



Bull Escala: Scalability & High Availability for Business Critical Environments

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PREPARED FOR

Bull

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Executive Summary

Customers of Groupe Bull know that the company pays close attention to the changing needs of the computing marketplace and extends its product offerings to address those evolving requirements. This respected developer of enterprise-class servers supports its long-time customers with enhanced mainframe systems and now offers systems based on "industry-standard" hardware and software for customers seeking Windows and Linux solutions. Nonetheless, UNIX on RISC servers remains the computing foundation for many customers. To address those needs, Bull's Escala product line delivers the scalable performance of POWER processors running the robust AIX UNIX operating system.

Throughout its long history, partnerships with other industry leaders have been an important part of Bull's strategy. For more than twelve years, Bull has collaborated extensively with IBM. This joint development effort created the first AIX SMPs (Symmetric Multiprocessors) and continues to enhance AIX capabilities. Bull currently markets the full range of POWER-based servers running AIX as its Escala line. On top of that industry-leading UNIX/RISC foundation, Bull offers unique software and industry solutions that leverage its long-running customer relationships. For example, Bull's Escala Essentials provide unique, integrated packages of software and hardware solutions to accommodate common IT environments.

Customers who have already deployed Escala know they can depend on Bull hardware, software, and solutions for their business-critical environments. This white paper will help to introduce the Escala line of AIX servers to potential customers not yet familiar with Bull's AIX/POWER family.

Introduction

Bull has been a trusted supplier of computing solutions since the earliest days of the industry. As the industry has evolved and expanded beyond mainframes to also include UNIX/RISC and Windows/Linux on industry-standard hardware, so too Bull has extended its range of offerings to address customer requirements for varied forms of computing. While continuing to support its GCOS mainframe customers, Bull also offers the Escala line for AIX users and the NovaScale servers for Windows/Linux users.

Throughout its long history, Bull has leveraged its own expertise by partnering with others to create industry-leading solutions. One highly successful collaboration has been Bull's joint development relationship with IBM that created the AIX/POWER product line. This product line has become the

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premiere UNIX/RISC platform.¹ Bull's Escala family offers that industry-leading AIX/POWER solution to those customers seeking scalable high performance for business-critical applications.

Escala servers span from 1 to 64 POWER processor cores, offering a nearly hundred-fold performance range.² All of these servers run AIX, including AIX 5.3, which supports innovative features such as Simultaneous Multithreading (SMT) and subprocessor Dynamic Micro-Partitioning. From a solutions perspective, Bull has established a number of competence centers in Europe where its experts assist customers in achieving the full benefit of AIX on POWER to satisfy their applications' requirements.

Bull's expertise is well known in France and throughout Europe, with a loyal base built over the years. This white paper prepared by Ideas International (IDEAS) will help introduce Bull's Escala family to those who are not as familiar with Bull's latest offerings.

The Escala Family of UNIX Servers

Table 1 provides an overview of the current Escala product line, powered by the POWER5 family. Specific details, such as processor clock rates, memory capacity, and I/O connectivity, are not shown in the table since Bull enhances these models as new technology becomes available. In fact, at the time this white paper was written, some of the Escala line had already been upgraded to employ POWER5+ processor chips. Certainly, over time, Escala models will incorporate faster processor chips, denser memory, etc. just as the current POWER5 line offered enhancements over Bull's prior POWER4+ models.³ This table illustrates the broad set of Escala offerings Bull provides to meet the needs of small businesses through the largest enterprise computing installations.

Table 1. Bull Escala Server Overview

Escala Model	Processor Type	Maximum Processor Cores	Form Factor
Escala PL250	POWER5	2	Rack and Tower
Escala PL450	POWER5	4	Rack and Tower
Escala PL850	POWER5	8	Rack and Tower
Escala PL1650	POWER5	16	Rack
Escala PL3250	POWER5	32	Rack
Escala PL6450	POWER5	64	Rack

Readers familiar with IBM's POWER-based server product line will notice a strong similarity between the Escala models and IBM's offerings. As IBM's development partner, Bull has access to all the latest IBM configurations and can ship new or enhanced models to its customers at the same time that IBM can deliver those systems to its customers. In other words, Bull can take full

¹ The Bull/IBM joint development agreement began in 1992 and continues to be a strong partnership. The agreement has been formally renewed to extend through at least 2009.

² Based on IBM/Bull-provided rPerf figures for POWER5 systems; a 1.9 GHz PL6450R delivers 304 rPerf while a single 1.5 GHz core PL250T offers 3.25 rPerf.

³ Refer to the Bull website for the latest information, for example: www.bull.com/aix/index.html.

advantage of the substantial investment IBM has made to produce the most powerful and most reliable processors available in the industry.

The POWER implementations attain high single-thread performance through fast clock rates and a sophisticated internal architecture that uncovers instruction-level parallelism within codes. The POWER5 family, including POWER5+, offers SMT, which allows a second code stream to execute on what otherwise would be underutilized processor circuitry. SMT can provide 20% to 50% (or even more) additional throughput on each processor core, depending on how much execution capacity was not being fully utilized by the workload. No other vendor's chips can match the per-core performance of POWER5 with SMT.

SMT is enabled through AIX 5.3. Note that customers do not have to rewrite applications to take advantage of SMT. To the software, the ability to execute an additional code stream appears as if a larger SMP were available. That is, the same SMP programming model remains in place but now AIX 5.3 assigns two code streams to an SMT processor core instead of just one.

IBM partnered with Bull in 1992 to create the initial RS/6000 SMPs. Since then, the SMP design has evolved to scale to large configurations while enhancing SMP performance. IBM leveraged the Multi-Chip Module (MCM) first used in its mainframes to create a new MCM that provided industry-leading, high-speed interconnections between the POWER chips and high bandwidth paths to memory and I/O. The result is an SMP that delivers near-linear performance scalability all the way to the 64-processor-core high end.

Of course, many applications do not need the full performance of 64 powerful POWER processor cores. Large SMPs are typically used to run a diverse collection of applications that were consolidated into that large server to ease operational management and load balancing. Logical partitioning of the servers via Dynamic LPARs (DLPAR) has been a well-received feature of POWER and AIX that allows diverse applications to share the power of the SMP while assuring that a software failure will not affect other applications.

Now with POWER5 and AIX 5.3, logical partitioning has been extended to allow partitions to be allocated with subprocessor granularity. That is, a logical partition can be assigned to use only a fraction of a processor. A full POWER5 processor is so powerful that many workloads from older servers can only consume a small portion of its capability. Micro-Partitions allow multiple smaller partitions to share the same processor. Up to ten of these Micro-Partitions can be defined per processor core. AIX 5.3 supports a maximum of 254 Micro-Partitions on the largest SMPs, such as the Escala PL3250R and PL6450R.

Complementing the sharing of physical processors, the advanced virtualization features in AIX 5.3 permit I/O adapters to be shared among the Micro-Partitions. That is, workloads that only require a fraction of a processor probably do not need entire disk or network I/O adapters dedicated only to their partition. By sharing disk drives or network paths, each partition can be allocated the I/O resources it needs, thus avoiding a configuration with excess, unused capacity. Of course, larger Micro-Partitions can be configured with dedicated disk drives or network adapters, if required. With the finer granularity of Micro-Partitions and I/O sharing, Escala servers are particularly well positioned as workload consolidation platforms, with the ability to replace large numbers of standalone smaller servers.

Some customers who have relatively well-defined workloads may be content to manually control repartitioning of their servers. For example, they may only wish to reallocate the resources assigned to their partitions at day's end for overnight processing, or on the weekend. But, many other customers find that an automated partition workload manager can be much more efficient in dynamically readjusting resources to achieve desired business goals. The Partition Load Manager (PLM) for AIX is such an automated workload manager. Using a set of attributes defined for each Micro-Partition (such as entitled capacity of capped or uncapped partitions⁴), the PLM automatically manages the allocation of processing capacity and memory to achieve optimum server utilization.

PLM efficiently reallocates active computing resources to achieve defined priorities among workloads. But, sometimes, peaks in computing demand outstrip total available resources and require additional capacity in order to meet objectives. Bull offers different capacity on demand options that activate unused capacity already installed in the server. *Reserve Power on Demand* works in conjunction with partition workload management to temporarily activate processing resources when they are needed to achieve desired workload goals. When that temporary capacity is no longer required, those resources are deactivated.⁵ *Permanent Power on Demand* provides a non-disruptive permanent upgrade of computing capacity to a server whose workloads have grown over time.

Other UNIX vendors have forms of dynamic workload management that they claim offer similar capabilities as PLM. And, other vendors offer forms of capacity on demand. However, none offer the comprehensive combination of Micro-Partitions, PLM, and Reserve Power on Demand. That integrated combination provides very efficient workload balancing, including the ability to respond to peak demand, which allows Escala to be an ideal workload consolidation server.

Customers consolidating workloads into large servers expect that those servers will be highly reliable. The advanced MCM packaging, derived from mainframe technology, has a remarkable record of high reliability. Building on that solid foundation, Escala servers have incorporated a number of features to detect, prevent, correct, and isolate any errors that do occur. POWER4-based servers included Chipkill memory, dynamic processor deallocation, PCI bus error recovery, first failure data capture, and a sophisticated service processor. With POWER5 models, Escala extended ECC to cover more busses, enhanced cache deallocation mechanisms; and added online firmware updates.⁶ The result is a solid, reliable platform that is able to continue running despite failures that could bring down other systems.

⁴ Generally, uncapped partitions can take advantage of any unused processing capacity, whereas capped partitions have a defined limit to the spare processing capability they can use. Specific details regarding reasons for defining which workloads are capped and which are uncapped is beyond the scope of this overview paper.

⁵ Details on Bull's capacity on demand pricing are beyond the scope of this paper. Basically, to allow it to be quickly activated, Reserve Capacity on Demand requires a prepayment for a block of processing days. Permanent Capacity on Demand is billed when the capacity is added.

⁶ Refer to the Bull website for a detailed explanation of the benefits of each of these features.

Escala's Performance Lead

Certainly, the high reliability of the MCM packaging technology and the robust resilience of AIX are compelling reasons for customers to deploy Escala for their business-critical computing needs. Unfortunately, reliability statistics are not available across the different vendor/server product lines to prove this point. What can be readily demonstrated, however, is the performance superiority of POWER/AIX.

Bull's partner IBM has invested in a well-staffed benchmarking center dedicated to demonstrating the performance superiority of AIX/POWER. Since Bull and IBM share the same hardware and software, Bull has not devoted resources to duplicate those measurements merely to formally resubmit results under the Bull model designators. Nonetheless, even though IBM officially submitted the record-breaking results, the Escala versions deliver identical performance.

One of the most widely used indicators of overall system performance is the OLTP benchmark TPC-C. Admittedly, no single industry-standard benchmark will precisely predict performance of any particular customer workload. Nevertheless, TPC-C has served as a respected gauge of interactive transaction processing capability for well over a decade. Moreover, tpmC results often determine which systems are to be considered on a "short list."

Measured results of AIX/POWER5 systems show compelling superiority over competitive platforms. Delivering over three million transactions per minute, a 64-processor core POWER5 server provides more than three times the OLTP performance of other systems with the same number of processor cores. From a different perspective, even with fewer processors, Escala servers can deliver more TPC-C performance than much larger competitive configurations. For example, an AIX/POWER5 server with 16 processor cores delivers more tpmC than the highest reported results for the largest configurations of the PA-RISC Superdome or the Fujitsu PRIMEPOWER servers. Table 2, in the Appendix, provides the supporting details confirming the impressive POWER/AIX TPC-C performance superiority. Note that some vendors have not submitted results recently on certain platforms, such as Sun UltraSPARC, presumably because they know they cannot match POWER/AIX performance.

Other industry-standard benchmarks that showcase POWER5 superiority include SAP R/3 SD, SPECjbb2000, and many others. As seen in the Appendix, for both the Two-Tier and Three-Tier versions of the SAP R/3 SD benchmark, POWER5 platforms deliver impressive performance with fewer processor cores. This capability translates to far more performance per processor core than any competitive offering. Similarly, POWER5 provides more SPECjbb ops/s per processor core than any other enterprise server.

Naturally, record-breaking benchmark results are obtained on large-scale configurations. Typical user environments may not require such high-end performance levels for a single application. Note from the tpmC results in the Appendix Table 2 that scaling those OLTP configurations from four through 64 processor cores delivers near-linear performance increases. Thus, Escala servers can be counted on to deliver compelling performance throughout the whole product range. Customers can dedicate small or medium Escala models to a single application. Advanced virtualization features, such as Micro-Partitioning and PLM, make large SMPs ideal candidates for consolidating

workloads that otherwise might be deployed on a collection of standalone servers. The entire range of servers employs the same AIX on POWER.

Clearly, POWER5 is unmatched in delivering impressive levels of performance, usually requiring fewer processor cores than competitive offerings. Price/performance leadership is usually more difficult to illustrate since the configurations used for most benchmark testing strive for highest performance and do not necessarily focus on the optimum price/performance. Nonetheless, the \$/tpmC results reported in Table 2 confirm that AIX on POWER is competitively priced. Remember that some software is licensed on a per core basis. This licensing basis offers a significant pricing advantage since fewer POWER5 processor cores are needed (compared to the less capable competitive chips). Of course, the best approach for any customer is to invite Bull to show just how attractive Escala pricing can be.

Bull's Added Value

Customers perceive Bull not only as a supplier of premier computing systems, but also as a trusted partner to help them solve their business computing problems. As active contributors to AIX development, Bull's engineers have the detailed knowledge to assist customers in taking full advantage of Escala's industry-leading hardware and software. Bull's competence centers in France, as well as its co-located competence centers with partners such as SAP, provide customers and prospects with the opportunity to learn just how Escala can enhance their businesses. Across Europe, in particular, customers turn first to Bull when they seek guidance on how to best deploy AIX and POWER-based systems.

Of course, Bull assists customers with the complete software stack associated with AIX, not just the operating system. For customers with complex, business-critical computing environments, Bull helps configure and deploy HACMP clustering software to ensure continued operation. For other customers, HACMP offers more functionality than needed. For those situations, Application Roll-over Facility (ARF), a Bull developed solution, offers an easy-to-use means of moving an application environment to another system. Based on a standard cluster architecture with multiple servers sharing disks, ARF can activate the applications associated with one server on another backup node. Available exclusively through Bull, ARF's ease of use reduces cluster administration complexity. The simplicity and low cost of ARF makes it attractive for customers seeking backup for possible hardware failures and planned maintenance activities, or even just for workload balancing.

Storage is another area where Bull offers solutions tailored to meet customer needs. Rather than focus on IBM's storage products, Bull teams with EMC to deliver a range of storage systems including the EMC CLARiiON AX, CLARiiON CX, and Symmetrix DMX families. Bull's expertise with EMC is illustrated by its adding CLARiiON AX100 support into AIX; previously that EMC storage system was only supported in Windows and Linux environments. Bull has also built up expertise in helping its customers efficiently integrate these widely used storage subsystems with the powerful Escala platforms. Additional Bull partners in the storage and backup arena include Brocade, Legato, and VERITAS, among others.

Escala Essentials

Escala represents excellent technology. However, there is still the real-world issue of moving the Escala offerings into production in the datacenter. Combining a number of hardware and software products together to make them work in a production environment can be very difficult and require more skills than many installations possess. The difficulties that may arise include:

- » Hardware maintenance levels may need to be synchronized to enable hardware products (e.g., storage and servers) to work together. These changes could affect the microcode as well as the hardware.
- » Operating system maintenance will be required to support the hardware products and hardware updates may be needed to support the operating system.
- » Other software products might require maintenance to work with each other, as well as with the operating system.
- » Once all the necessary products are working together, some tuning will probably be required to achieve the desired performance levels.

Simply put, industry-leading technology by itself does not address such deployment issues. Some customers have spent months attempting to solve the problems just mentioned (and others) in order to move new technology into production. Bull provides exceptional assistance to its customers to address this major integration concern. For example, Bull provides several solutions that address the most common customer requirements. Bull calls these solutions "Escala Essentials." They are based upon AIX and allow a customer to buy a complete integrated solution supported by Bull. The Escala Essentials currently available include:

- » Affordable Disaster Recovery
- » Scalable, Networked Storage solutions
- » Affordable High Availability solutions
- » Scalable Data Protection solutions

The Disaster Recovery solution provides a remote backup, enabling processing to be switched to another center in the event of a disaster that knocks out a datacenter. The Networked Storage solution allows customers to configure different SANs to meet different datacenter storage requirements.

The High Availability solution is a hardware, software, and services solution that can be the basis of a contract with Bull guaranteeing 99.9% availability. Bull will support this guarantee with its HA-Center, which specializes in high availability and provides 24x7 operational support.

Bull's Data Protection solution provides both the hardware and software for backup solutions. Customers can choose Bull's OpenSave backup software, VERITAS (Symantec) NetBackup, or Legato Networker. Bull will integrate the backup software with an appropriate disk system and an Overland PowerLoader for tape storage.

Each of these solutions is built around a POWER5 server running AIX. Additional hardware and software products needed for a complete solution are added by Bull as required. This additional equipment constitutes best-of-breed

solutions from partners like Brocade. Bull also offers training and consulting to help customers implement and manage these solutions.

Bull's Escala Essentials⁷ provide a powerful way for customers to quickly deploy new technology in production to address their needs. With the use of Escala Essentials:

- » The time to ready solutions for production is reduced, enabling business benefits to be realized more rapidly.
- » Customer costs are sharply reduced, since the time required for the systems integration tasks described above is drastically diminished or eliminated.

What's Next?

AIX and POWER-based systems have come a long way since 1992 when Bull became IBM's development partner. The current POWER5 Escala platforms and AIX 5.3 offer a clearly superior solution. It is no wonder that AIX has been the fastest-growing UNIX in recent years.

Clearly, POWER5 and POWER5+ do not mark the end of the line. Future systems, employing advanced chips beyond POWER5, will continue to maintain Escala as the leading choice for UNIX environments. POWER5+ has already been introduced in parts of the Escala line. Over time, the new fabrication technology underlying POWER5+ will allow improved performance, in part through faster clock rates. Development is already underway on POWER6, which promises even greater performance and additional functionality.

Of course, impressive hardware is only part of the story. It is the AIX operating system that enables IT managers to take full advantage of hardware features, such as POWER5's SMT and Micro-Partitioning. Future versions of AIX undoubtedly will make it even easier for customers to solve their business computing needs through unique and innovative server functionality. AIX is highly regarded as a robust enterprise-class operating environment – well suited to the needs of customers from SMB through enterprise – and it will continue to evolve to remain the leading UNIX. Bull, as an active partner with IBM in the development of AIX, will continue to be well equipped to guide its customers in attaining the full benefit of AIX/POWER features.

The IDEAS Bottom Line

Through its ongoing partnership with IBM, Bull has helped develop the industry's leading platform for UNIX customers. Leveraging the strengths of the AIX operating system and POWER processors, Bull's Escala line offers a broad range of servers to meet the needs of entry through enterprise customers. Compared to servers of competing vendors, these AIX/POWER systems offer outstanding performance and partitioning flexibility. Without a doubt, Bull AIX/POWER systems should be on every UNIX customer's short list.

IBM also offers its own models of these same systems. Although Bull may not be as strong in all geographies as IBM, where Bull is established, it has gained a loyal following of those who admire Bull's ability to assist and support its customers (e.g., Escala Essentials). Those customers select Escala not only for

⁷ See Bull's web site for more information:
<http://www.wcm.bull.com/internet/pr/rend.jsp?DocId=79475&lang=en>.

its superior technology but also because of Bull's extensive expertise. Bull has married its own mainframe experience with knowledge gained as IBM's development partner to help customers solve their business needs. Bull's own ARF high availability software and partnerships with other industry leaders, such as storage provider EMC, provide a unique set of resources to help Bull customers.

Bull is well respected throughout Europe, particularly in the public, banking, finance, telecommunication, utilities, and manufacturing sectors. Long-time customers know Bull as a trusted partner, helping them to solve their business computing needs. However, potential customers in geographies or industries where Bull has a smaller presence may not have first hand knowledge of Bull's capabilities. This short white paper has introduced Escala servers to those who may not be familiar with Bull's AIX product line. IDEAS believes that Bull and Escala deserve serious consideration from customers seeking industry-leading UNIX solutions.

Appendix

The benchmark results listed in the tables below illustrate the performance superiority of POWER5 and POWER5+ servers compared to representative servers from competitors.

Bull's partner IBM has taken the lead in obtaining benchmark results for POWER5/5+ servers running AIX. Although the results were submitted to the benchmark sponsors as being measured by IBM, these benchmark results also apply to the equivalent Bull models.

Table 2 shows that POWER5 delivers far more tpmC than SPARC or PA-RISC systems using many more processor cores. Table 3 indicates that POWER5 can provide nearly the same SAP SD performance as a SPARC system using twice as many processors. Tables 4 and 5 demonstrate that POWER5 and POWER5+ offer more SPECjbb2000 performance than SPARC, PA-RISC, or Opteron.

These results are current as of the beginning of November 2005. For latest results, please refer to: www.ideasinternational.com/benchmark/bench.html.

Table 2. TPC-C Performance of Leading Enterprise Servers

Tested System	Processors	Performance Price/Perform.	Software	Date
IBM p5-595 (Bull PL6450R)	64 cores 1.9 GHz POWER5	3,210,540 tpmC \$5.19/tpmC	AIX 5.3 DB2 8.2	Nov/04
IBM p5-595 (Bull PL6450R)	32 cores 1.9 GHz POWER5	1,601,784 tpmC \$5.27/tpmC	AIX 5.3 Oracle 10g	Apr/05
IBM p5-570 (Bull PL1650R)	16 cores 1.9 GHz POWER5	809,144 tpmC \$4.95/tpmC	AIX 5.3 DB2 8.1	Jul/04
Fujitsu / ICL PRIMEPOWER 2500	64 cores 1.3 GHz SPARC64V	595,702 tpmC \$12.43/tpmC	Solaris 8 Oracle 10g	Oct/03
HP 9000 Superdome	64 cores 875 MHz PA-8700+	541,674 tpmC \$11.66/tpmC	HP-UX 11i Oracle 10g	Jul/03
IBM p5-570 (Bull PL850R)	8 cores 1.9 GHz POWER5	429,899 tpmC \$4.99/tpmC	AIX 5.3 DB2 8.1	Aug/04
IBM p5-570 (Bull PL850R)	8 cores 1.9 GHz POWER5	371,044 tpmC \$5.26/tpmC	AIX 5.3 Oracle 10g	Jul/04

Table 3. SAP R/3 SD 2-Tier Performance of Representative Enterprise Servers

Tested System	Processors	Performance	Software	Date
Fujitsu PRIMEPOWER 2500	128 cores 2.08 GHz SPARC64V	6,349,000 steps/hr 21,000 users	Solaris 9 Oracle 9i	Mar/05
IBM p5-595 (Bull PL6450R)	64 cores 1.9 GHz POWER5	6,042,000 steps/hr 20,000 users	AIX 5.3 DB2 8.2	Oct/04

Table 4. SPECjbb2000 Performance of Representative High-End Servers

Tested System	Processors	Performance	Software	Date
Fujitsu PRIMEPOWER HPC 2500	120 cores 2.08 GHz SPARC64V	2,438,088 ops/s	Solaris 8 Hotspot 1.5.0	Oct/04
Fujitsu PRIMEPOWER 2500	128 cores 1.82 GHz SPARC64V	2,214,996 ops/s	Solaris 8 Hotspot 1.5.0	Oct/04
IBM p5-595 (Bull PL6450R)	64 cores 1.9 GHz POWER5	2,200,162 ops/s	AIX 5.3 J2RE 1.4.2	Oct/04
Sun Fire E25K	88 cores 1.2 GHz UltraSPARC IV	645,042 ops/s	Solaris 10 Hotspot 1.5.0	Jan/05

Table 5. SPECjbb2000 Performance of Representative Entry and Midrange Servers

Tested System	Processors	Performance	Software	Date
IBM p5-550Q (Bull PL850R)	8 cores 1.5 GHz POWER5+	294,315 ops/s	AIX 5.3 J2RE 1.5.0	Sep/05
Fujitsu PRIMEPOWER HPC 650	8 cores 2.025 GHz SPARC64V	240,673 ops/s	Solaris 10 Hotspot 1.5.0	Apr/05
HP 9000 rp4440	8 cores 1.0 GHz PA-8800	214,932 ops/s	HP-UX 11i Hotspot 1.4.2	Jun/04
IBM p5-550 (Bull PL850R)	4 cores 1.9 GHz POWER5+	190,445 ops/s	AIX 5.3 J2RE 1.5.0	Sep/05

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