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Setting the record straight on power and cooling

IBM BladeCenter vs. HP BladeSystem

In November 2006, IBM did extensive power testing on the BladeCenter and HP BladeSystem c-Class solutions. The results depict a clear advantage to IBM. Through a well-planned system design that includes more energy-efficient power supplies and thermals and a smarter power delivery solution, IBM showcased power savings up to 19% to 24%, depending on the load and processor architecture.

In response to the IBM test results, HP published its own contradictory information. To clear up the confusion, IBM challenged HP to third-party power and cooling testing. What a surprise, HP declined. Let's look at HP's claims and IBM's response.

HP says: HP claimed IBM had an advantage in power and cooling only when one idle server is installed in the chassis.

IBM says: IBM did see its largest lead in lightly loaded chassis. Why? The IBM power supply reaches peak efficiency very quickly – 85% of peak at only 20% loading. Given that most x86 servers are utilized at well under 15-20%, leadership at near-idle operation is quite significant. IBM testing showed that the HP power supply is extremely inefficient at lower loads.

HP says: HP testing showed that a fully configured HP BladeSystem c7000 used less energy per blade than a fully configured IBM BladeCenter H, both at idle and fully stressed conditions.

IBM says: IBM tested several configurations of Intel® and AMD™ processor-based blades. In every stress test we performed, and at every utilization level we tested, IBM came out on top. The leadership efficiency is the result of smarter chassis architecture; one with more efficient power supplies and cooling and a smart sharing of common parts.

HP says: HP testing showed that the IBM BladeCenter H enclosure requires more air flow than the HP BladeSystem c7000 enclosure.

IBM says: HP may be able to claim a slight advantage in cubic feet per minute (CFM) per blade, but the exit air temperatures from the c-Class may be hotter than the typical data center can handle. In addition, lack of air through the HP chassis can lead to poor life span, especially for the switching components and those new fans at the back of their chassis. The HP BL460c blade is so tightly packed with items that 413CFM might not be enough to cool processors like the quad-core Intel processor, which IBM BladeCenter H will be able to run easily.

It is likely that HP misunderstood the IBM Power Calculator CFM readings. Airflow in IBM BladeCenter is constant and is based on incoming air temperature changes, not utilization. Having airflow requirements change with server utilization is unworkable for the data center. The raised floor is capable of delivering a set amount of airflow that can be easily predicted and planned for. Constantly changing server air demands will cause headaches for the facilities manager who may not be able to accommodate all the changing volume requirements.

IBM testing on the HP c-Class airflow design uncovered some interesting limitations[1]:

- HP's cooling capacity will likely limit their ability to safely support the new 120W quad-core Intel Xeon® processor. Even the c-Class with the 80W dual-core Intel Xeon processor that IBM tested was running very close to its maximum safe temperature when running under normal data center conditions (24C incoming air temperature). Addition of an even hotter processor will likely worsen this internal temperature.
- In the BL460c, the memory DIMMs are placed extremely close together. The limited spacing in this design results in reduced airflow and higher temperatures, which can impact performance. Additionally, when hot-swap hard drives are removed, airflow bypasses the DIMMs, which can further impact the performance and reliability.
- IBM memory stress testing on the BL460c blade resulted in excessively high DRAM thermal profiles, which could lead to early and frequent memory failures. HP does not appear to be able to guarantee single refresh rates for stacked memory due to this high thermal profile. It appears that this blade is simply not designed for high-performance computing.

Less is not always better. In the case of airflow, the right balance between air volume and internal chassis temperatures as well as exit air temperatures is critical. IBM has deployed the shared cooling topology since November 2002 with BladeCenter. The c-Class is HP's first attempt at a shared cooling topology and they may have fallen into a trap that will limit what the chassis is capable of in the very near future. Maybe HP will need to correct this apparent limitation, perhaps in yet another enterprise chassis.

HP says: HP testing showed that the IBM BladeCenter H produced more noise than the HP BladeSystem c7000.

IBM says: IBM places a great deal of emphasis on acoustics, as several regions across the world are very sensitive to noise levels. As the below data from IBM test suggests, at idle the IBM and HP systems carried the same acoustic signature. As utilization increased, the HP solution produced more noise than BladeCenter. The turbine-style fans HP uses and the high impedance of the blades and switches quickly pair up to lead to extremely high acoustic signatures that will break the commonly accepted limitations for data center equipment.

	HP BladeSystem c-Class (Db)	IBM Blade Center H (Db)
Idle	7.7	7.7
Dual-core Intel Xeon @ 70%: (typical applications)	8.1	7.7
Dual-core Intel Xeon @ 90%: (worst-case applications)	8.4	7.8

HP says: HP testing showed that IBM Power Executive™ incorrectly reported power usage by as much as 42%, while the HP Onboard Administrator power monitoring accuracies were within 1% of independent power meter readings.

IBM says: Had HP understood IBM's tools and used them properly, they would have seen that IBM PowerExecutive is not only extremely accurate, but goes well beyond what HP offers for power management.

- The readings that HP claims are PowerExecutive numbers are in fact part of the Management Module's Fuel Gauge, which is intended to give worse-case planning information to clients that have not deployed the full PowerExecutive suite – not measure power.

[1] IBM testing was conducted with one HP BladeSystem BL460c and minimum power and cooling configuration.

	IBM PowerExecutive	HP Power Regulator	Comments
Point-in-time power monitoring	Yes, hardware based	Yes, OS based	IBM supports blades and rack servers. System and rack-level data is available. The HP solution is only for the c-Class. This is very limiting as most clients have a mix of blades and rack servers.
Historical power trending	Yes	No	HP delivers only point-in-time information, which can lead to poor decisions on power infrastructure and thermal requirements. IBM's trending yields a complete picture to help in better decision making.
Enforceable power capping	Yes (available March 2007)	No	HP can turn power capping on and off, but that does not mean they can enforce a cap.
How to enable	Director plug in, no agents, no OS dependency	OS dependent, software based	The HP solution is only supported for select operating systems. IBM PowerExecutive works for all our supported operating systems.

HP says: IBM states that a fully populated 42U rack of IBM BladeCenter enclosures requires 30kW of power. However, the IBM Rear Door Heat eXchanger is specified to remove only 15kW of heat.

IBM says: HP simply does not understand the purpose of the Rear Door Heat eXchanger. It is a supplemental cooling solution that allows our clients (rack and blade users) to install higher density racks than the room would ordinarily allow.

The HP Modular Cooling System comes in at nearly seven times the price of the IBM Rear Door Heat eXchanger. It can destroy the typical data center layout and it brings into the mix new points of failure and new parts that consume power. If it fails, the doors on the unit must be forced open before the servers start to bake. Where's the HP advantage?

	IBM Rear Door Heat eXchanger	HP Modular Cooling System
Price	$4,299	$30,000
Rack foot print change	5" increase to rack depth	Width increase and 12" additional depth
Moving parts	No	Yes, three fans
Capability to run in failure mode	Yes, no action needed	No, doors must be forced open or servers overheat
Maximum thermal load	15kW supplemental to data center	30kW self contained
Fits on standard EOM rack	Yes, IBM Enterprise Racks	No, unique design

A great example of how clients are using the IBM Rear Door Heat eXchanger is the Georgia Tech Razor Super Computer. When installed earlier this year, it was the fastest Ethernet-connected cluster in the world. The data center it is housed in had a rather limiting 14" raised floor. Yet with the supplemental cooling provided by the Rear Door Heat eXchanger, this older data center was able to provide 300W/ft2 of cooling while saving the client nearly $160,000 on air conditioning costs.

HP says: HP Dynamic Smart Cooling is the industry's first solution that integrates data center-wide sensors, intelligent control and automated provisioning, which allows the computing infrastructure to interact with the data center facilities to optimize cooling. IBM has nothing like it.

IBM says: The IBM Cool Blue™ initiative is tackling the power and cooling problems with a holistic approach that begins with smarter system design, adds solution management and control, room-level solutions that can extend the capabilities of the room, and finishes with free and fee-based data center/facilities design and planning. In fact, the IBM Global Technical Services group is designing and installing state-of-the-art computer rooms that are built to efficiently house today's technology as well as prepare our clients for the future products they will need to install.

Summary: HP has fallen short on power and cooling efficiency for the past several years. With the BladeSystem c-Class, HP started from scratch and still fell short in designing a solution that matches the system-level efficiency of IBM BladeCenter. It also appears that – once again – with the c-Class, HP failed to build in the longevity clients need for investment protection. If, as IBM believes, the BL460c might not support the 120W quad-core Intel Xeon processor, how will this blade hold up for next-generation technology?

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