



IT@INTEL

Boosting Efficiency with a Single Data Center Management Solution

Using Intel® Data Center Manager, our data centers are achieving the following results:

- Obtain power and thermal predictive analysis
- Identify “ghost” (underused) servers
- Reduce costs

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Executive Overview

Energy costs are the fastest-rising expense for today's data centers. Naturally, power consumption is a top concern for managers of data center, enterprise, and cloud environments. Moreover, there are multiple proprietary power measurement and control protocols supported by various solution providers, making it challenging to have a single solution for power management across all devices in the data center.

After a successful Intel IT proof of concept (PoC) using Intel® Data Center Manager (Intel® DCM) that ended in 2013, we deployed the solution across data centers in multiple countries. In our initial use of Intel DCM, we considered the solution to be focused primarily on gaining a better understanding of the power consumption and thermal status of servers. With broad deployment, we learned that Intel DCM is capable of much more.

The Intel DCM solution provided us with real-time and historical data center thermal maps and cooling analysis. The analysis covered not only servers and racks from different OEMs but also storage, networks, and facilities equipment. We were able to detect hotspots and cooling anomalies and find “ghost” (underused) servers. Because Intel DCM was easy to implement, integrate, administer, and operate, this solution provided significant ROI in a short amount of time.

The Intel DCM PoC generated good business value, enabling us to receive funding to use Intel DCM worldwide. We found that this solution matched most of Intel IT's needs. After a successful deployment on a large Design data center, we plan to implement Intel DCM globally in all our Design data centers.

Contents

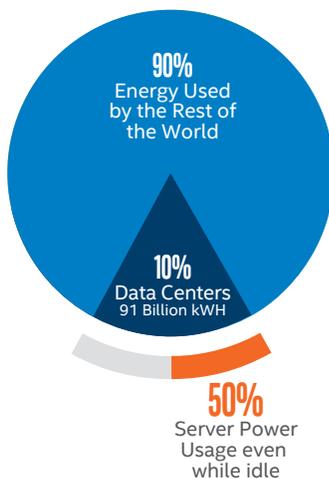
- 1 Executive Overview
- 2 Business Challenge
- 3 Deploying Intel® Data Center Manager Worldwide
 - Increasing Data Center Efficiency Using Intel® Data Center Manager
 - Expanding Our Use of Intel® Data Center Manager beyond Power Consumption and Thermal Status
- 7 Conclusion

Acronyms

CRAC	computer room air conditioning unit
Intel® DCM	Intel® Data Center Manager
PDU	power distribution unit
PoC	proof of concept
PUE	power usage effectiveness
UPS	uninterrupted power system

Global Energy Use

Source: Digital Power Group, "The Cloud Begins With Coal – Big Data, Big Networks, Big Infrastructure, and Big Power." August 2013



Business Challenge

Intel IT has been looking for a standardized data center management solution for the 60 data centers in Intel's global environment. Given recent increases in data and energy costs, we were looking for a solution that is designed to manage the complex data center infrastructures, can help reduce costs, and is easy to deploy and use.

Managing power usage in the data center environment can be complex. Servers consume most of the energy managed by IT. The facility team for a particular building may be tasked with measuring and managing power at rack and power distribution unit (PDU) levels, but those teams often have limited visibility into server consumption. Jeff Klaus, general manager of Intel Datacenter Solutions, says that servers use 50 percent of a data center's power, even when those servers are idle.

Adding to the complexity, there are multiple proprietary power measurement and control protocols supported by different solution providers, making it challenging for a single solution to manage power and temperature across all devices in the data center.

To boost the efficiency of our data centers, we needed a data center management solution that could meet the following requirements:

- Real-time thermal monitoring of the environment with a high level of data granularity
- Predictive analysis of thermal data that could identify temperature issues before they cause critical incidents
- Monitoring and aggregation of real-time power consumption on IT devices to develop, analyze, plan, and manage data center capacity compared to actual utilization so that we can use the power and cooling infrastructures efficiently
- Integration of Intel IT's knowledge and controls of IT equipment, such as servers and infrastructure, and building facility teams' knowledge of PDUs, air handlers, and CRAC units (computer room air conditioning units)
- Deployment of a standard management solution in the data center environment without increasing the data center's operation managers' overhead

In 2012 and 2013, we conducted a proof of concept (PoC) to learn whether Intel® Data Center Manager (Intel® DCM) could meet the needs of Intel's data centers around the world. After the PoC, we determined that Intel DCM fulfilled Intel's data center management requirements and provided a measurable return on investment (ROI).

Deploying Intel® Data Center Manager Worldwide

The significant ROI generated by Intel DCM since the completion of the initial PoC helped us to obtain funding for a global rollout in 2015. Intel DCM met three criteria for a successful deployment:

- **Ease of use.** The console software (see Figure 1) can reside on any independent management server and coexist with other software products on the same server.
- **Simplicity of deployment.** Intel DCM is agentless, which makes it simple to deploy; we did not have to install any software agents on managed nodes. Our deployments of Intel DCM scaled to manage tens of thousands of servers from different suppliers. Monitoring 7,000 assets spread across several data centers required only three to four days' deployment time—significantly less than the other management solutions we have tried.
- **Interoperability.** The PoC proved that Intel DCM can complement other management solution deployments. Because Intel DCM is supplier-neutral, it can manage many server models from many suppliers as well as manage a variety of products from PDU and rack suppliers.

We are using a phased rollout plan. We are currently in Phase 1, which was implemented initially on 8,000 production nodes in a subset of the data centers in Israel, Russia, Ireland, and India. By the end of 2015, we had deployed Intel DCM to cover about 10,000 nodes in multiple data centers.

While rolling out the software, we also tested Intel DCM scalability. We achieved our goal to expand each instance from 5,000 to 10,000 nodes. We integrated Intel DCM with our directory service to simplify the user experience and account management and to align the solution with Intel security practices.

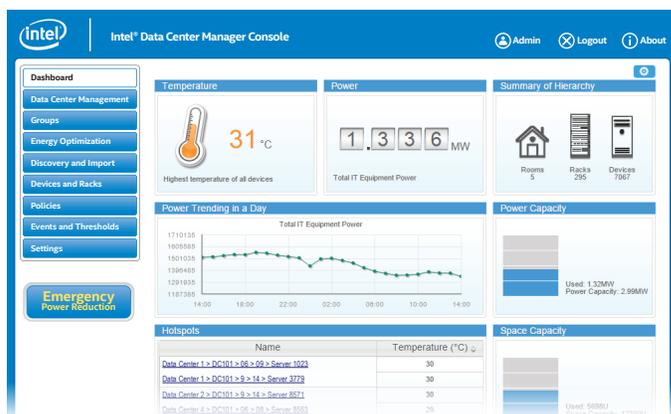


Figure 1. The Intel® Data Center Manager Console is easy to use, can reside on any independent management server, and can coexist with other software products on the same server.

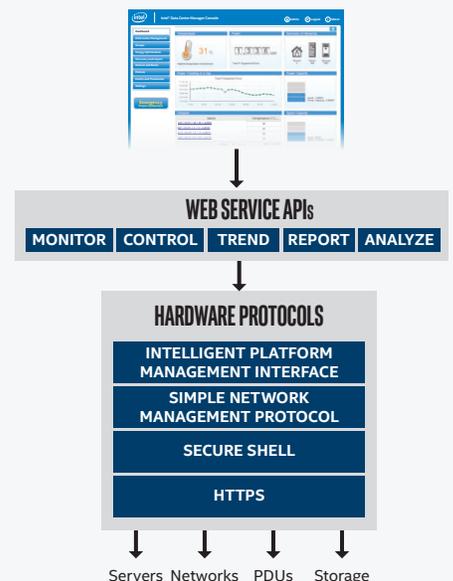
A Closer Look at Intel® Data Center Manager

Intel® Data Center Manager (Intel® DCM) is a standalone solution that provides accurate, real-time power and thermal monitoring and management for individual servers, groups of servers, racks, and other IT equipment, such as power distribution units (PDUs). Intel DCM provides benefits for both IT and facility administrators, enabling these groups to collaborate to reduce the data center's energy footprint.

As illustrated below, Intel DCM supports a variety of hardware, including rack and blade servers, and PDUs and uninterruptible power systems (UPSs). In fact, Intel DCM's ability to be supplier-agnostic is one of its main values. Intel DCM also supports many industry-standard hardware protocols.

Intel DCM enables data center managers to monitor, control, and analyze data center operations, track trends, and create reports. The data and reports are available through an easy-to-use dashboard called the Intel DCM Console.

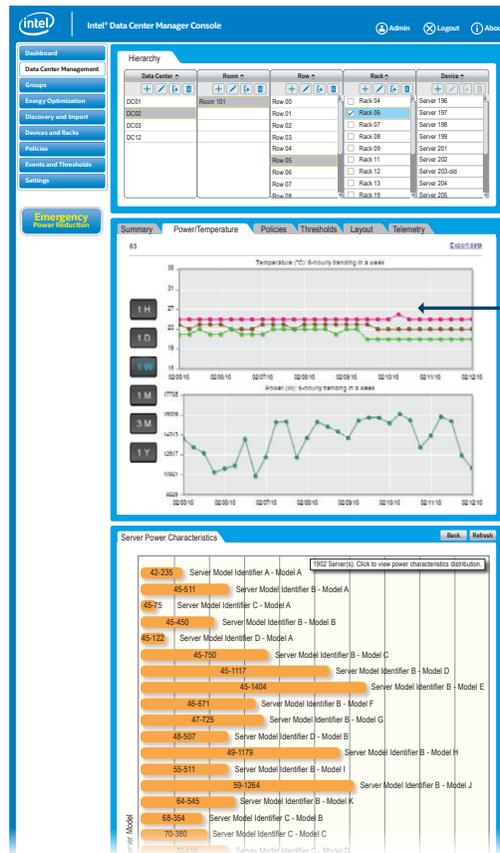
For more information about Intel DCM, visit software.intel.com/sites/datacentermanager.



Increasing Data Center Efficiency Using Intel® Data Center Manager

Intel DCM helped us increase energy efficiencies in our data centers. Some immediate benefits we observed included the following:

- Real-time power and thermal data for racks, rows, blades, and data center rooms.** The real-time power consumption and thermal data (see Figure 2) helps us to manage data center hotspots and perform power usage planning and forecasting. These features have enabled us to replace costly intelligent power strips (smart PDUs).
- Increased rack density.** Intel DCM provides detailed information about server power characteristics (see Figures 2 and 3). This information helps us set fixed-rack power envelopes and enables us to safely increase server count per rack, which improves data center utilization.
- Real-time thermal maps from aggregated power monitoring.** We can create a real-time view of power consumed by the servers by aggregating the data for the rack, row, and room with temperature data for the server inlets. This results in thermal maps that span these same assets. (See the sidebar, “Intel® Data Center Manager in Action: Detecting Hotspots.”)
- Simplified operations management.** Intel DCM helps us manage power across various devices from multiple suppliers, eliminating the need for separate equipment-specific tools.
- Business continuity.** Intel DCM helps us maintain operations during power outages. The real-time data helps our data center managers make data-driven decisions when managing incidents.



Hierarchy
Hierarchy system allows for monitoring at various levels: data center, room, row, rack, and device.

Temperature
Temperature monitoring shows spikes when servers are heating up.

Power
Weekly trends clearly show a difference between the power consumption during working and non-working hours.

Server Power Characteristics
Power characteristics show power range for each server model installed in the data center and can drill down to individual models.

Figure 2. Intel® Data Center Manager displays real-time information for data center rooms, server racks, rows, and blades.



Server Power Characteristics Drill-Down
Peak power distribution shown for a specific server model.

Figure 3. The detailed view of server power characteristics helps us increase rack density and properly design power capacity on the room, row, and rack levels.

Expanding Our Use of Intel® Data Center Manager beyond Power Consumption and Thermal Status

In our initial use of Intel DCM, we considered the solution to be focused primarily on better understanding power consumption and the thermal status of servers. However, we discovered that Intel DCM was also able to help us achieve the following results in our data centers:

Server Capacity Planning

Real-time data from a large sample of servers enables more accurate and proactive capacity planning. Intel DCM provides historical server power consumption data that enables us to efficiently plan for future server needs. The Intel DCM data is more accurate than relying on nameplate or de-rated power specifications. Now we can make strategic decisions as to where to invest in new capacity or how to utilize capacity based on power costs.

Cooling Capacity Planning

Aggregating all the server-inlet temperature data into thermal maps enables us to check the effectiveness of our cooling solutions and airflow design (see Figure 4). Intel DCM has proven to be extremely accurate for our planning in this area. For example, we determined that one data center had a cooling analysis that aligned with the room’s low power usage effectiveness (PUE), and another data center had a cooling analysis indicating that the room was overcooled, which aligned with that data center’s less-efficient PUE.

Aggregated Control Of Power Devices

Intel DCM helps eliminate the need for expensive smart power strips. Where we were already using smart PDUs, their real-time data was integrated into the Intel DCM Console.

Intel® Data Center Manager in Action: Detecting Hotspots

One afternoon, an Intel data center facility manager received overheating alerts for several servers. The manager checked the Intel® Data Center Manager (Intel® DCM) Console to locate the hot servers. The building’s facilities team had not seen anything abnormal on their monitors because fewer temperature sensors in the data center are connected to their building management system.

The data center facility manager found that an air conditioning unit had been accidentally powered off (therefore, it did not trigger a facilities alert). The unit was turned on, and the hotspot was fixed. Without the Intel DCM’s rack- and server-level granularity of thermal data, the servers might have shut down resulting in costly downtime.

In another instance, Intel DCM data in one data center revealed some hotspots. We deployed additional cooling with increased perforated floor tiles and then used Intel DCM to verify that the hotspots were eliminated.



Cooling Analysis
Aggregating server-inlet temperature data into thermal maps shows effectiveness of cooling solutions and airflow design.

Figure 4. Intel® Data Center Manager’s cooling analysis shows temperature measurement distribution in the data center.

Prevention of Thermal Incidents and Detection of Hotspots

Intel DCM provides predictive thermal analysis, which helped in several cases to eliminate thermal risks (see Figures 5 and 6). Intel DCM helped identify hotspots and thermal inefficiencies that provided our data center managers with enough information to change the design of problematic rooms to increase energy efficiency.

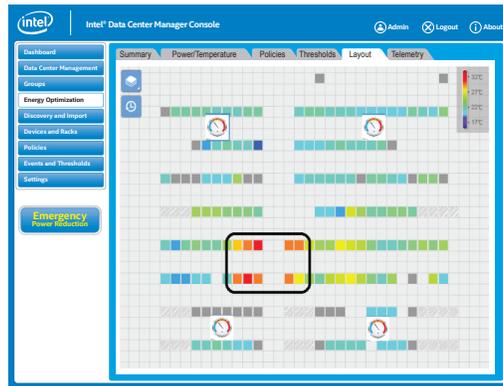
Intel DCM's cooling analysis function alerted us to hotspots and also helped identify faulty temperature sensors in one of the data centers. We found Intel DCM to be a much more efficient and effective tool in this area, compared to our previous manual computational fluid dynamics analysis. Real-time hotspot detection allowed us to solve thermal issues in the room and increase both the thermal and energy efficiency.

Discovery of "Ghost" (Underused) Servers

The automatic identification of idle or rarely used servers revealed opportunities for consolidation and virtualization. Besides saving power, this feature helped us determine optimal server reuse and reassignment of assets. Our strategy is to migrate low-usage devices into virtual servers.

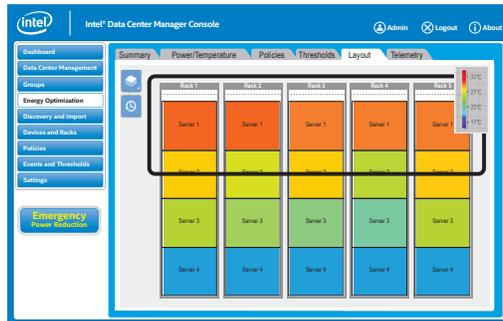
Lowering Total Operating Costs

We used real-time power and thermal data to make better decisions about load balancing and right-sizing the data center's environment. We also created user-defined alarms that warn of potential circuit overloads before any actual failures or service disruptions occur. We estimate that this type of data will help us reduce our overall data center energy consumption while improving operational efficiency.



Layout
Server- and rack-level thermal status granularity identifies hotspot that cannot be detected by the regular four temperature sensors installed in the data center.

Figure 5. Intel® Data Center Manager's real-time, server- and rack-level thermal map can identify hotspots that cannot be detected by standard facility temperature sensors.



Layout - Detailed View
Server-level thermal monitoring shows hotspots in racks.

Figure 6. This detailed view of server locations within racks reveals that the servers in the top row are hot, a common occurrence that cannot be detected without server-level thermal monitoring.

Conclusion

In our PoCs and production rollout, we found that Intel DCM meets most of Intel IT's data center management needs. After a successful deployment in a large Design data center, Intel DCM was approved and we are working toward a global deployment in all of Intel's Design data centers. Intel IT remains optimistic about future features and benefits to be gained from Intel DCM innovations. In the short term, Intel DCM continues to yield value with its ease of use and insightful results. The combination of device-level and higher-level visibility (by rack, row, or room) has changed the way that we manage liabilities and efficiency related to energy and temperature. We can fully exploit real-time data to identify problem areas, and we get more done with less—both of which help lower Intel's data center operating costs.

We believe that the real-time device-level visibility, the flexible aggregation capabilities, and the historical trend reports will enable more data center management studies. We found that Intel DCM helped us to bridge the gap between the IT and facilities organizations, providing them with the ability to consolidate their efforts toward data-driven decision making.

Intel IT will continue to analyze data center management solutions as the industry matures, and we will work with suppliers to guide them in meeting enterprise data center management needs. In particular, we will stay informed about data modeling and analysis capabilities of various products. Intel DCM is certain to be a major building block in any new solution Intel IT might choose in the future.

For more information on Intel IT best practices, visit www.intel.com/IT.

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Our goal is simple: improve efficiency throughout the organization and enhance the business value of IT investments.

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