitable hardware technologies and rough performance estimations of their features Fernando,R and Okuda,A [3] prepared for green ICT by simulating economic activities, advancing social development goals and promoting sustainable development based on ICT policy makers. While having the potential to exponentially reduce emissions in other areas by catalyzing technological, institutional and behavioral change, while bringing forth socio-economic benefits ,“Green and cool ICT” is defined as ICT to produce comparatively low levels of carbon emissions.

2. Overclocking Perspectives by Changing Multiplier

There are several purposes for overclocking. Overclocking allows testing over-the-horizon technologies that available component specifications are not capable of, without having to enter the expensive realm of specialized computing. For professional users, overclocking improves professional personal computing capacity, therefore allowing improved productivity.

As a result of overclocking, the processor becomes more heat generator and so need to be downloaded processor monitoring tools. With the help of these tools, this method yields the most effective speed up performance for server based computations.

2.1. Objectives of Overclocking

The following facts briefly explain why this paper is written for processor overclocking. To reduce energy consumption for each PC by using centralized system which then share its resources to low specification thin clients, to upgrade a computer system to run faster , to change the adaptable multiplier values, to push the processor’s rate rather than the specified rating and to function at much higher clock frequencies this boosts the processor.

2.2. Advantages and Disadvantages of Overclocking

The following factors are advantages of overclocking method based on multiplier changing. They can lower hardware cost, lower IT cost and even renew the processor without changing the infrastructure. But they can also provide the significant pitfalls. The thermal

problem with respect to lifetime reliability, completely down the processor when overheating occurs, failure problem due to exceeding the core temperature and sometimes, it is very hard to recover the total system from damaging when implementing overclocking method.

2.3. The testbed Server Specification to change Multiplier Values

Overclocking is in fact trial and error process. The original value x16 has been successfully changed into x34 without errors.

Maximum Thermal Design Power =77W
Technology =22nm
Core Voltage =0.776V
Core Speed =1695.95 MHz
Multiplier =16 to 39
Bus Speed =99.76
Temperature Junction Maximum =105°C
Number of cores =4
Number of threads =8

Figure 1. Changing Multiplier Values into x34

2.4. Intensive Benchmark Test Results

The following benchmarks are used to measure the latency of the processor and the smaller the latency value leads to the better processor.

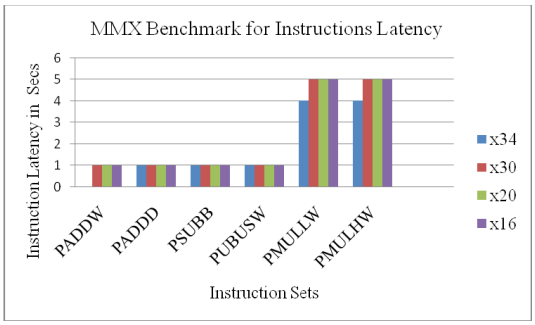

Figure 2. Different Multiplier Values with Multimedia Extension Benchmark Instructions

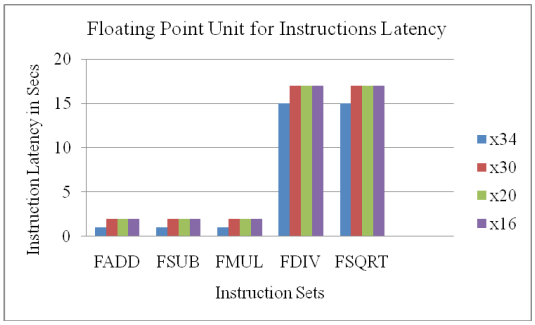

Figure 3. Different Multiplier Values with Floating Point Unit Benchmark Instructions

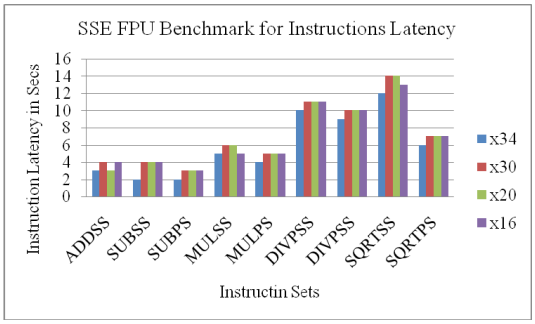

Figure 4. Different Multiplier Values with Streaming Single Instruction Stream Multiple Data Stream Extension Floating Point Unit Benchmark Instructions

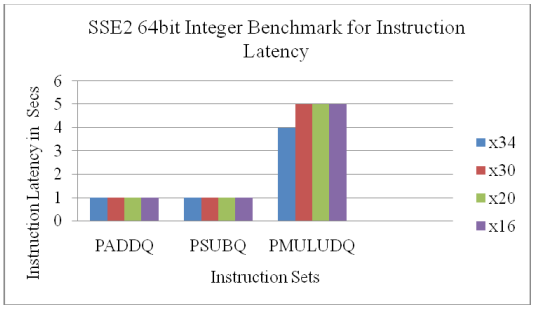

Figure 5. Different Multiplier Values with Streaming Single Instruction Stream Multiple Data Stream Extension2 64bit Integer Benchmark Instructions

According to Figure 2 to 5, the higher multiplier values lead to reduce the latency effectively for all kinds of datasets. Multimedia Extension (MMX), Floating Point Unit, Single Instruction Stream Single Data Stream Extension and Single Instruction Stream Single Data Stream 2 for 64bit Integer Benchmarks with millions of calculations are used to measure the overclocking method.

2.6 2.5. Temperature Changing Conditions by CPU Overclocking

The below Figure 5.40 shows the temperature becomes hotter when the multiplier value changes.

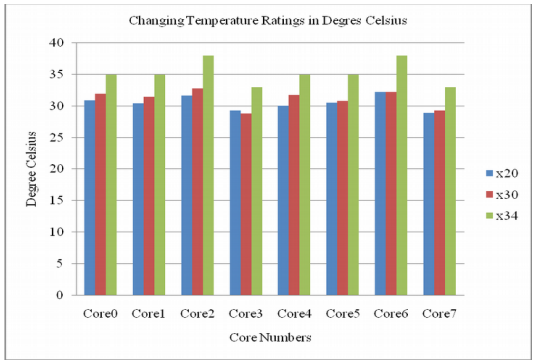

Figure 6. Individual Core Temperature in Degrees Celsius with Multiplier Values 20, 30 and 34 respectively

Less significant results exist at the multiplier values 20 and 30 but the significant temperature results can be seen at multiplier 34.

3 3.Tools Usage and Overclocking Method

Without having the tools usage experiment, overclocking method is hard to implement successfully. The information provided from the tools is useful to prevent and detect the processor from all kinds of failure.

So we need to collect the following tools to accomplish the overclocking method.

CPUID CPU-Z tool is used to investigate the overall specification of the processor.

Real Temp tool is very useful when to control the CPU from overheating. Another **FFT-z** applied to benchmark the processor performance after overclocking.

Overclock Checking Tool (OCCT) examined the system's stability beyond overclocking process. The last valuable **Tthrottle** tool is used to protect the system from exceeding the system temperature specified by the manufacturer.

3.1. Intel Voltage Limits

The following Table 1 displays the minimum and maximum voltage limits of the testbed processor. The Core voltage changes between 0.25 and 1.50 when overclocking. The CPU

overclocked voltage goes from 1.71 to 1.89 volts. The system agent voltage comes from 1.5 to 1.65 volts.

Table1. Minimum and Maximum Intel Processor Voltages

Type	Min	Max
V_{CORE}	0.25 V	1.50 V
V_{CCIO}	1.02 V	1.08 V
V_{CCPLL}	1.71 V	1.89 V
V_{DRAM}	1.5 V	1.65 V
V_{CCSA}	0.879 V	0.971 V
V_{AXG}	0.25 V	1.50 V

3.2. Intel Processor Temperature Limits Description

In Table 2, the maximum value of the testbed processor is 105℃ and when it exceeds over 98℃, it will throttle automatically. The optimal temperature is 90℃ and the minimum value reaches at -50℃.

Table2. Intel Processor Limits Description

Type	Ivy Bridge
Maximum	105℃
Throttle	98℃+ (above)
Optimal	90℃-(below)
Minimum	-50℃-C (below)

3.3. Temperature Ratings from Idle to Full Load

Table3. Intel Processor Limits Description

Temperature in Degree Celsius	Load Percentage
80	Hot (100%load)
75	Warm
70	Warm (Heavy load)
60	Norm
50	Norm (Medium load)
40	Norm
30	Cool (Idle)

The above Table 3 presents the rising temperature based on the load percentage. The temperature sits at 80 degrees Celsius when full load. And the coldest or idle state is at 30 degrees.

4. Overall Performance Outcomes of Overclocking

When overclocking method is implemented, there may be advantages as well as disadvantages.

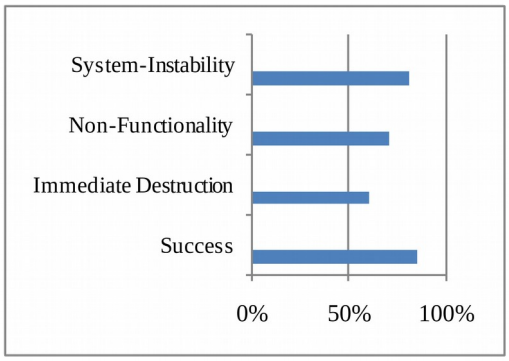

Figure 7. Performance Outcomes caused by Overclocking

Due to processor overclocking, the system instability becomes higher than the normal and also the functionality. As a result, the system may face the immediate destruction but the success rate is favorably better when the user follows the formal overclocking procedures.

The following Figure 8 expresses to control the processor temperature under a safe condition with the help of tool. The temperature will exist under 75 degree Celsius by controlling the heat exceeding with the statement below.

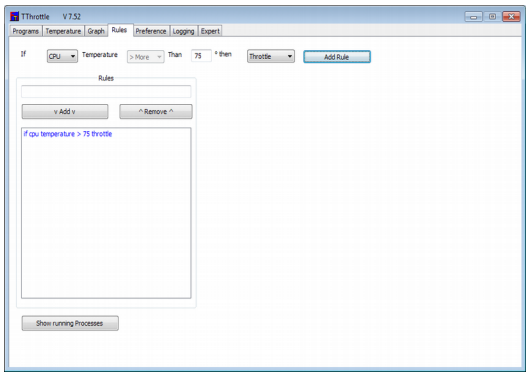

Figure 8. Controlling the Processor Temperature with Tthrottle Tool

4.1. Dual Architecture for Overclocking

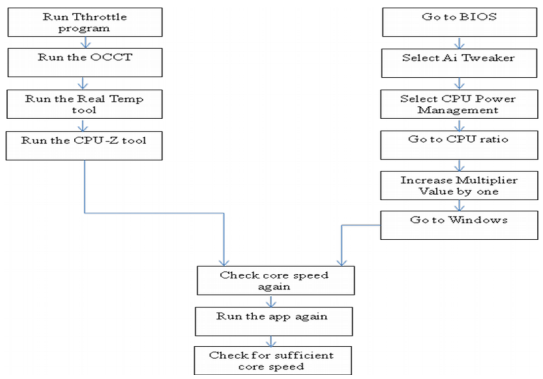

Figure 9. Dual Ways to Overclock

The above architecture captures the two ways to overclock the processor. By simultaneously doing the two procedures, the desired core speed is obtained for the system user. Running Tthrottle program after going to BIOS section is also important. Then follows the architecture and run the application to test that the overclocking method has successfully implemented.

5. Conclusion and Future Work

By changing multiplier values of the processor, overclocking procedure has been succeeded in increasing the rate of the processor. But it is very important to note the enemy of the CPU which is heat. With the help of tools, this method has already prevented from totally system failure. The different benchmark results has increased a lot from multiplier x16 to x34. Among the benchmark testings, the highese score is gained from applying x34. Temperature monitoring is important and requires not being exceeded 75°C with the help of tool. Overclocking method implementation is better than worst case design without touching the infrastructure of the processor design. In the future, this method can be implemented on thin client (less memory) server computing. Moreover, automatic changing multiplier values may be a big challenge for future researchers.

Literature Reviews

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