

WHITE PAPER

EM64T: A Bridge to 64-bit Computing

Sponsored by: IBM

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IDC OPINION

While the largest benefits of Intel Extended Memory 64 Technology (EM64T) in the x86 market initially will be delivered with computationally intensive high-performance workloads, such as databases, transactional processing, financial modeling, design and simulation, the design of the processor ensures that customers running 32-bit applications will also see a significant performance improvement. EM64T allows customers to deploy scale out and clustering infrastructures for these workloads without requiring a large commitment in expensive SMP boxes. This technology further enables users to roll-out 64-bit computing on the volume x86 form factors of rack-optimized and blade servers. Early indications are that initial x86-64 migrations will involve moving workloads from Unix to Linux, but further down the road a Microsoft 64-bit OS will allow for deeper market penetration. The development of EM64T server solutions will not only offer users more computing power at lower price points, it will also afford them a migration path that protects the technology investment and allows for a deliberate and planned migration to 64-bit computing.

For customers, savvy hardware designs will provide the initial product purchasing differentiation, but in the long run it will be the services and support of 64-bit that will prove to be the essential differentiators of the market leaders. Users are encouraged to begin developing strategies not only to bring 64-bit processing into their volume server environments as the transition to EM64T occurs, but to take advantage of the opportunity to drive significant reliability, scalability, and performance improvements to these platforms as well as service and support of this environment.

IN THIS WHITE PAPER

In this white paper, IDC examines the current environment surrounding the development of the Intel® Xeon-based Extended Memory 64 Technology (EM64T) chip, code named "Nocona," for the x86 server market. In addition, this paper also reviews the adoption of 64-bit computing in the x86 market, how this technology further enables the move toward industry standards, as well as the design point differentiation IBM is targeting.

SITUATION OVERVIEW

In February 2004, Intel announced its plans to release the Xeon-based EM64T chip — Nocona — for deployment in the x86 server and workstation markets. The capabilities of this chip fill the gap between Intel's existing 64-bit Itanium chip and its 32-bit Xeon line of processors.

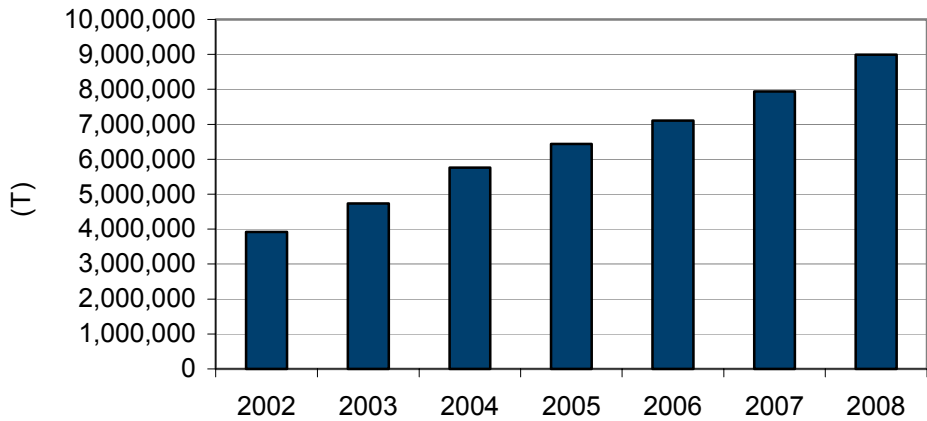
Since February, each of the major x86 server vendors has partnered with Intel to develop EM64T-based solutions for the emerging 64-bit server market. This migration is expected to follow three clear stages of market evolution:

- ☒ **Hardware acquisition.** Buyers will acquire hardware that is 64-bit capable, often during refresh periods of their replacement cycles and periods during which server consolidation, workload migration, and large-scale IT initiatives are planned.
- ☒ **OS updates to 64-bit.** While Linux can run on EM64T-based servers presently, the broadest user benefits will come as Microsoft rolls out its 64-bit extensions, which will begin as part of the Windows Server 2003 SP1 upgrade.
- ☒ **64-bit applications.** As ISVs and customers gain a clearer understanding on how to harness the new capabilities that EM64T offers, they will be developing and deploying 64-bit applications that fully leverage the technology advantages. Wide market application of the 64-bit capabilities is not expected to take place until a significant amount of relevant 64-bit applications have been made available to the market.

As a technology, EM64T is well poised for broad market adoption for a variety of reasons (Figure 1), including the fact that with EM64T there is no need for a "forklift" upgrade. Unlike the situation with migrations from 32-bit to Itanium, where the OS, primary applications, and supporting utilities had to be migrated before taking full advantage of the 64-bit capabilities of Itanium, users can run existing 32-bit applications on new EM64T hardware as is with no OS changes. Additionally, EM64T allows users to run 32-bit and 64-bit together in a mixed bit code. This provides a significant advantage to users by enabling them to dictate the roll out of the 64-bit technology according to their business needs rather than vice versa. This flexibility provides a compelling value proposition that IDC believes will be a key component in the migration to 64-bit computing in the x86 market.

FIGURE 1

Worldwide x86 Server Forecast, 2002–2008



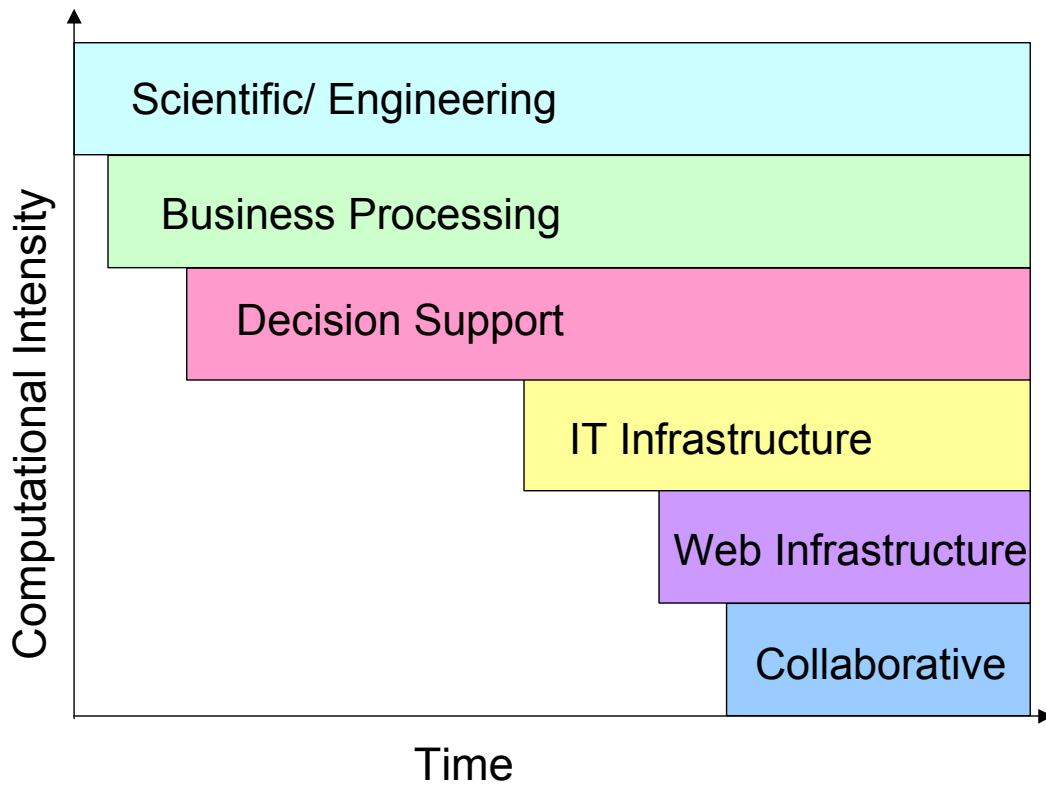
Source: IDC, 2005

Once users do migrate their applications — whenever they want or need to — they will experience the additional performance improvement that will be available with 64-bit applications. EM64T offers both enhanced performance benefits as well as business continuity benefits. These benefits will be of critical importance as these platforms are leveraged to take on more mission-critical and business-critical application and IT services (Figure 2). As 64-bit x86 systems penetrate deeper into the enterprise datacenter and as the applications that run on traditional 2-way systems are expanded to take advantage of the capabilities associated with 64-bit extensions, customers will require systems that offer higher reliability, availability, serviceability, as well as more manageability and vendor support. Simply put, these areas mark the opportunity for design differentiation from the server OEMs.

Intel has expressed its commitment to delivering extensions that will ensure standardization and ubiquity in a 64-bit environment. Intel's endorsement of the technology has helped to raise the visibility of extension technology and will help accelerate the rate at which ISVs and customers port applications to the platform. As the transition occurs, systems vendors, ISVs, and customers are all taking advantage of the 64-bit extension capabilities and increasingly rolling out a broader range of 64-bit performance solutions — at volume system pricing.

FIGURE 2

Workload Migration Path of EM64T



Source: IDC, 2005

Like with other technologies, the true test of the value is not in the technology itself, but rather how the technology can help users achieve the goals of increased productivity and competitive differentiation within their particular industries. With the migration to EM64T-based platforms, IBM is focused on providing users with a platform that provides:

- ☒ The EM64T platform enables higher throughput for both 32-bit and 64-bit applications. The performance of EM64T-based processors exceeds any previous Xeon offerings.
- ☒ EM64T processors offer an opportunity for lowered cost of computing relative to both traditional 64-bit Unix and Itanium platforms as well as price/performance improvements over 32-bit Xeon-based solutions. Demonstrable return on investment is critical as users balance technology innovations with IT cost reduction.
- ☒ More robust fault-tolerant system designs — including robust thermal solutions — handle the increased workload and business criticality in demanding datacenter environments.

- ☒ Infrastructure simplification allows users to apply the increased capacity to consolidate the number of systems in their environments.
- ☒ Increased productivity with faster time to solutions and increased granularity on the detail of analysis equip users with competitive advantages and more complete information on which to base their business decisions.
- ☒ Increased service levels relating to the need to deliver faster response times and more integrated services as well as support a greater number of users and offer more resilient operations are all critical and extend to the hardware and its design and support.
- ☒ Pay as you grow scalability has always been a major advantage in the volume systems space. Users are able to scale out their environments over time and thereby benefit both from the commodity pricing trends as well as from performance improvements from Intel. Users can spread large investments out over time and at the same time benefit from lower prices and increased performance.

IBM EM64T PRODUCT OVERVIEW

Like other Intel chips, EM64T is either currently or scheduled to be available to OEMs in every tier of the market. Those vendors who embrace the technology and develop viable hardware that can be deployed easily in the datacenter will be the first to grab hold of market leadership positions in this area. However, the hardware designs will vary from OEM to OEM, and the resulting solutions, while built off the same chip, will vary from vendor to vendor.

A unique aspect in the advent of EM64T is the ability of all EM64T vendors to offer the processing power of high-end Unix servers at an entry-level price point. For the first time, with EM64T, server OEMs can offer mainframe capabilities through x86 entry-level pricing and hardware. This offers not only the ability to run new workloads on x86 servers, but it also offers investment protection for customers as these platforms have been designed to allow for future expansions in memory, storage, I/O, or even processing capacity. This opens up the market for smaller SMB buyers to purchase systems that will allow them the headroom to scale as they require.

In developing its EM64T solutions, IBM placed an emphasis on four key areas: performance, availability, manageability, and flexibility. The following are features that IBM has focused on when rolling out the new product portfolio:

- ☒ **Performance.** 64-bit extensions enhance performance through improved memory expansion and addressability with 64-bit address spaces, and faster I/O with PCI Express. IBM's design solutions for power issues in the datacenter help to support higher processor performance and increased memory footprints.
- ☒ **Availability.** Integrated RAID on the motherboard, memory mirroring, and online sparing allow for automatic memory fault recoveries, hot swap, and redundant components for components like disk drives and vectored cooling to minimize the heat associated with these faster processors.

- ☒ **Manageability.** Intel's EM64T is integrated with the IBM Director for remote management. This enables rapid deployment and ease of serviceability.
- ☒ **Flexibility.** Users are offered the choice of running 32- or 64-bit applications, choice of operating systems, and the ability to scale both server and storage capacity modularly.

Beyond the hardware design and the associated reliability, availability, and scalability features, differentiation with EM64T solutions will also come from services and support that the vendor brings to help users make a smooth migration to a 64-bit environment.

To say IBM has experience in the 64-bit market would be a significant understatement. The company's experience spans its work in the mainframe space to its iSeries and pSeries lines of servers, as well as its work with AMD's Opteron chip, the first 64-bit chip in the x86 market.

The IBM xSeries with EM64T has 64-bit optimized designs with strong memory expansion, I/O, and availability features. These designs are the result of two things: IBM's understanding of the importance of higher availability of these features with 64-bit and IBM's experience with successfully developing and delivering these functionalities in other 64-bit environments.

The overriding principles associated with Enterprise X Architecture and the Xtended Design Architecture developed by IBM in earlier 64-bit environments are driven into the xSeries EM64T offerings. This situation relates back to IBM's years of Unix/AIX experience and provides the company with a wealth of total systems design success from which to draw in developing its EM64T products.

One area of early investment by the company is in the packaging and cooling of these new systems, what IBM terms Calibrated Vecteded Cooling. Cooling of servers has long been a concern, especially as customers continually demand that the vendor pack higher power (and heat generating) processors in greater numbers into smaller form factors (rack-optimized and blade servers). With the emerging transition to EM64T, this concern is only heighten as 64-bit systems typically consume more memory, storage and even I/O. In turn, these added components all generate additional heat that must be effectively dissipated in order to maintain system stability. With Calibrated Vecteded Cooling, IBM is leveraging years of mainframe system design to create optimized paths for air flow to cool the system. This has enabled IBM to offer 64-bit systems that have some of the smallest form factors in the industry.

Another result of IBM's experience in the 64-bit market centers on its ability to design products that can be highly scalable. The scalability aspect also facilitates clustering with x86 servers, which is important when considering the types of applications that will receive the greatest benefits from 64-bit environment, namely those which process data and computationally intensive workloads, such as databases, transactional computations, and financial modeling. The result of this focus on scalability has been the productization of a cluster offering — the eServer 1350. The product is highly integrated and offers customers an easily managed scale out Linux cluster solution for high performance, scientific and technical workloads, and

commercial computing workloads. Finally, these integrated clusters based on EM64T processors help to lower deployment costs because IBM handles much of the hardware and software integration work.

Beyond the hardware, IBM has developed software in support of EM64T, which has been directly derived from its expertise in software supporting 64-bit with OS/400, AIX, DB2, WebSphere, etc. This software will enable such workload deployments as a DB2 scale-out model on smaller, less expensive systems doing data mining, financial modeling, other data rich workloads. In addition, the incorporation of IBM Director into the EM64T platforms means that users will have the ability to manage both 32- and 64-bit platforms using a consistent set of management tools across both platforms.

Finally, a key area for sustainable, long-term market differentiation in the EM64T market is that of services. While the hardware may all be built off the same chip, support for this hardware will differ from vendor to vendor, based on past experience with 64-bit computing environments, expertise with 64-bit-specific hardware design, and experience supporting customers and their workloads in 64-bit environments.

Within customer services, expertise in consulting and implementation services will be important considerations for buyers when making purchasing decisions around EM64T servers. IBM has a successful track record in the area of customer services with its demonstrated focus on consultative customer support as well as its support for migration both between platforms (i.e., Unix to Linux) and within platforms (i.e., Microsoft to Microsoft with extensions).

Customers who choose to implement EM64T technology will be able to deploy many more users on the platform than they could in previous x86 environments. This anticipated user scale-up will provide a clear demand for integration services and support services, thus making proven experience in these areas all the more valuable. Additionally, demand for Unix to Linux migration services will have a noticeable role in the migration to EM64T for many customers. For its EM64T services, IBM drew upon its experience in supporting RISC Unix users when it designed its services in support of EM64T offerings. IBM also has demonstrable success with its experience in Unix to Linux migration through its work with the eServer Cluster 1350.

EM64T environments, by their computationally intensive nature, often will be deployed in heterogeneous environments. As a result, there will be clear demand from buyers for support services from vendors with experience in these conditions. In IDC migration studies, IBM emerges as one of the migration leaders because of its ability to understand the unique issues of heterogeneous environments.

IBM has experience offering support to customers who are running business-critical applications in 64-bit environments. Through past experience in migrating high-end workloads, IBM has demonstrated an ability to provide 24 x 7 support, integration, and consulting services, which can be applied toward the emerging x86-64 marketplace.

This is differentiation that can not be created overnight. It is the result of years of hands-on experience with customers, walking through the fire of initial deployments,

and applying the lessons learned. Because of this experience, vendors with years of work in this area know how to walk around the conflagration or extinguish it altogether rather than just know where the ointment is after they've been burned.

CHALLENGES/OPPORTUNITIES

IBM's hardware designs and history will be beneficial in the migration to x86-64 computing out of the starting gate, but the staying power in the race will lie in IBM's services experience and the translation of that experience into successful customer deployments and support for their EM64T product line.

Challenges with EM64T include:

- ☒ **End user education.** One challenge that lies ahead for IBM and other EM64T vendors is educating the target buyers of the technology. Key points that must be communicated to buyers include the ability to deploy EM64T hardware without requiring a complete update to all applications and utilities from the 32-bit environment to the 64-bit. Users must be shown that 64-bit x86 solutions are valuable for their significant computing power at highly competitive prices.
- ☒ **Positioning the technology within a portfolio of products.** Clearly, IBM is providing customers with a choice at the platform level, but at the same time the company will need to articulate the benefits and help customers develop a platform strategy that best fits their needs. 64-bit platform choices by IBM include:
 - ☐ **AMD's Opteron.** Opteron, the first 64-bit chip to the x86 market, has begun to gain traction in the x86 market, with server products containing the chips either currently being sold or slated for deployment by all of the top server vendors except Dell. As market penetration of Opteron grows, users will need to evaluate where EM64T fits within their environments and for which solutions Opteron would be the more suitable processor choice. To date, IBM has positioned its Opteron products squarely in the HPC space.
 - ☐ **Intel's Itanium.** Intel has stated it will continue to offer Itanium to the market but will position it as a solution for workloads that are complementary to those targeted by EM64T. While this may appear to be a viable scenario for the short term, the possibility exists that over the long term EM64T will marginalize Itanium to select, niche deployments for limited applications.
 - ☐ **IBM Power.** Additionally, IBM is rolling out the 64-bit Power 5 processors as the foundation to both the pSeries and iSeries server lines. These new processors contain significant enhancements over Power 4, such as micro-partitioning. The addition of Linux as a supported operating system also means that customers will need to evaluate these systems as well.
- ☒ **Direct EM64T competition to IBM.** Both HP and Dell are deploying EM64T technology in their x86 server products. While the market strategies for HP and Dell are relatively distinct from each other, they both present potential threats to IBM in this market. Like IBM, HP has proven experience in 64-bit computing

environments. So, too, does HP have an established customer base that is loyal and through which HP has developed distinct customer service expertise. Dell's target market, which historically has been that of deployments of 1- and 2-way servers for less computationally intensive workloads, is undergoing a shift through Dell's realigned strategic focus on the enterprise. Should Dell manage to develop exceptionally strong partnerships with experienced 64-bit integration and support vendors, it could potentially pose a threat to both IBM and HP in the EM64T market.

Ultimately, because of the mission- and business-critical nature of 64-bit computing, the inclusion of EM64T into a portfolio of products provides IBM with a significant opportunity to leverage its hardware design and its 64-bit services and support to differentiate itself and help users make a seamless migration to the new platform.

CONCLUSION

EM64T will help accelerate the market for 64-bit applications in the x86 world. While the timing of the milestones essential for fully migrating the market adoption of full 64-bit functionality cannot be predicted precisely, it is clear that this transition will occur over a protracted period of years. EM64T has been designed to protect customer investment during that period, which is major contribution to its broad market adoption.

While initial rollouts of EM64T will occur across all workloads, the biggest benefits will be associated with computationally intensive workloads, such as ERP, CRM, and data analysis. Once success has been attained in those areas and users have been able to work through any concerns or issues relating to their migration to 64-bit operating systems and applications, these same benefits will begin to be realized in the less intensive workloads, such as IT and Web infrastructure.

Once users have installed EM64T hardware and begun to migrate their applications from 32- to 64-bit, the x86 market adoption of this technology will start to take off. As discussed earlier, 64-bit computing will become standard in the x86 market, but at this current juncture, the precise timing of market changes in response to 64-bit is unclear. What is clear, however, is the three staged approach to market adoption of hardware acquisition, OS updates to 64-bit, and the development and proliferation of 64-bit applications.

In this market, users are encouraged to begin developing a strategy not only to bring 64-bit processing into their volume server environments as the transition to EM64T occurs, but to take the opportunity to drive significant reliability, scalability, and performance improvements to these platforms as well as service and support of this environment.

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