IT@Intel Brief

Intel Information Technology

Computer Manufacturing

Data Center Management

July 2009

Realizing Data Center Savings with an Accelerated Server Refresh Strategy

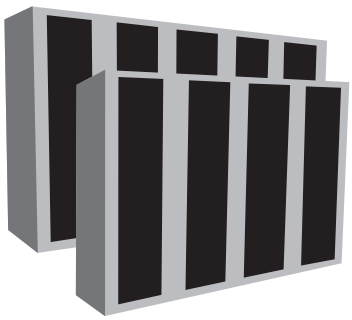
In 2007, Intel IT established a four-year server refresh rate across our design computing environment. By replacing aging servers on a regularly scheduled cadence, Intel has realized operational cost savings, avoided incremental data center capital spending, and gained capacity to support growing, business-critical design computing needs. The strategy saved Intel USD 45 million in 2008, and we expect to achieve savings of up to USD 250 million over eight years.

Profile: Server Refresh

- Projected 8-year savings of USD 200 to 250 million
- USD 45 million savings realized in 2008
- Delaying 2009 refresh would increase costs by USD 19 million

Recent economic conditions forced us to re-evaluate many of our capital investments, including continued execution of our four-year refresh strategy. However, analysis showed that deferring server refresh until 2010 would increase operating and data center capacity costs by USD 19 million.

We are therefore continuing to execute our strategy to refresh aging servers in 2009 with new servers based on Intel® Xeon® processor 5500 series. When replacing older servers, we have found we can achieve consolidation ratios ranging from 7:1 to 13:1 depending on the workload and other factors, while substantially reducing energy consumption.



2005

- 9 Racks
- 184 Servers
- 360 Square Feet (Sq. Ft.)
- 451 Kilowatts (kW)
- Intel® Xeon® Processor (3.8 GHz) with 2 MB L2 Cache

2009

- 1 Rack
- 21 Servers
- 40 Sq. Ft.
- 42 kW
- Intel® Xeon® Processor X5570 (2.93 GHz)

Same Performance Using 90% Less Power and Space

Figure 1. Accelerated server refresh allows Intel IT to consolidate workloads onto newer, more powerful servers, avoiding the need for new data center construction. Based on estimated Specjbb2005* benchmark.[1] Intel internal measurements, February 2009.

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Business Challenge

Like most IT organizations, Intel IT faces the challenge of accommodating ever-increasing compute requirements within data center space, power, and cooling constraints.

Most of our server resources support semiconductor design. As Intel® processors have become more complex, design computing requirements have risen steadily, driving a rapid increase in the number of design computing servers—from about 1,000 in 1996 to 68,000 in 2007.

During this time, we focused on maximizing the useful life of each server, so we kept most of them in service well beyond their warranty. As compute requirements outgrew existing data center space or power and cooling capacity, we built or expanded data center facilities.

However, building data centers is extremely expensive. It was also expensive to maintain and operate our growing population of older, less-efficient servers.

Solution

In 2007, as part of an enterprise-wide strategy to increase data center efficiency, we began exploring a proactive server refresh strategy that takes advantage of increasing server performance and energy efficiency to reduce costs.

Server performance has accelerated dramatically since the introduction of processors based on Intel® Core™ microarchitecture in 2006. This translates into greatly improved performance for Intel design workloads, as shown by the Intel IT test results in Figure 2. However, the new processors are much more energy-efficient, so server power consumption has remained about the same.

By accelerating the rate at which we refresh servers, we can take advantage of this increasing performance and energy efficiency, consolidating multiple server workloads onto each new server while reducing overall energy consumption. This effectively increases data center capacity, letting us accommodate growing compute demands without adding facilities.

Financial Analysis

Intel IT performed an extensive financial analysis to determine both the business value of accelerating server refresh and the most cost-effective cadence for our computing environment. We analyzed the return on investment (ROI) that could be delivered by adopting different refresh cadences ranging from one to six years.

We examined the effect of applying these cadences across Intel's entire worldwide design environment. For example, with a six-year refresh cadence, we would consolidate and replace all design servers more than six years old.

Our model examined total costs over eight years. We assumed that the cost of each new server would remain stable over this evaluation period, while computing requirements would continue to increase by 15 percent per year. Our analysis took into account regional variation in construction and utilities costs. A comprehensive TCO model, similar to the one used by Intel IT, can be accessed at www.intel.com/go/xeonestimator.

We analyzed key factors that significantly affect ROI:

Total server costs. This includes total server acquisition costs as well as warranties. For cadences of more than four years, we also include the expected cost of repairing out-of-warranty servers. In general, faster refresh rates result in increased total cost for acquiring new servers, because we purchase more servers over our eight-year evaluation period. Our analysis assumes consolidation onto blade servers. Consolidation ratios are based on our expectations of the performance of future Intel processors and vary depending on the cadence and type of application.

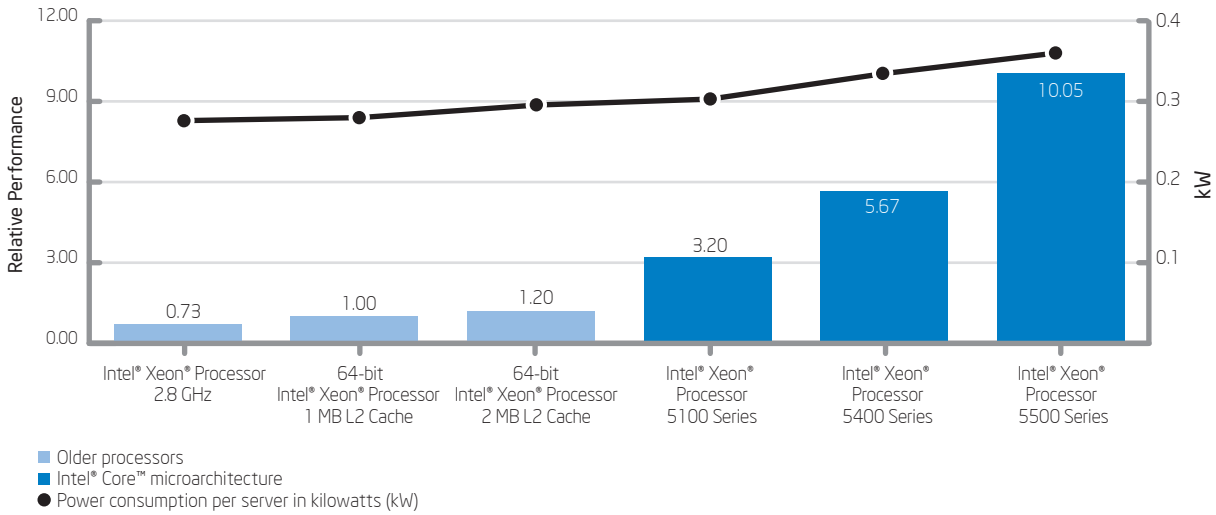

Figure 2. Server performance has accelerated, while power consumption has remained approximately constant. Results of tests running end-to-end electronic design automation applications on multiple Intel silicon design workloads. Intel internal measurements.

Construction cost avoidance. The newest, most powerful servers support the highest consolidation ratios, reducing the need to expand facilities. Therefore, faster refresh rates result in the most construction cost avoidance.

Utilities. The most recent server models are also the most power-efficient on a compute per watt basis. The more frequently we refresh, the more we save in power and cooling expenses required to support our compute demand.

Network. Higher refresh rates reduce network switch port requirements because we can achieve higher consolidation ratios.

Tax impacts. These include the tax benefits of server and facilities depreciation as well as operating expenses.

Our analysis, shown in Figure 3, compared each cadence with our existing approach, in which we replaced only about 20 percent of servers after four years, effectively resulting in an overall cadence of more than seven years.

We found that a four-year refresh cycle delivered the greatest ROI, reaching nearly USD 250 million due to the best combination of construction avoidance, server refresh costs, and utilities savings.

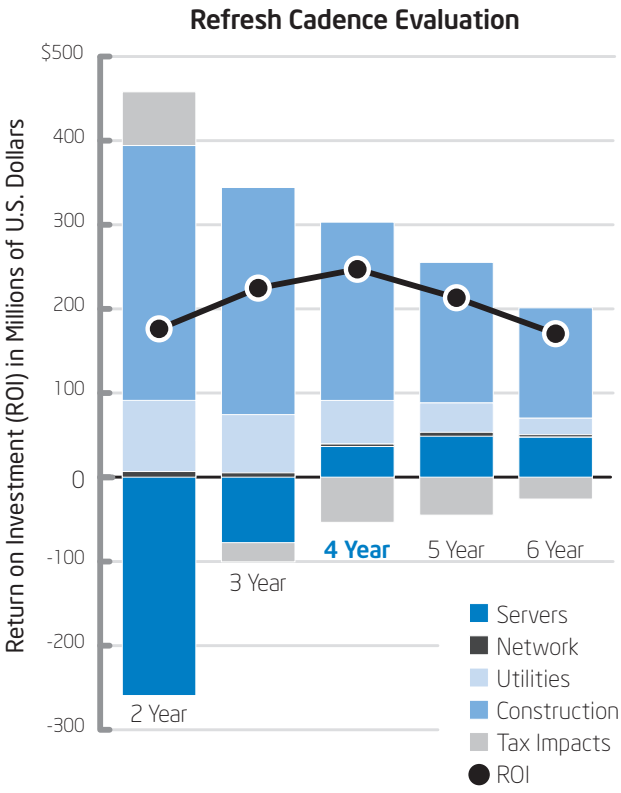

Figure 3. Return on investment (ROI) analysis comparing server refresh cadences with our existing approach. For each factor, a positive value indicates financial benefits compared with existing approach; a negative value indicates greater cost compared with existing approach. ROI is the net benefit of all the listed factors. *Note: Evaluation performed in 2008 found that a four-year cadence delivered the greatest ROI. This conclusion was unchanged following re-evaluation in 2009 using performance and power specifications of production servers based on Intel® Xeon® processor 5500 series.*

Other Benefits

An accelerated refresh cycle delivers other benefits not included in our ROI analysis.

Sustainability. We can significantly reduce power consumption, thereby reducing Intel's carbon footprint. Based on the high consolidation ratios we can achieve in design batch computing, we estimate we can reduce energy consumption by approximately 850 to 890 kilowatts (kW) for every 500 older servers we consolidate using blade servers based on the Intel Xeon processor 5500 series. Adopting more energy-efficient servers also has enabled us to qualify for local government energy credits (see sidebar).

Better capabilities for design engineers. Many of our older servers have 4 GB or less of memory. Increasing design complexity propels a need for more memory: Our current semiconductor design validation jobs can require up to 25 GB. Newer servers can accommodate these memory requirements, helping to accelerate chip design by letting our design engineers become more productive. For example, high-performance computing servers based on the Intel Xeon processor 5500 series can accommodate up to 192 GB of memory.

Sustainability Incentives

Because server refresh reduces power consumption, it can enable organizations to qualify for local green computing incentives. For example, one program in Oregon provides incentives for projects reducing energy consumption by at least 5 percent. This program, administered by the Energy Trust of Oregon (ETO), requires organizations to submit detailed documentation of results for verification and approval. In 2008, our server refresh activities were approved under this program, yielding an additional USD 250,000 savings.

Strategy Implementation

The development and execution of our server refresh strategy required coordination among business units, IT, corporate finance, facilities engineering, and senior management. Avoiding common pitfalls, such as looking at costs from only one group's perspective, was critical to gaining buy-in from all stakeholders.

Because server refresh affects so many business groups, we found that perseverance was required to communicate the benefits to all stakeholders. This required an internal champion to drive the initiative.

We began implementing the accelerated server refresh strategy, based on our four-year cadence, in 2008. In our first year of implementation, we consolidated about 20,000 older servers onto newer, more powerful platforms. We realized substantial benefits in 2008, including savings of USD 45 million:

- USD 40 million in data center capital avoidance by eliminating the need to add capacity at four locations

- USD 5 million savings in reduced annual operating costs
- Additional capacity to support the growing requirements of critical design engineering projects

Staying Committed to Server Refresh in an Economic Downturn

The recent economic downturn forced Intel IT, like most other businesses and IT organizations, to re-evaluate all 2009 capital investments—including server purchases for our refresh strategy.

Our analysis indicated that deferring 2009 server refresh would increase operating and capital costs by an estimated USD 19 million and require us to add approximately 1.3 megawatts (MW) of new data center capacity across eight strategic locations.

Therefore, in 2009 we are continuing to execute our four-year server refresh strategy, using servers based on the Intel Xeon processor 5500 series. Our testing shows that we can achieve significant consolidation ratios by replacing four-year-old servers based on single-core processors.

Options for Old Servers

We found several worthwhile options for disposing of the thousands of old servers we have replaced. In all cases, we followed our standard security procedures to remove data from the systems before reuse or resale.

- **Resale.** We arranged for a technology supplier to purchase servers.
- **Internal reuse.** We reused some servers internally for testing and development. We carefully weighed the benefits against the impact of increased utility costs.
- **Donations.** We donated servers to schools for use in training.
- **Scrap.** We sold some servers for their scrap value.

Refining the Strategy

Server refresh evaluation is an iterative process. Each year we may adjust our strategy to deliver maximum savings, taking into account changes in server price and performance, construction costs, and other factors.

For example, it might be beneficial to accelerate the refresh rate to a three-year cadence if:

- Construction costs increase.
- Server performance increases or average server prices drop.
- Utility costs increase or governments expand incentives for conserving energy.

Location dependencies also play a role; it may make sense to refresh more quickly at a specific facility if we need to add compute capacity and the facility is already nearing its space or power and cooling limits.

Other factors that favor a faster refresh cadence include higher resale values for recycled servers. Because of this potential variation, we are projecting that actual savings could range between USD 200 million and USD 250 million over eight years.

Conclusion

Our proactive server refresh strategy is one of the biggest drivers of IT value in our environment. This continues to be true even in current economic conditions, when capital budgets are under tight scrutiny. The strategy has already saved USD 45 million in 2008, and we anticipate increasing those savings to USD 200 to 250 million over eight years.

Learn more about Intel IT's best practices at www.intel.com/IT.

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[1] Performance increase based on Intel comparison using SPECjbb2005 business operations per second (bops) between four-year-old single-core Intel® Xeon® processor 3.8GHz with 2M cache based servers and new Intel Xeon processor X5570 based server. Intel consolidation based on replacing nine four-year-old single-core Intel Xeon processor based servers with one new Intel Xeon Processor X5570 based server while maintaining SPECjbb2009 performance. Costs and return on investment have been estimated based on internal Intel analysis and are provided for information purposes only. Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing. For more information, visit www.intel.com/performance/server.

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