The Trend from UNIX to Linux in SAP® Data Centers

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Management Summary

In roughly the last two years of Linux migrations with REALTECH, the percentage of UNIX as migration source has risen to 68.2%, or expressed differently, more than two out of three SAP migrations to Linux come from UNIX. The percentage of discontinued UNIX flavors (Tru64, Reliant) has dropped to roughly 5%. The UNIX flavors now suffering the greatest losses are HP-UX (40.9%) and AIX (18.2%). The average Linux migration customer gets bigger in size, revenue, and number of employees, and comes from industries with increasingly more business-critical applications. A significant portion of REALTECH's Linux migration customers has even run mainframe systems for several years. In the database sector, ORACLE has recovered from its previous loss in market share in migrations to Linux and is gaining market share on Linux at roughly the same pace as MaxDB (+13.6%). The average size of databases migrated to Linux increases significantly every year, and in absolute size the TB limit has been crossed long since. The absolute number of migrations to Linux has almost doubled from the first statistical evaluation period (2001 – 09/2005) to the second one (10/2005 – 03/2008). There is no doubt that the movement towards Linux in SAP data centers is gaining momentum strongly and fast.

Cost is frequently named as the major motivation for migrating to Linux, and frequently the cost argument is connected with the motivation of attaining vendor independence. As a result, Linux on Power or Itanium does not play a very significant role in the SAP migration market. Stability and readiness for business-critical applications are assumed to be indispensable prerequisites, and hardly questioned any more. The list of REALTECH's Linux customers includes the high-tech defense industry, airlines, energy providers, automotive suppliers, and chemical companies, as well as narrow margin businesses such as hosting providers. The largest SAP production database running on Linux and known to REALTECH exceeds 10 TB in size in a high-availability configuration. Linux has reached the final level of criticality in SAP data centers.

REALTECH presents a model to calculate and compare SAP-related server cost in this whitepaper for you to be able to examine the cost implications of a SAP deployment on Linux versus UNIX. To appreciate the current development in the server market, an understanding of the development of CPU performance over the last couple of years is necessary. Multi-core and multi-threading technologies have multiplied CPU-power in such a way that frequently a standard two- or four-CPU server will easily outrun much larger systems of the same OS only one or two years older. Deployments that previously required 8- or 16-way servers may be implemented on

2- or 4-way servers now, or deployments which required a considerable number of application servers before can now be consolidated on fewer servers.

The rise of x64-based servers into the midrange section of server performance is a problem for UNIX: Four- and eight-way x64 server systems now easily reach into benchmark regions previously reserved for eight-way systems and higher, usually running UNIX. In undiscounted EURO/SAPS, the x64 processor architecture with Linux provides the best four results overall, and six out of the best eight; and the best price/performance ratio does not come in the order of lowest server performance. Thus, it's not simply the smallest servers offering the cheapest solution.

Mainly the x64 cost advantage triggers migrations to the Linux platform, and this corresponds well with our observation that Linux on Power or Itanium plays an almost negligible role as SAP platform migration target. It is true that Microsoft Windows would likely deliver the same advantage in associated direct costs. The reason why UNIX customers are going to Linux on x64 is the greater affinity between Linux and the current operating system. Even large discounts for servers based on traditional UNIX architectures will not make them competitive with comparable x64 offerings.

Migration costs are customer-specific and largely depend on the size of enterprise, the size of the SAP systems to be migrated, and especially availability and downtime requirements. Those customers REALTECH evaluated so far have achieved a return on investment (RoI) in migrating from UNIX to Linux between 9 months and 2 ½ years.

In this analysis, we will present an example of a customer who realized high platform-related cost savings in a business-critical SAP landscape with high-availability requirements by moving to Linux.

In the future, virtualization based on Linux will play an increasingly important role in production environments. The trend from UNIX to Linux will gain further momentum. This assumption is backed by independent research both on a regional level for Germany/Europe (RAAD Consult), and on a global and international level by Gartner and IDC, and corresponds with our perception of the SAP market.

Linux and SAP: Historical Development

Statistical Review on SAP Migrations to Linux

This part of the document will answer the following questions: In REALTECH's 8 years of migration experience to Linux, which are the originating operating systems? Which are the originating databases, and which are the target databases? What are our conclusions from these statistics?

In 2005, in preparation of an article for Germany's largest computer magazine for professionals (Computerwoche), REALTECH evaluated all migrations towards Linux done by REALTECH from the very first one in June 2001 until September 2005. The results were, in many respects, distinct and surprising: More than 60% of all migrations in a period of more than four years came from UNIX, not quite 20% from Windows, and almost exactly 20% from mainframe-operating systems like OS/400 (13.3%) and OS/390 (6.7%). Not discussed in the Computerwoche article and undisclosed in the statistics, already then there was a trend from Windows and discontinued UNIX flavors (Reliant, Tru64) in the very early years (2001 – 2003) of SAP migrations with target Linux towards fully continued UNIX flavors (HP-UX, AIX, Solaris) and OS/400 in the second period (2004 – 2005), whereas the Windows quota constantly declined.

How did this trend continue, and what conclusions can be drawn from the re-evaluated statistics?

Researching the migration statistics for the period after the Computerwoche article (the period of Q4/2005 until March 2008, including projects ordered for this period), supports the following conclusions from the first evaluation: In roughly the last two years of Linux migrations with REALTECH, the percentage of UNIX as migration source has risen to 68.2%, while Windows as migration source experienced a further drop to a mere 13.6%. In plain words: More than two out of three SAP migrations to Linux come from UNIX. Even more interesting is the distribution within the UNIX flavors: Whereas during the first statistical period described, about 20% of all Linux migrations came from discontinued flavors like Reliant and Tru64, this percentage has dropped to roughly 5% in the second period, and is fading out naturally since Reliant in fact **is** eliminated from the installed base of SAP systems in the market, and Tru64 is dying quickly. The UNIX flavors suffering the greatest losses now are HP-UX (40.9%) and AIX (18.2%), and it is only

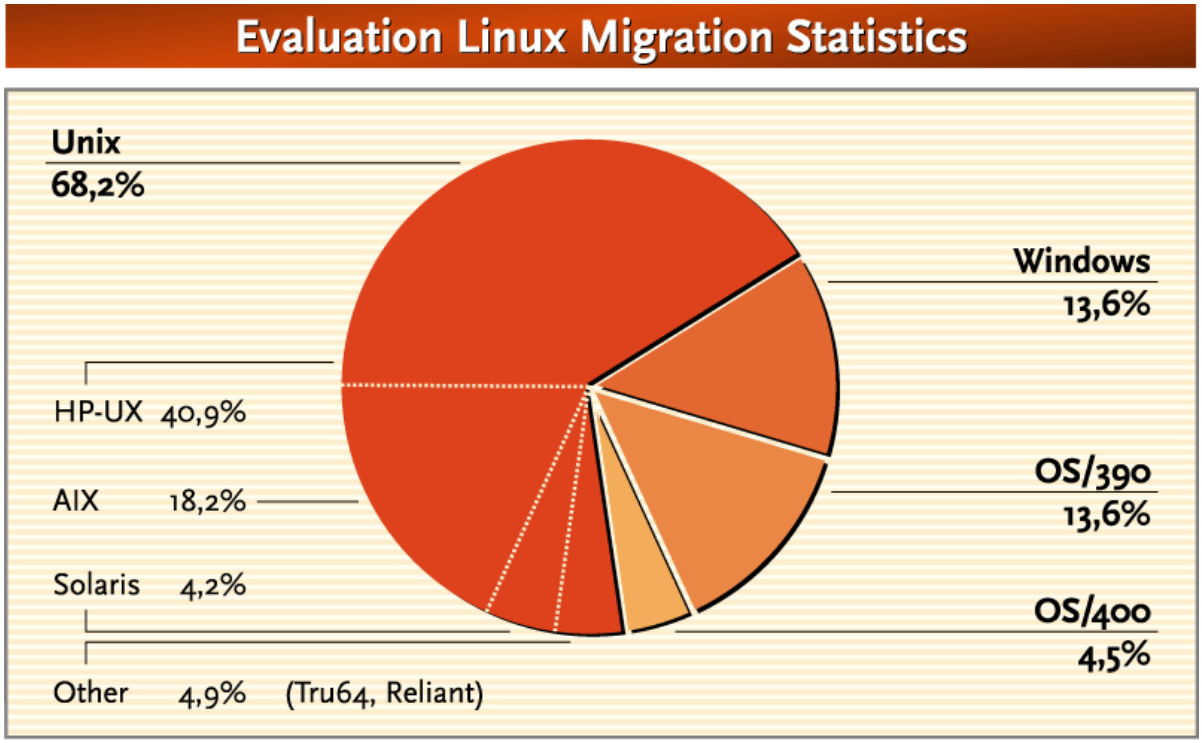

Figure 1: Source Operating Systems in SAP Linux migrations from REALTECH during 10/2005 – 03/2008.

minor good news for UNIX vendors that Solaris is a rare source (4.2%) of SAP migrations – yet maybe. This distribution factor of current UNIX flavors as sources might have more to do with their market share in certain industrial sectors than with their potential attractiveness for a Linux migration, but we will evaluate this in the next chapters. The discussion on industrial sector level shows that those businesses in which SUN traditionally is very successful (banking, public sector) also tend to be the most conservative ones to introduce Linux into their SAP data centers. Other industries with higher cost pressure or more progressive IT strategies take the lead.

Also interesting for the discussion later on will be another statistical fact: While the Windows share as a source system declines at roughly the same pace the UNIX share goes up, the percentage of migrations from mainframe-like architectures remains almost constantly close to 20%. In the first statistical period discussed OS/390 was the rarer source with 6.7% compared to 13.3% coming from the more mid-range OS/400 systems. In the second period of statistical evaluation, the relative share of the two system-classes has more than reversed: Now, 13.6% of our productive migration sources are OS/390, whereas the percentage of OS/400 systems has dropped to only 4.5%. This gives us a valuable indication of which customers are migrating, and what their average size and scope are: To put it simply, the average Linux migration customer gets bigger in size, revenue, and number of employees, and comes from industries with much

more business-critical applications. A significant portion of REALTECH's Linux migration customers has even run mainframe systems for several years.

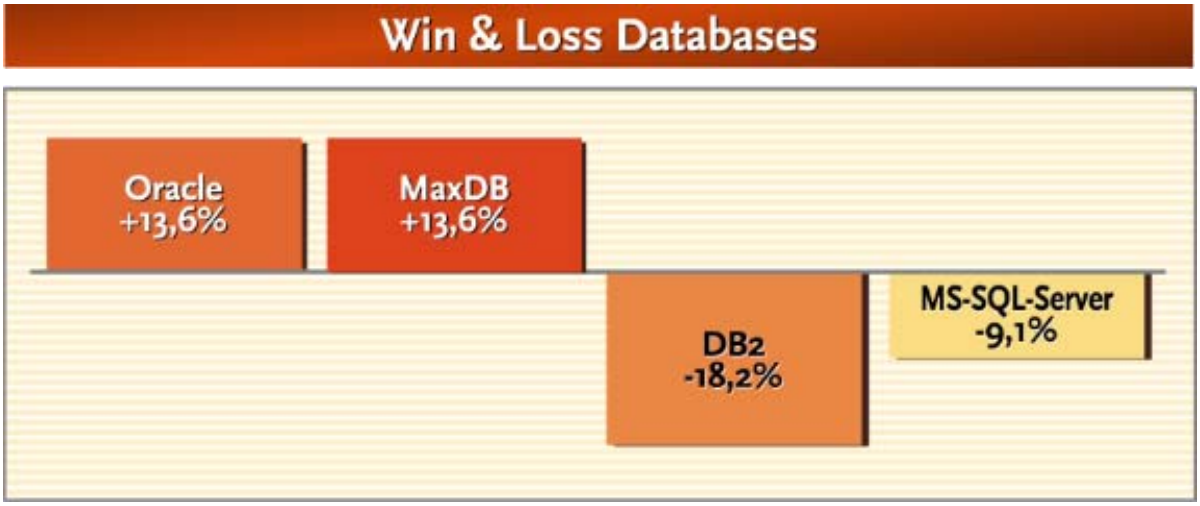

Figure 2: Database win & loss statistics in SAP Linux migrations by REALTECH during 10/2005 – 03/2008.

Database statistics give hints into the same direction: The first Linux migration wave saw a clear winner with MaxDB (+33% to an absolute share of 40%), with all others losing market share. In the second evaluation period, ORACLE and MaxDB both gained 13.6% (absolute market shares in that period ORACLE 63.6%, MaxDB 31.8%, DB2 4.5%), with ORACLE coming from a market share loss of -13.2% during the first evaluation period. There is an easy explanation for this phenomenon: The average Linux customer gets larger in size, has a more complex IT infrastructure, and sometimes has applications using ORACLE databases outside the SAP domain. Hence, these customers are reluctant to execute a switch of database platforms, which always goes along with a switch in standardized operational procedures. Coming from mainframe-architectures utilizing DB2 in large installations, these customers are also more prone to trust their data to a proven and well-known solution like ORACLE rather than something with a quieter reputation like MaxDB. This does not mean that there are no big businesses with critical applications migrating towards MaxDB (see the ENSO case later in this analysis), but smaller customers are more likely to switch to MaxDB. Vice versa, the rising share of ORACLE as target database platform indicates that the average Linux customer gets larger and has more critical applications. As for DB2, since the absolute number of mainframe customers deserting the platform has risen significantly while the absolute number of Linux customers choosing DB2 as target database has remained at a constant level, the loss in market share of DB2 in the Linux area has aggravated from -6.5% in the first evaluation period to -18.2% in the second period. This

leaves DB2[1] with only 4.5% share left within the SAP Linux deployment market. The database win & loss statistics, by the way, also implies that only 9.1% of our Linux migration customers ran Microsoft SQL Server as source database, since the relative loss in market share equals the absolute loss – there is no Microsoft SQL Server for Linux.

Another interesting statistical fact is the absolute size of the SAP databases migrated to Linux: The first four production databases migrated to Linux by REALTECH were 25 GB, 120 GB, 20 GB, and 60 GB in size. The last four production databases REALTECH migrated to Linux were 400 GB, 80 GB, 280 GB, and **1 TB** in size. We will comment these facts with conclusions concerning the customer structure in the next chapter.

The absolute number of migrations to Linux is REALTECH confidential, of course, but it almost doubled from the first statistical period (40 months) to the second one (30 months). There is no doubt that the movement towards Linux in SAP data centers is gaining momentum strongly and fast.

[1] It might well be discussed if DB2 for OS/400 and OS/390 is the same database platform from a technical point of view as DB2 UDB for UNIX and Windows. However, IBM consciously markets DB2 under this name for all platforms. Thus, we decided to treat it as one product statistically.

Customer Structure and Motivation of Migrations

Which trends can be recognized in the size or industry? Are specific industrial sectors more likely or more reluctant to go to Linux than others? If yes, which ones, and why? Are any developments with regards to these factors perceivable over time? What were and what are the motivations of those moving to Linux? Is Linux ready for highly critical applications?

Again as with the statistical data, let's take a look into the historical development for hints. The first customers REALTECH migrated to the Linux platform were a real estate agency service with less than 50 users in the SAP system, a well-known but rather smaller engineering company[2] restructured from a procedure comparable to Chapter 11 (300 employees at the time), and a medium-sized pharmaceutical company which had to migrate away from Reliant. None of these customers had more than 1500 employees at the time, or even closely reached the one-billion-revenue per year limit. Database sizes discussed previously also indicate that criticality and performance requirements of these systems were limited. The focus in SAP modules used was in the FI, FI-CO, and HR areas – important tasks, certainly, but usually with little criticality in response time and overall system performance requirements. Thus, the very early adaptors of Linux came from the segment of very small to small SAP customers, and from industrial sectors with unspectacular if not uncritical performance and availability requirements. We found in our early marketing evaluations for reference and success stories that customers almost unanimously stated the search the search for the "best compromise of cost-efficiency and stability while minimizing system administration overhead".

The customer range to follow the "earliest birds" (but still well-deserving to be called early adaptors) came from the electronics sector, food industry, and engineering domains. Still, the focus of usage was in the FI, FI-CO, and HR modules, however these systems for the first time also included Sales & Distribution (SD), Material Management (MM), and Production Planning (PP) – Linux became an essential part of the production process. Cost efficiency was a decision factor in these migration projects, as well, and as always maybe, but the decision-making reason quoted most frequently was the desired "stability" of the new environment. It was also the time (2003/2004) when the percentage of Windows customers migrating to Linux had reached its

[2] BORSIG – a REALTECH Linux reference customer for many years now.

peak, and the vast majority came from obsolete Windows NT installations, which was never exactly famous for stability. Microsoft obviously addressed the issue with the server versions of Windows 2000 and 2003, and as much as they did the number of migration customers from Windows to Linux declined.

Thus, with Linux having proven to be both a cost-efficient and enterprise-ready solution, our Linux migration customers came from a wider range of industries and included (several, usually smaller) insurances, and logistics, electronics and larger engineering companies, as well as industries known to have tight margins such as construction materials manufacturers. This was the period (2005) when REALTECH for the first time migrated Linux systems with customers easily exceeding a billion EURO of revenue per year, and installations with up to 1500 concurrent users of all and explicitly business-critical SAP modules. Installations of this size and criticality had to take high-availability into consideration, of course, and one of these migrations was REALTECH's first towards Linux that broke the 1 TB limit. The motivation for migrating had shifted back to the cost argument, but stability and readiness for business-critical applications were assumed to be indispensable prerequisites, and to some extent taken for granted already. For the first time, hardware vendor independence as an important motivation was named, and repeatedly is mentioned until today. This confirms our observation that Linux on Power and Linux on Itanium does not play a significant role in the SAP world – one of the major advantages of Linux is left out.

Potential Linux customers with even higher performance requirements and even more critical applications had to wait for a technology that would allow for stronger servers in terms of CPU power, and virtually unlimited memory. With the dawn of the x86_64 (in the future referenced as "x64") technology[3] this was the case, and it wasn't that no one was waiting. Shortly after the availability of this technology especially utilities and hosting companies asked REALTECH for assistance in migrations towards Linux. IS Utilities, the SAP add-on for energy providers, is known to be an extremely performance-intense module, and this time the barrier of 10000 SAPS for a single productive system running on Linux was broken. As for a number of large hosting companies switching enormous numbers of SAP landscapes over to Linux, their main motivation for migrating was and until today is the high degree of automation Linux provides on the least cost-intense hardware platform, x86 architectures. This is nothing but another cost argument – IT

[3] From AMD with the OPTERON first, INTEL soon to follow.

hosting is a tight margin business, and success or failure depend on automation of operational procedures[4] and homogenization of the landscapes in order to keep knowledge cost low.

Today, the list of REALTECH's Linux customers includes the high-tech defense industry, airlines, energy providers, automotive suppliers, and chemical companies. The average size of database migrated almost doubles every two years, and the largest productive SAP database on Linux known to REALTECH runs in an ORACLE RAC setup, exceeds 10 TB in size, and is run by a telecommunications company. Recently, for the first time a REALTECH customer seriously considered our Zero Downtime offering for a UNIX to Linux migration – Linux has reached the final level of criticality in SAP data centers. The main motivation is to take advantage of the x64 cost benefit, while doubts in the readiness of Linux for business-critical deployments hardly if at all pose an issue any more.

[4] Single-image boot and single-image patch-management, Adaptive Computing and automated cloning, just to name a few of the possibilities that either require UNIX with proprietary hardware and/or are extremely hard to realize in the x86 world with Windows as OS of choice.

Cost Factor Operating System: TCO and ROI Investigations

Our Cost Calculation Model: Procedure and Normalization

If cost is one of the main motivations, how can it be reasonably expressed and compared? This chapter will explain a procedure how to normalize CPU power and hardware cost in SAP environments for proper comparison. We will provide key data and operating figures for easy estimation of saving effects on a customer's own environment.

In May 2007, REALTECH was approached by an automotive supplier (annual revenue exceeding 4 billion EURO, over 35000 employees worldwide) to evaluate the cost of replacing their current AIX based SAP infrastructure with Linux, and to evaluate a payback period. Thus, REALTECH had to develop a model of pricing an existing SAP hardware landscape and compare it with available new configurations on the AIX and Linux platforms[5]. Our approach was as follows: We made a review of the complete SAP landscape in terms of production criticality, system utilization, performance requirements and, of course, current hardware setup (number of CPUs and their performance, average and peak utilizations, depreciation periods). From this starting point, we calculated the existing SAP performance actually utilized and normalized it to the same benchmark release (SAP ECC 6.0). Then we determined a configuration that would fit the same landscape with the options available – the existing AIX Power5 platform, the newest available[6] AIX Power6 platform within the same server class (in that case IBM p570), and two variants of x86 platforms (quad core and dual core) from the IBM xSeries family. Of course, high availability requirements and disaster recovery distributions were taken into account for suggested configurations. These configurations then were priced based on the configuration prices listed by the transaction performance council, including hardware and software acquisition cost and maintenance for three years. Thus we attained the total cost for 3 years for each configuration, from which we calculated the annual cost per benchmark value in EURO/SAPS. Knowing that IBM would discount more heavily on the pSeries architecture than on the xSeries, especially for a large customer like the one who ordered this analysis, we assumed a discount of 70% on the pSeries, and a minor discount of 10% on the xSeries side. Despite this pro-AIX-config

[5] Within the IBM product range – it was one of the customer constraints that they did not intend to leave IBM as their preferred hardware supplier.
[6] At the time announced for November 2007, to be exact.

assumption, Linux had the edge over AIX with a ratio of 6.55 EURO/SAPS for Power6 (12.47 EURO/SAPS for Power5) versus 3.89 EURO/SAPS on INTEL XEON 5355 Quad Core (6.77 €/SAPS for INTEL XEON 7150N Dual Core) in a landscape actually utilizing 157400 SAPS. It has to be noted that the Power6 architecture was not available yet at the time of the analysis, and a comparison of price per benchmark value only really holds for a timeframe where both options are in fact available. This clearly increased the cost edge of Linux over the UNIX platform even more.

For the evaluations of this whitepaper, we have generalized and adapted the model. Due to some slightly modified assumptions (in the customer case, we were including the cost of a known source and target database), the key figure EURO/SAPS will slightly deviate from the findings above, however the key messages will hold.

Assumptions

All models generalizing technical parameters for comparison purposes have to make assumptions to provide a fair and equal starting point for all competitors. The following assumptions pose the framework for our cost evaluation model in this whitepaper.

(1)

Storage costs are excluded both from the acquisition and the maintenance part of the model. Storage cost contributes significantly to the total cost of TPC-benchmark configurations. This would adversely impact our model, which focuses on server and CPU architecture cost. Also, storage cost is much more dependent on the volume and availability level needed than on the backend server OS chosen.

(2)

For similar reasons, database costs are excluded both from the acquisition and the maintenance part of the model. Database cost contributes significantly to the total cost of TPC-benchmark configurations. This would adversely impact our model, which focuses on server and CPU architecture cost. SAP provides a strong incentive for MaxDB by a 3% license & support fee model versus a higher fee for all other databases. These potential savings are not included in the model here.

(3)

If our pricing source accounted for extra cost for a HA/cluster solution, these costs will not be included in our model, i.e. we did not count costs for cluster solutions as per se OS cost. SUSE Linux Enterprise 10 from Novell includes a cluster solution at no extra fee. In this respect, Linux offers another cost advantage.

(4)

From the enormous selection of processors, those with the most recent benchmarks published have been chosen for the cost evaluation to be on the very latest level of technology and competition. This applies if we were able to retrieve relevant pricing information for the architecture. If we could not retrieve relevant pricing information from public or other sources, an architecture from a vendor could not be taken into account. This applies to SUN x64 architectures, and unfortunately to the most recent Opteron processors since the TPC-C benchmark is mostly done with INTEL CPUs.

(5)

If a TPC configuration deviated in processor class, we assumed the higher level processor class for the same price ("in dubio pro vendor" assumption). The UNIX flavors clearly profit most from this assumption.

(6)

If a TPC configuration was tested on a different OS or a different Linux distribution for an x64 architecture, we replaced software acquisition and maintenance prices by the ones for SUSE Linux Enterprise 10. For UNIX processor architectures, we assumed pricing for the corresponding UNIX flavor.

(7)

If our cost figures did not come from TPC[7] but other sources, we adapted the discount assumed to the character of the source. I.e. if our source already delivers a configuration price we know to be highly competitive we assumed a lower discount option.

[7] We were forced to search for other pricing sources than TPC only since e.g. SUN has not published a TPC-C (transaction processing) benchmark for several years, and also for comparison purposes and to get accurate estimates for the discount range assumed. However, it is a REALTECH policy not to disclose other sources. Readers of this whitepaper are encouraged to simply trust in the correctness of our information due to our impartiality towards hardware vendors.

(8)

If an SAP benchmark for a CPU architecture was done on an OS platform different from the ones considered here, we assumed no significant effect on the CPU benchmark value, neither for good nor for bad. It has been shown that the influence of the OS on (classical[8]) SAP benchmark performance is overestimated and usually ranges well below ±5%. The performance of the database chosen for a benchmark, system parameters and especially the CPU and overall server architectures (buses, I/O) are much more important.

(9)

All SAPS given in this document and used in calculations have been normalized to the current benchmark release SAP ECC 6.0 (Non-Unicode). Since all processors taken into account for the cost comparison below were benchmarked for this release anyway, this posed no difficulty.

(10)

Prices given in USD were recalculated to EURO on basis of a currently very conservative exchange rate of 1.000 EURO = 1.450 USD.

[8] This statement holds for the Web AS ABAP world only. In the Web AS JAVA world, OS influence is a highly significant factor and creates easily measurable benchmark differences for the same CPU architecture. These effects are certainly not for the disadvantage of Linux, the few benchmarks published for EP/ESS have been done for SUSE Linux Enterprise Server or AIX.

A Comparison: Linux versus UNIX

If the previous discussion of cost savings or "best compromise of cost-efficiency and stability" as one of the major motivations is correct, is this because of the different licensing and support model Linux offers, or are we really discussing a cost advantage of a certain architecture? If we are considering x64 to be a favorable architecture from a price/performance point of view, why do UNIX customers seem to have a greater affinity to Linux than to Windows? Based on key figures developed and explained in this chapter (undiscounted and discounted EURO/SAPS, cost per server, comparison of server classes) we will compare the three main UNIX flavors (AIX, HP-UX, and Solaris) to Linux in terms of cost, and include architectural aspects.

General Discussion of Architectural Development

To appreciate the current trends in the server market, one has to take a look into the spectacular development of CPU performance over the last couple of years. Multi-core and multi-threading technologies have multiplied CPU-power in such a way that frequently a standard two- or four-CPU server will easily outperform a much larger system with the same OS only one or two years older. The SUN Niagara 2 recently surpassed 10000 SAPS – corresponding to more than 2000 SAP SD users generating heavy load – on a single CPU for the first time in an SAP SD benchmark. This increase in CPU performance is a general evolution, and therefore it is not restricted to the SPARC architecture. The development of Power4 to Power6 is an equally impressive example, and the same applies to x64 architectures – the first 64-bit x86 architectures, usually AMD Opterons, measured in the range of around 1000 SAPS per CPU, an impressive value in 2005. The very latest benchmarks on this platform deliver between 4500 to more than 6100 SAPS, however.

The explosion in hardware performance poses a new challenge for SAP system architects. Production servers, for safety reasons, are recommended never to run on just one CPU. But 2-CPU systems in many cases already exceed the actual performance requirements of many SAP customers for single production systems. So the new challenge is not to oversize, or to use the left-over performance reasonably, e.g. for other applications or SAP systems. But every challenge implies a chance: Deployments that previously required 8- , 16-, or even 32-way servers may be implemented on 2- or 4-way servers now, or deployments which required a considerable amount of application servers before can now be consolidated on fewer servers.

And if an SAP customer may downsize the server-class he/she has to use, what should hinder him/her to have a look around if there are less expensive alternatives, especially since the x64 architecture is extremely competitive in 2- or 4-way configurations?

Server Vendor	Benchmark-OS	Processor Name & Type	Cores	Threads	Frequency [MHz]	CPU Performance [SAPS, normalized]	Benchmark Year or Year of Value Research
IBM	AIX	Power4	1	1	1600	**965**	2005
HP	Linux	Opteron 252	1	1	2600	**1007**	2005
IBM	AIX	Power5	2	4	1950	**1310**	2005
SUN	Solaris	Opteron 8222	2	4	3000	**1848**	2007
HP	Windows	Opteron 2218	2	2	2600	**2003**	2006
IBM	Windows	XEON MP	2	4	3300	**2092**	2006
HP	Windows	Opteron 8218	2	2	2600	**2626**	2006
SUN	Solaris	SPARC64 VI	2	4	2400	**2846**	2007
IBM	Windows	XEON 5160	2	4	3000	**3210**	2006
HP	HP-UX	Itanium 9050 (Montecito)	2	4	1600	**3648**	2007
DELL	Windows	XEON 5355	4	4	2660	**4086**	2007
IBM	Linux	XEON 3210	4	4	2130	**4396**	2007
IBM	Windows	XEON 5355	4	4	2660	**4490**	2007
IBM	Linux	XEON 7350	4	4	2930	**4629**	2007
FSC	Windows	XEON 5355	4	4	2660	**4831**	2007
IBM	AIX	Power6	2	4	4700	**5001**	2007
SUN	Solaris	UltraSPARC64 T1 (Niagara 1)	8	32	1400	**5522**	2007
HP	Windows	XEON 5460	4	4	3160	**6118**	2007
IBM	Linux	Power6	2	4	4200	**7812**	2008
SUN	Solaris	UltraSPARC64 T2 (Niagara 2)	8	64	1400	**10942**	2007

Figure 3: CPU architectures and benchmark values from 2005 – 2008 (example selection). Grey background denotes single core, yellow background dual core, green background quad core, and blue background 8 core CPUs. The enormous development in CPU performance can easily be seen (order by result, low to high).

Now, in REALTECH's observation this is what happens to the classic UNIX flavors. Traditionally very strong in multi-way configurations, the rise of x64-based servers into the midrange section of server performance is the real problem for UNIX. Figure 4 lists the servers and CPU architectures chosen for the cost-evaluation (see next chapter) in order of maximum performance per server. It is not surprising that newer architectures outperform older ones, but it is at least notable that a four-way x3850 outruns its slightly older eight-way Power5 cousin from the IBM server family.

Server Vendor	Processor Name & Type	Server Type	Maximum number of CPUs in configuration	Maximum Performance per Server [SAPS, normalized]	Undiscounted EURO/SAPS p.a.
DELL	XEON 5355	DELL PowerEdge 2900	2	8172	€ 1,34
IBM	XEON 5355	IBM x3500	2	8980	€ 2,36
IBM	Power5	IBM p570 P5 M-9117	8	10483	€ 24,51
HP	XEON 5460	HP Proliant ML 370 G5	2	12236	€ 0,76
HP	Itanium 9050 (Montecito)	HP rx6600 Integrity	4	14592	€ 5,07
IBM	XEON 7350	IBM x3850 M2	4	18518	€ 6,45
SUN	SPARC64 VI	SUN Enterprise M5000	8	22771	€ 6,69
HP	XEON 5460	HP Proliant DL 580 G5	4	24471	€ 0,78
IBM	XEON 7350	IBM x3950 M2	8	37035	€ 6,49
IBM	Power6	IBM p570 P6 M-9117	8	62496	€ 8,54
SUN	SPARC64 VI	SUN Enterprise M9000 VI	32	91085	€ 18,12
SUN	UltraSPARC64 T1 (Niagara 1)	SUN Enterprise M9000 N1	32	176691	€ 10,36
HP	Itanium 9050 (Montecito)	HP Integrity Superdome	64	233472	€ 15,96
SUN	UltraSPARC64 T2 (Niagara 2)	SUN Enterprise M9000 N2	32	350157	€ 5,68

Figure 4: Server types in order of maximum performance per server with the CPU type denoted.

Vice versa, the four- and eight-way x64 server systems now easily reach into benchmark regions previously reserved for eight-way systems and higher, usually running UNIX. And with high probability this development will continue in favor of the x64 architectures: Due to the competition between INTEL and AMD, this platform has a higher renewal frequency than any other. AMD has announced and published a quad core architecture code-named "Barcelona", and one might be anxious for good reasons to see first benchmarking results in the SAP domain.

Cost Comparison

Server Vendor	Processor Name & Type	Server Type	Maximum number of CPUs in configuration	Maximum Performance per Server [SAPS, normalized]	Undiscounted EURO/SAPS p.a.
HP	XEON 5460	HP Proliant ML 370 G5	2	12236	€ 0,76
HP	XEON 5460	HP Proliant DL 580 G5	4	24471	€ 0,78
DELL	XEON 5355	DELL PowerEdge 2900	2	8172	€ 1,34
IBM	XEON 5355	IBM x3500	2	8980	€ 2,36
HP	Itanium 9050 (Montecito)	HP rx6600 Integrity	4	14592	€ 5,07
SUN	UltraSPARC64 T2 (Niagara 2)	SUN Enterprise M9000 N2	32	350157	€ 5,68
IBM	XEON 7350	IBM x3850 M2	4	18518	€ 6,45
IBM	XEON 7350	IBM x3950 M2	8	37035	€ 6,49
SUN	SPARC64 VI	SUN Enterprise M5000	8	22771	€ 6,69
IBM	Power6	IBM p570 P6 M-9117	8	62496	€ 8,54
SUN	UltraSPARC64 T1 (Niagara 1)	SUN Enterprise M9000 N1	32	176691	€ 10,36
HP	Itanium 9050 (Montecito)	HP Integrity Superdome	64	233472	€ 15,96
SUN	SPARC64 VI	SUN Enterprise M9000 VI	32	91085	€ 18,12
IBM	Power5	IBM p570 P5 M-9117	8	10483	€ 24,51

Figure 5: Same selection of server types as in figure 4, this time in order of undiscounted EURO/SAPS with the CPU type denoted.

Figure 5 above shows the same selections of servers as figure 4, but this time the order is from low to high in undiscounted EURO/SAPS as calculated in a procedure described later in this chapter. Again, it is hardly surprising that newer architectures like the only recently benchmarked XEON 5460 and the Niagara 2 score well since benchmark performance is rising much faster than server cost. The best four systems from a price/performance point of view (undiscounted EURO/SAPS) are x64 servers, and they do not necessarily provide the lowest maximum performance in the roundup. Again, the strongest competition comes from the own family: A 4-CPU HP Proliant DL 580 outruns a 4-CPU rx6600 Integrity both in performance and in cost, although we assumed in favor of the HP-UX architecture the newest processor class benchmarked (see “Assumptions”, number (5)), in this case the Itanium 9050. And this leads to a conclusion with a somewhat speculative character since we cannot prove it, but that seems logical: Maybe the high percentage of HP-UX customers does not leave HP as their trusted hardware vendor – they just get a highly competitive offering from the same account manager, however only if they explicitly ask for it. We didn’t open the target hardware vendor discussion in our statistics evaluation, but the HP x64 hardware definitely is a frequent target in our Linux migrations. It is no surprise this was also the case with ENSO, the customer example discussed below. Not to create this effect may well be a reason for IBM to put up political pricing for their

higher-class x64 systems: Customers loyal to IBM as their preferred vendor will not turn away from the Power architecture as long as the difference does not get too big.

Server Vendor	Server Type	Initial Hardware Cost per CPU	Annual Hardware Maintenance Cost per CPU	Initial Software Cost per CPU	Annual Software Maintenance Cost per CPU	Undiscounted Cost per CPU (3 years)	Undiscounted Cost per Server (Maximum performance, 3 years)	OS for Cost Calculation
HP	HP Proliant ML 370 G5	€ 11.824	€ 294	€ 1.293	€ 0	€ 14.000	€ 28.000	SLES 10
HP	HP Proliant DL 580 G5	€ 12.771	€ 272	€ 646	€ 0	€ 14.232	€ 56.926	SLES 10
DELL	DELL PowerEdge 2900	€ 14.440	€ 221	€ 1.293	€ 0	€ 16.395	€ 32.790	SLES 10
IBM	IBM x3500	€ 29.992	€ 179	€ 1.292	€ 0	€ 31.822	€ 63.644	SLES 10
HP	HP rx6600 Integrity	€ 48.837	€ 1.479	€ 2.241	€ 0	€ 55.514	€ 222.057	HP-UX 11i
SUN	SUN Enterprise M9000 N2	€ 171.232	€ 4.679	€ 352	€ 283	€ 186.472	€ 5.967.108	Solaris 10
IBM	IBM x3850 M2	€ 88.283	€ 200	€ 646	€ 0	€ 89.530	€ 358.119	SLES 10
IBM	IBM x3950 M2	€ 87.981	€ 592	€ 323	€ 0	€ 90.081	€ 720.644	SLES 10
SUN	SUN Enterprise M5000	€ 44.941	€ 3.660	€ 501	€ 241	€ 57.143	€ 457.146	Solaris 10
IBM	IBM p570 P6 M-9117	€ 184.669	€ 3.658	€ 579	€ 1.334	€ 200.226	€ 1.601.807	AIX 5.3
SUN	SUN Enterprise M9000 N1	€ 155.666	€ 4.254	€ 320	€ 946	€ 171.586	€ 5.490.760	Solaris 10
HP	HP Integrity Superdome	€ 153.127	€ 4.944	€ 6.723	€ 0	€ 174.684	€ 11.179.770	HP-UX 11i
SUN	SUN Enterprise M9000 VI	€ 140.099	€ 3.828	€ 320	€ 946	€ 154.744	€ 4.951.792	Solaris 10
IBM	IBM p570 P5 M-9117	€ 89.199	€ 1.495	€ 871	€ 602	€ 96.360	€ 770.877	AIX 5.3

Figure 6: Initial and annual hard- and software costs as researched for this analysis. Please note that annual software cost is frequently bundled with initial software cost. Same order (undiscounted EURO/SAPS) as figure 5. (SLES = SUSE Linux Enterprise Server)

To create transparency, we want to explain our method of estimating overall server cost for three years, and how we get to EURO/SAPS from there. From our different sources (public if possible, other if not) we got configuration prices. We deducted everything not belonging into our model (see “Assumptions”, numbers (1), (2), and (3)) and, for x64 systems, replaced OS software cost by SUSE Linux Enterprise 10 from Novell (see “Assumptions”, number (6)) in a Premium Support model – in REALTECH’s project experience something strongly recommended. We computed initial and annual hard- and software cost according to the configuration prices given on a per CPU basis, recalculated for 3 years, and then assessed total cost for a fully equipped server. Using official SAP benchmark values, it then was easy to calculate our key figure EURO/SAPS per year. Figure 6 lists our price research results in the same order as figure 5 (undiscounted EURO/SAPS p.a.).

There are a few comments on figure 6: First of all, similar classes of systems match surprisingly well regarding the undiscounted cost per CPU, e.g. the high-end UNIX systems SUN Enterprise M9000, the HP Integrity Superdome, and IBM’s p570 Power6. Second, not necessarily the smallest servers with regards to maximum performance provide the best price/performance ratio.

And third, the x64 processor architecture with Linux provides the best four results overall, and six out of the best eight.

This is the point to answer our previous question: Are we leading a mainly architectural discussion? – Yes, we are. Mainly the x64 cost advantage triggers migrations to the Linux platform, and this corresponds well with our observation that Linux on Power and Linux on Itanium plays an almost negligible role as SAP platform migration targets. And it is also true that Microsoft Windows would likely deliver the same advantage in associated direct costs, since Premium Support for Linux and for Windows are not so much different in pricing. The reasons we get from our UNIX customers going to Linux on x64 (instead of Windows on x64) lie in the indirect cost, or, expressed differently, in the greater affinity of Linux with the originating operating system: UNIX administration staff is more easily turned to and trained in Linux, and there is no real change in OS philosophy, so acceptance from dedicated UNIX administrators will be higher. Also, there is no slash versus backslash problem in existing scripts, OS exits and interfaces, no EOL problem for transport cofiles, and similar, there is no disk drive adaption necessary. Each by itself, these are rather small advantages, but they frequently sum up to the decisive difference in favor of Linux.

Server Vendor	**Server Type**	**Discount Assumed** (dep. on source of cost ass.)	**Discounted Cost per Server** (Maximum performance, 3 years)	**OS for Cost Calculation**	**Maximum Performance per Server [SAPS, normalized]**	**Undiscounted EURO/SAPS p.a.**	**Median EURO/SAPS p.a.**	**Discounted EURO/SAPS p.a.**
HP	HP Proliant ML 370 G5	10%	€ 25.200	SLES 10	12236	€ 0,76	€ 0,72	€ 0,69
HP	HP Proliant DL 580 G5	10%	€ 51.233	SLES 10	24471	€ 0,78	€ 0,74	€ 0,70
DELL	DELL PowerEdge 2900	5%	€ 31.151	SLES 10	8172	€ 1,34	€ 1,30	€ 1,27
IBM	IBM x3500	10%	€ 57.280	SLES 10	8980	€ 2,36	€ 2,24	€ 2,13
HP	HP rx6600 Integrity	50%	€ 111.029	HP-UX 11i	14592	€ 5,07	€ 3,80	€ 2,54
IBM	IBM p570 P6 M-9117	60%	€ 640.723	AIX 5.3	62496	€ 8,54	€ 5,98	€ 3,42
SUN	SUN Enterprise M5000	40%	€ 274.288	Solaris 10	22771	€ 6,69	€ 5,35	€ 4,02
SUN	SUN Enterprise M9000 N2	20%	€ 4.773.687	Solaris 10	350157	€ 5,68	€ 5,11	€ 4,54
IBM	IBM x3850 M2	10%	€ 322.307	SLES 10	18518	€ 6,45	€ 6,12	€ 5,80
IBM	IBM x3950 M2	10%	€ 648.580	SLES 10	37035	€ 6,49	€ 6,16	€ 5,84
HP	HP Integrity Superdome	60%	€ 4.471.908	HP-UX 11i	233472	€ 15,96	€ 11,17	€ 6,38
SUN	SUN Enterprise M9000 N1	30%	€ 3.843.532	Solaris 10	176691	€ 10,36	€ 8,80	€ 7,25
IBM	IBM p570 P5 M-9117	70%	€ 231.263	AIX 5.3	10483	€ 24,51	€ 15,93	€ 7,35
SUN	SUN Enterprise M9000 VI	40%	€ 2.971.075	Solaris 10	91085	€ 18,12	€ 14,50	€ 10,87

Figure 7: Same selection of server types as in figure 4, this time in order of discounted EURO/SAPS with the CPU type denoted in figures 4 & 5. (SLES = SUSE Linux Enterprise Server)

As a last point, we want to discuss the known practice in the market to more aggressively discount certain architectures than others. Depending on the source of our pricing assumption, we assigned a discount to each of the servers in our list and recalculated the EURO/SAPS to a

correspondingly discounted value. As a result, the order of positions 5 to 14 in our evaluation changes but the order of the first four doesn't. I.e. even if you manage to persuade your HP account manager to give you a discount of 50% on your Itanium Integrity server it will not have a better price/performance ratio than the competing x64 Proliant. And even a 60% discount on the p570 Power6 server will not make it competitive to comparable x64 offers of other vendors. However, with such aggressive pricing versus a generally more modest discount behavior by all vendors in the x64 range, IBM manages to provide a cost advantage over its own upper-class x64 offerings, thus giving a strong incentive to stay with the Power architecture.

If you want to use this model to estimate your own potential savings, here are the necessary rules of thumb (quick cookbook):

Calculate the current performance of your hardware and its utilization. Define the number of servers you need for a distribution of SAP applications that fits your performance and disaster recovery requirements. Then calculate the number of CPUs required per architecture, and the number of servers needed. (At this point, don't forget that some server architectures only come in even numbers of CPUs, and please also confine yourself to comparable server classes – it really doesn't make sense to compare a Superdome to a PowerEdge 2900. The maximum performance per server, or the number of CPUs are very good indicators for similar server classes.) With this information and the configuration prices given above (discounted or not, depending on your preferred vendor and their willingness to negotiate), you will get an **estimate** for server costs over the next 3 years per architecture. Take into account depreciation effects as applicable to your landscape, and the resulting difference between your existing platform and the one with the best price/performance ratio are your potential savings.

Migration costs are customer-specific and largely depend on the size of enterprise, the size of the SAP systems to be migrated, and especially availability and downtime requirements. Those customers REALTECH evaluated so far have achieved a return on investment (RoI) in migrating from UNIX to Linux between 9 months and 2 ½ years.

Practical Example: ENSO – A Linux Migration Customer

One of our larger Linux customers (six system landscapes[9] had to be migrated initially, later a seventh landscape was added to the project), expressed in various discussions and user groups that one of their main motives was to lower cost. Although they are not the typical UNIX customer, they have high system and criticality requirements and thus we will shortly describe their case and the effects of the migration with respect to their motivations.

ENSO is an IT service provider for energy providers of the former Eastern Germany region. At the time of the migration evaluation (early 2005), six production SAP systems of the SAP components SAP R/3® and SAP BW were running in a disaster-proof (redundant servers and SAN in two data centers) zOS/DB2 mainframe set-up with zLinux partitions. System availability and performance were satisfying, however ENSO was facing the challenge of having to upgrade to SAP ECC and to introduce the debundling process into their SAP Utilities (IS-U) module. Both processes are known to increase performance requirements significantly. Since ENSO is an IT service provider, their challenge was to realize this performance increase with as little cost increase as possible, and without lowering system availability for customers. ENSO calculated their cost for various OS and database scenarios, and came up with hardware cost of 19.46 EURO/SAPS per month for the existing platform (i.e. 233.52 EURO/SAPS p.a.), and with 1.67 EURO/SAPS per month (i.e. 20.04 EURO/SAPS p.a.) for the best platform evaluated, which was SUSE Linux Enterprise/MaxDB on the then recently published AMD Opteron 64-bit platform running on HP x64 servers. Migrations were done successfully by REALTECH between June 2005 and December 2005.

In a number of presentations, ENSO has provided material showing that with no loss in availability, their new set-up provides better performance (lower dialogue response times, less time needed for database-heavy operations like client copies) and significantly less administrative overhead at significantly lower costs. Thus, ENSO realized high platform-related cost savings in a business-critical SAP landscape with high-availability requirements by moving to Linux, and is a NOVELL and REALTECH reference customer since then.

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[9] An SAP system landscape usually consists of the production system PRD, a development system DEV, and a quality assurance system QAS. Sometimes a sandbox system SBX is part of a landscape, as well. For our statistics, we only count production systems. Within the technical migration process, the whole system landscape is moved to the new platform. Thus, seven system landscapes add up to about 20 single migrations (export/import of data), depending on how the QAS system is rebuilt and how many tests are necessary.

Future Outlook: Effects of Linux Virtualization on SAP Landscapes

In which way will the virtualization of Linux have an impact on the issues discussed previously?

So far and according to REALTECH's observations, virtualization does not play a very significant role in our customers' considerations if and why to move to Linux (or to any other platform). If at all, we have encountered virtualization as an argument **not** to move away from an existing UNIX platform. In the x64 world, virtualization so far predominantly is seen to serve as a means of increasing interoperability of uncritical platforms, or as a feature that makes it easy to manage landscapes that have to be reset frequently (e.g. training landscapes).

With SUSE Linux Enterprise 10 from Novell, we think this will change, and will do so rapidly. Virtualization will become an essential part of SAP production environments. SUSE Linux Enterprise 10 provides all means to utilize hardware at a maximum level with the automation and orchestration features necessary, thus lowering overall hardware and administration cost even further. We think that this will especially hold true for SAP NetWeaver® components that scale out clearly better than scale up, e.g. the SAP NetWeaver Portal. These components will be provisioned on a dynamic and flexible basis, and will be based on workload management.

Since these qualities in combination with the cost offer of the x64 platform should be especially appealing to hosting and service providers, this is where we expect to see heavy use of virtualization on a productive level first. Others, especially large companies, will follow. We also think that this will further increase the momentum towards Linux.

Appendices

Sources and References

Internet

- http://www.sap.com/benchmark
- http://www.tpc.org/
- http://www-03.ibm.com/servers/
- http://welcome.hp.com/country/us/en/prodserv/servers.html
- http://www.sun.com/servers/
- http://www.novell.com/linux
- http://www.amd.com/barcelona
- http://www.intel.com
- http://www.gartner.com
- http://www.idc.com
- http://www.heise.de/newsticker/meldung/104182
- http://www.realtech.com/linux

Other

- RAAD Consult presentation: “SAP-Markt Deutschland – Trends und Potenziale 2008/2009“, February 2008
- ENSO presentation on DSAG congress – “Kostensenkung und Vorteile durch Datenbank-Migration von DB2/390 nach MaxDB auf LINUX X86_64“, February 2006

About REALTECH

The company was founded in 1994 as a basis technology specialist with close ties and good connections to SAP from the very beginning. Specialized in the implementation of SAP R/3 landscapes on INTEL servers, which automatically implied Microsoft Windows at the time, REALTECH immediately recognized the potential importance of Linux as a new strategic server platform with its beginning emergence in the second half of the 90's. Thus, with the official publication of the availability of SAP R/3 on Linux, REALTECH was **a founding member of the SAP LinuxLab** to then become and stay until today the only independent consulting company in SAP's flagship Linux organization.

REALTECH is a full service company taking care of **all technological aspects of SAP ERP and SAP NetWeaver implementation, optimization, Going-Live,** or **migration projects**. We set up requests for proposal, evaluate hardware vendors' bids and project suggestions, scrutinize hardware configurations and sizing as well as project plans, set up, examine and document lab configurations for refereeing decisions, perform benchmarking and specialized set-ups for hardware vendors. We also do project planning, project management and project controlling for our customers. Of course, REALTECH will deliver the plain doing of installations, migrations, and upgrades as well as the previously described conceptual work whenever the customer feels more comfortable with REALTECH's technical and business expertise than anyone else's.

If you are interested in our services, contact REALTECH via www.realtech.com or customer-services@realtech.com .