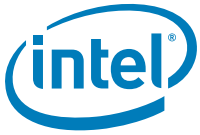

Intel® Server Board and System Products Update on Intel® Turbo Boost Technology Support with Low Power Intel® Xeon® Processor 3400/5500/5600 Series

Revision 1.0

April, 2010

Enterprise Platforms and Services Division

Revision History

Date	Revision Number	Modifications
April 27, 2010	1.0	Initial release.

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Table of Contents

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1. Introduction

1.1 Purpose of this document

The target audience of this document is Intel® server board and system products users who enable Intel® Turbo Boost Technology and use low power Intel® Xeon® processor 3400/5500/5600 series.

This document describes Turbo Boost operations and the reason why some low power processors' operating core frequency may drop out of max Turbo Boost frequency when the system processor core loading is near 100% on Intel® server board.

1.2 Intel® Turbo Boost Technology Overview

Intel® Turbo Boost Technology opportunistically, and automatically, allows the processor to run faster than the marked frequency if the part is operating below power, temperature and current limits. Intel® Turbo Boost technology can be engaged with any number of cores or logical processors enabled and active. This results in increased performance of both multi-threaded and single-threaded workloads.

BIOS contains a set-up option to enable or disable Intel® Turbo Boost Technology and it operates under operating system (OS) control by engaging when the OS requests the highest performance state (P0). Power Management settings within the OS can be adjusted to optimize these setting. For ACPI aware operating systems, no changes are required to support Intel® Turbo Boost technology. The maximum frequency is dependent on the number of active cores and varies based on the specific configuration on a per processor number basis. The amount of time the processor spends in the Intel® Turbo Boost technology state will depend on workload and operating environment.

Intel BIOS setup also contains a Turbo Boost Power Optimization setting. For Intel® Xeon® Processor 5600 Series processors with Intel® Turbo Boost Technology, there is a Power Optimization feature which can be engaged to further improve power/watt performance. Intel's studies show that by delaying engaging Turbo Boost until the P0-state has been continually requested for approximately 2 seconds, the overall average system performance per watt can be increased.

When enabled, Turbo Boost Power Optimization induces this optimal 2 seconds delay in activation of Turbo Boost. When disabled, or on processors where it is not supported, Turbo Boost will take effect immediately in P0 state.

Intel® Turbo Boost Technology is available only on supported processor versions. With Intel® Turbo Boost technology, the processor is capable of maximizing core frequency while ensuring that it does not exceed its electrical and thermal specifications. This means workloads that are naturally lower in power or lightly threaded may take advantage of headroom in the form of increased core frequency. Continual measurements of temperature, current draw, and power consumption are used to dynamically assess headroom.

Intel® Turbo Boost Technology core frequency upside availability performance is constrained by

the following factors:
– The number of active cores (in C0 or C1 state)
– The estimated current consumption of the processor (Imax)
– The estimated power consumption (TDP - Thermal Design Power) of processor
– The temperature of the processor

Refer to http://www.intel.com/technology/turboboost/index.htm for more details about Intel® Turbo Boost Technology.

1.3 How to observe Turbo Boost Technology operation in Windows OS

By using a tool that monitors processor utilization such as Windows Task Manager - Performance tab, in conjunction with a tool that monitors the CPU frequency such as Intel® **Turbo Boost** Technology Monitor (Microsoft* Win7/ Vista) , a user can observe the processor Turbo Boosted frequency when turbo mode is engaged. In that case, the user can see the transition of the CPU to the P0 state, at a core frequency that is higher than the marked frequency of the processor, and can verify that active cores are in turbo mode. For example using a processor with a 2.6 GHz marked CPU frequency, the user will see a frequency between 2.67–2.8 GHz when turbo mode is engaged.

2. Intel® Turbo Boost Technology support on Intel server boards

2.1 CPU load current monitor (IMON) on Intel® Server Boards and Systems are optimized for higher TDP processors

Per Voltage Regulator Module (VRM) and Enterprise Voltage Regulator-Down (EVRD) 11.1 Design Guidelines, IMON (i.e. CPU load current monitor) is an analog output signal (from VR to CPU ISENSE pin) whose voltage level is proportional to the VR's total output load current. The VR regulation on the platform will provide gain setting to CPU during the Power-On Configuration (POC) time. The accuracy of the proportional gain will be platform and processor dependent. The accuracy of the IMON reporting and the optimization of the processor specific IMON gain setting will determine Intel® Turbo Boost Technology performance on a particular board or system. More accurate IMON reporting will have a positive impact on Intel® Turbo Boost Technology performance.

Specific to the Intel® server boards and systems, the CPU load current monitor (IMON) settings described above are optimized for processors with higher TDP specifications. As a result, some lower TDP processors may not realize the full benefit from the Maximum Turbo Frequency. It is expected that these processors may drop back to their marked operation core frequency sooner, and the point at which a processor drops out of Turbo Boost is dependent on the constraints listed above in Section 1.2. These processors include Intel® Xeon® Processor 3400 series with 30W/45W TDP and Intel® Xeon® processor 5500 and 5600 series with 40W/60W TDP.

2.2 Customer Impact and Action Recommendation

Intel® Turbo Boost Technology is a feature that adds extended performance to customer's applications. This Turbo Boost enhancement is most pronounced at moderate workloads where the processor can achieve the maximum frequency boost. When all other conditions are equal, higher CPU utilization rates, higher environmental temperatures or processors with lower TDP's will cause the system to drop from Turbo Boost mode sooner.

The Turbo Boost Technology support on Intel's server boards and systems for the above mentioned lower TDP processors has rather limited impact on the overall system performance across typical workload; therefore Intel does not recommend any specific customer actions when using the low TDP processors on Intel's server boards and systems.

Glossary

Thermal Design Power (TDP): Thermal Design Power or Thermal Design Point designates maximum amount of power a chip or a system is required to dissipate.

Load Current Monitor (IMON): An IMON is an analog output signal proportional to the VR's total output load current.

Advanced Configuration and Power Interface (ACPI): ACPI is an open-standard specification for unified OS-centric device configuration and power management. It brings power management into OS control, as opposed to BIOS central systems. ASL is the ACPI Source Language used for specifying the desired device behavior.

C-state: The processor C-state is the processor's capability to go into various low power idle states (with varying wake-up latencies). Intel architecture-based processors have several C-states representing parts that can be switched off to save power. C0 is the operational state, meaning that the CPU is doing useful work. C1 is the first idle state: The clock running the processor is gated; that is, the clock is prevented from reaching the core, effectively shutting it down in an operational sense. C2 is the second idle state: The external I/O Controller Hub blocks interrupts to the processor. And so on with C3, C4, and others.

P-states: The processor P-state is the capability of running the processor at different voltage and/or frequency levels. Generally, P0 is the highest state resulting in maximum performance, while P1, P2, and so on, will save power but at some penalty to CPU performance.

Intel® Turbo Boost Technology: Intel Turbo Boost Technology allows a processor's cores to run faster than the base operating frequency if the package is operating below its power, current, and temperature specification limits. Intel Turbo Boost Technology is activated when the OS requests the highest processor performance state (P0). Maximum frequency depends on the number of active cores. The amount of time the processor spends in the Intel Turbo Boost Technology state depends on the workload and operating environment, providing the extra performance. Intel Turbo Boost Technology increases the performance of both multi-threaded and single-threaded workloads.

References

Intel® Turbo Boost Technology:

http://www.intel.com/technology/turboboost/index.htm

Intel® Server Processors:

http://www.intel.com/p/en_US/products/server/processor