

# *Linux on Mainframe Computers and Other Alternatives*

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## Executive Summary

Due to continuing rapid developments in technology, competition and economics, IT organizations are faced with the dual challenges of managing change in the operating environment while simultaneously lowering operational costs. As a result, data centers have been forced to adopt certain attributes of the Internet, namely speed and flexibility. Often, such changes can also translate into additional complexity, pushing up costs and jeopardizing the desired flexibility, availability and scalability.

Data centers environments have changed dramatically in the last years. The past decade has seen a rapid growth in the use of Enterprise Resource Planning (ERP) software packages, such as SAP, and Customer Relationship Management (CRM) software packages that are mainly hosted on UNIX systems. These software packages have replaced many previous mainframe-oriented workloads such that today, the remaining mainframe data center applications are predominantly homegrown or bespoke applications written largely in Cobol using CICS transaction processing, and using either DB2 databases or VSAM indexed sequential files. These applications are usually more than 10 years old and, while essentially stable, many companies are faced with the dilemma of supporting these systems in the future with decreasing skilled-staff (from older generation support staff nearing retirement) and increasing support costs. The different options to be considered for an organization operating mainframes are:

- Stay on the mainframe (and endure cost increases)
- Replace the system with a (hopefully equivalent) software package
- Re-write (re-host) the application onto another environment.

Another option, loading even more applications onto the mainframe to make it more cost effective is now also being considered, where the operating environment Linux serves as a virtual partition on the mainframe hosting a Unix-based software package. Certain IT vendors are marketing the advantages of mainframe Linux with various arguments. However, META Group research has not been able to substantiate many of these arguments. In general, adding Linux to the mainframe environment is yet another operating system to manage and could defocus the operating staff and force them to become more of an IT integrator than desired.

In response, this document:

- Discusses the advantages/disadvantages of Linux on mainframes
- Advises the reader about important considerations when re-hosting applications off the mainframe.

The information and advice contained in this document has been provided to META Group clients over the last 6 months through META Group Client Advisors (newsletters summarizing important trends) and in META Group Deltas that are advisory papers analyzing one trend in more detail.

META Group publishes periodic Multi-Client Studies on various topics and META Group Germany has recently completed such a study on Linux in Germany. This study is also referenced in the document. The Study can be assessed, in summary, and purchased at [www.metagroup.de](http://www.metagroup.de). Lastly, META Group has also published a Case Study of how one company successfully re-hosted its applications environment from a mainframe and the lessons learned in that project. That document is available separately from META Group or from Sun Microsystems.

META Group, Ismaning, Germany, February 2003



## Linux on Mainframes

### Mainframes in the Data Center

The long-term future for mainframe computer systems is not positive. This is because of onerous software licensing costs (between 2 and 5 times those of high-end Unix and about 10 times those of Windows2000) and an only slightly improving hardware price/performance metric (15 to 20% per year compared to 50%/60% for the other platforms). Therefore most companies with small/medium mainframe installations will want to move to alternative platforms in the next 5 years. Only the large mainframe sites will continue to view their installations as strategic due to the prohibitive cost of migration and transactional volumes. In total, the data center infrastructure is segmenting into the following broad sections:

- Mainframe carrying legacy, proprietary back-office transactional systems
- High-end UNIX Servers for transaction, database and storage management
- Mid-range UNIX, Win2000 and, increasingly Linux servers for file and print services
- UNIX/Solaris, Linux and WIN2000 servers for web-servers, firewall and miscellaneous services.

META Group sees the future developments in a data center as illustrated below. Sun Solaris has established itself as a mainstream OS while other Unix systems (e.g. AIX, HP-UX) will increasingly become “legacy environments” with decreasing levels of support from Independent Software Vendors (ISVs) and an increasing risk of being replaced by a more-commodity Linux platform.

## **Scaling Server Infrastructure Tiers and Selecting the Right Operating System**

Storage Layer	Server Layer	Hardware Scalability	High Availability	Operating System	
				2002	2006
<ul style="list-style-type: none"> <li>▪ Internal</li> <li>▪ Direct Attached</li> <li>▪ Network Attached Storage (NAS)</li> <li>▪ Storage Area Networks (SAN)</li> </ul>	<b>Web Server</b>	<ul style="list-style-type: none"> <li>• Scale out (many systems)</li> <li>• Thin rack form factor (1-2U)</li> <li>• Small SMP (1-2 CPUs)</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple Boxes</li> <li>• IP load balancing</li> </ul>	<ul style="list-style-type: none"> <li>• NT</li> <li>• Linux</li> <li>• Unix</li> <li>• W2K</li> </ul>	<ul style="list-style-type: none"> <li>• W2K</li> <li>• Linux</li> <li>• Solaris</li> </ul>
	<b>App Server</b>	<ul style="list-style-type: none"> <li>• Scale out (several systems)</li> <li>• Rack or stand-alone form factor</li> <li>• Medium SMP (1-4 CPUs)</li> </ul>	<ul style="list-style-type: none"> <li>• Same as above plus:               <ul style="list-style-type: none"> <li>– Application Server Session Mgmt</li> <li>– App server load balancing</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• NT</li> <li>• Unix</li> <li>• W2K AS</li> </ul>	<ul style="list-style-type: none"> <li>• W2K AS</li> <li>• Linux</li> <li>• Solaris</li> </ul>
	<b>DBMS Server</b>	<ul style="list-style-type: none"> <li>• Scale up</li> <li>• Single instance*</li> <li>• Large SMP or hybrid (NUMA) (4-16+ CPUs)</li> </ul>	<ul style="list-style-type: none"> <li>• Data Storage (Mirroring, RAID, Replication)</li> <li>• OS Clustering</li> <li>• DBMS Clustering</li> <li>• Typically 2 nodes (moving to 4+)</li> </ul>	<ul style="list-style-type: none"> <li>• Unix</li> <li>• Legacy</li> <li>• NT</li> <li>• W2K</li> </ul>	<ul style="list-style-type: none"> <li>• W2K DCE</li> <li>• Unix &amp; Legacy</li> <li>• Linux</li> </ul>

**Figure 1: Operating Systems Trends**



## Considering Linux on Mainframes

As mainframes become limited to platforms for older, bespoke applications with surplus capacity because other applications are already offloaded onto other platforms, IT organizations are challenged to maintaining these systems with increasing costs and skilled staff bottlenecks. Many observers, especially vendors with a vested interest, now promote the concept of hosting the Linux operating environment, as a partitioned environment for new applications, on these mainframes in order to leverage existing operating costs and installed systems capacity instead of purchasing new CPU units.

Indeed, there are good arguments to follow such a strategy. The mainframe has operations and management features which are highly valued by existing mainframe operating staff. There are numerous advantages in workload partitioning and management, process prioritization and general systems management. Thus, META Group has observed that some users are deploying Linux applications on their existing mainframes when mainframe MIPS are readily available in order to leverage the mainframe operating capabilities for Linux applications. The installation of Linux on mainframes is most apparent at small and medium mainframe sites with less than 1,000 MIPS capacity, where these users are now seeking an early start in their, as described above, inevitable platform transitions (e.g., S/390 and z/OS to Unix, Win2000 and Linux operating environments). Usually, the applications being hosted on Linux mainframe are not mission-critical and can be discretely managed.

### Why does it happen?

However, few users are actually buying any **new** mainframe capacity to run Linux. The only exception is when service providers seek to exploit the ease of virtual machines via the IBM z/VM or VM/ESA functionalities. Simply put, mainframe Linux will remain a niche, whose lifetime will be determined by the following deltas between mainframe and Unix:

- Cost (a widening delta, as other systems become more cost effective and mainframe less)
- Management Functionality (a closing delta as Unix acquires even more mainframe-class management features).

META Group research actually indicates that the main attraction of mainframe Linux is actually its ease of operations – much more than its price or total cost of ownership.



### Recommendation concerning Use of Linux

META Group recommends that the mainframe should be viewed only as an interim port in the Linux storm. In fact, it could even be an expensive port depending on how existing MIPS are charged in the organization. If an IT organization decides to adopt Linux, then META Group sees near-term Linux mainframe deployment, meaning through 2004, as best restricted to consolidation and integration projects of simple and discrete applications.

This enables an IT organization to gain Linux experience in a controlled, low-risk environment. Longer-term (2005 and later), META Group believes that Linux will be most prevalent on Intel-based servers (Lintel) which, by then (2005), will also offer compelling economics and improved management capabilities. At that time, it will be difficult to justify mainframe Linux at all. But bear the following details in mind when comparing this route (mainframe Linux) to an alternative immediate build out of UNIX or Win2000 servers.

<b>Food for Thought for Mainframe Linux Users</b>
Fault recovery, long a strong point of z/OS, has not been passed on to Linux just because it runs on zSeries hardware and, though z/VM does have some fault recovery features, it is not nearly as resilient as z/OS. As a long-standing operating system stepchild, VM device support has been slow; as hypervisor, it can be a single point of failure.
Linux is not always Linux, and applications have been ported to different versions of Linux, such as SuSE, Red Hat and Turbolinux. IT operations groups will have to put a stake in the ground as to version and support requirements such as 24*7, or a fragmented, difficult-to-support Linux environment will wreak havoc on data centers.
Because Linux is Intel-based, IBM has supplied the "magic" for mapping Intel's IRQs (Intel's interrupt architecture) to IBM's channel architecture, supplying 64K types versus Intel's typical 15. Some shops may require services for implementing and exercising this hardware/software-mapping layer that lies above IBM's hardware and below Linux software.
While providing a Unix application look and feel, Linux still thinks Intel. And although some ports have proven to be quite easy, subtle internal data format differences (e.g., Intel's little endian versus z/OS's big endian) can affect application ports for applications that manipulate "word" formats.
Although Linux can run natively on zSeries, it lacks critical hardware utilities, such as IOCP and EREP, which dramatically complicates and limits operations.
IPL engines are Linux only and will not IPL anything but Linux. Customers should strike simple thoughts from their minds, such as IPLing z/OS versions just to see if they work, or using them for backup or unexpected load swings.
Linux for S/390 is ASCII-based, which enables Unix codes to use the same character sorting and processing codes with modifications – an improvement over USS.
Under VM, all Linux I/O and application operations can be instrumented and analyzed via traditional mainframe tools that can provide reliable billing. Together with common console management, the two can aid in enterprise- and service-provided server farms.

Figure 2: Excerpt from META Group Delta No. 1094



## META Group

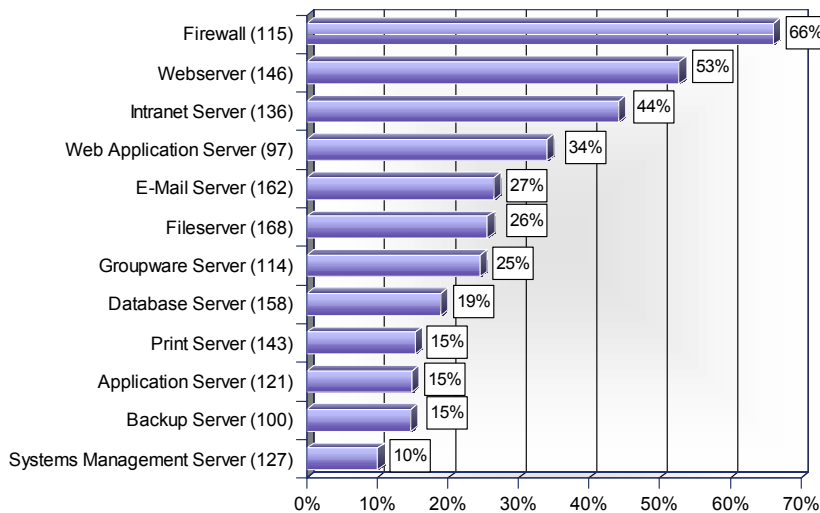
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### General Linux Influence

META Group expects the influence of Linux to increase in almost all types of server. The most effect will be in the area of appliances, web servers and file & print servers, threatening Microsoft's position as dominant influence in this area. The dominating influence of Solaris for application and database management servers will be maintained in the future.

The country that already has the greatest Linux penetration is Germany. In a recent Multi-Client Study by META Group Germany, 36% of all IT Managers polled stated that they are already using Linux. Of those, 188 organizations provided the following information.

### Which Server Functionality is supported by your Linux system(s)



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Figure 3: Survey of 188 German Linux Users Nov 2002

As can be seen, the most common uses for Linux are in commodity servers such as firewalls and web servers. Although Linux will undoubtedly achieve a position of being a mainstream operating environment, the usage of Linux on mainframes was not statistically relevant in the survey although IT Managers were interviewed. META Group has observed a similar distribution in other geographies. .



To document the worldwide trends behind Linux, the following table summarizes the current analysis from META Group on Linux. These findings were documented in a META Group Client Advisor, sent to all META Clients, in December 2002.

<b>Findings Summarized in META Group Client Advisor December 2002</b>
<b>The Linux Scenario</b> By late 2003, managing and administering Linux will be mainstream. Scalability to that of proprietary Unix Oss (e.g. Solaris) will take a couple more years. Widespread Linux adoption during the next five years will catalyze major changes in the IT industry landscape (e.g., we believe that in late 2004, Microsoft (and its partners) will begin moving some of (to-date) proprietary application enablers to the Linux environment.
<b>Ready for Management</b> Management is not a barrier to Linux adoption, but it is important to account for the training and tools needed to ensure consistent support with all open systems platforms.
<b>Linux in the Storefront</b> Linux-based dedicated function platforms will grow rapidly (due to lower perceived cost) and begin attracting more client interest; we also believe there will be Linux-based content management, personalization, middleware, portals, and search functions (after 2004), but not complete business suites.
<b>Linux development: Waiting for Demand</b> Linux adoption in application development should be driven by its acceptance as a deployment platform. To best position themselves to exploit the cost savings Linux will eventually provide, organizations should focus on solutions that enable easy code portability.
<b>End-User Linux: Competing in Invisible Places</b> Linux maturity will primarily cannibalize existing Unix workstation environments and minimally affect corporate Windows desktop users.
<b>Network and Security Impacts of Linux</b> Companies should exploit the low cost and customizability of Linux, but be prepared for increased security exposure in the future.
<b>Linux vs Unix vs Windows ... and the Winner is Intel</b> Where possible, users should exploit Intel-based solutions – which will continue to be the low cost dominant solution – over more expensive RISC and CISC alternatives.
<b>Linux: No Silver Bullet for Total Server Ownership Cost</b> Although anticipated cost savings typically are the key driver behind Linux data center deployments, true comparisons (vs. political or perceived) are rare. IT organizations must evaluate platform costs from a Total-Cost-of-Ownership (TCO) perspective.
<b>Open Source/Linux: The Government Take</b> Linux will have significant public-sector acceptance, which will encourage further commercial developments. By 2005/06, public-sector deployments (typically outside US) will provide the basis for accelerated Linux (and other open source) implementations.

**Figure 4: Main Findings of META Group on Linux**





## **A Mainframe Alternative – Re-hosting**

Some companies actually follow a totally different strategy. They consolidate their mainframe systems onto alternative systems such as a data center of purely Unix systems or at least just a mix of UNIX and Win2000 servers. As the IT infrastructure separates more and more into application, web and database servers, it is becoming preferable to standardize these functions on medium-range server farms. Consolidation of like servers then results in significant operating savings compared to mainframe-based infrastructures. These savings are in operating costs, skills concentration, reduced floor-space utilization (saving operators and utility costs) as well as the more obvious savings in hardware and software licenses and maintenance. If a data center already has a majority of UNIX systems in operation and just one or two mainframes, then it could be considered better to eject the older hardware than to continue to operate an exotic system that requires special skills and tools. .

For many companies, the homegrown mainframe applications still meet the needs of the businesses they serve. Re-hosting is defined as a way to move these existing business services from one platform to another and this should be totally transparent to end-users. Re-hosting can help a business “re-use” rather than replace existing the business assets, while leveraging current business rules and processes that are key organizational assets compared to the platform they run on.

However, the danger exists that the anticipated savings could be offset through migration costs if the re-hosting project itself is not effectively planned and staffed. META Group research indicates that few organizations will spend money to replace systems that are working adequately, especially in the current economic climate. Furthermore, the general slowdown in business means that few users are size constrained on current systems. In fact, many companies that had installed extra capacity a year ago in anticipation of continued economic expansion still have excess capacity.

But pressure to do something will increase. IBM is recommending its customers to migrate from OS/390 to z/OS, not a trivial task. Often, IT organizations find it difficult to find the right people to manage mainframe environments. The costs of hiring staff (or IBM) to migrate the mainframe to z/OS could trip the balance. And software companies like SAP are also encouraging their R/2 customers to find alternatives.



## **META Group Recommendations**

It is therefore very critical to fully analyze the possible benefits of mainframe re-hosting with a detailed audit of all operating costs and factors. This will enable IT organizations to justify the initial investment and serve as a risk analysis. Incidentally, Returns on Investment (ROI) expectations in most businesses are now between one and two years.

It is also imperative to select vendor(s) that can clearly demonstrate their experience in these types of projects. In summary, important factors for companies to succeed with their re-hosting projects include the following:

- The new platform must have a sufficient mainframe-like environment, emulating typical mainframe software like VSAM, COBOL, CICS.
- The vendor must be able to provide professional services staff with experience in both mainframe environments and in previous mainframe re-hosting projects.
- Sufficient migration utilities should be available to convert code, utilities like sorting and report writing.

In addition, a strict project management discipline and fair but rigorous allocation of responsibilities between user and vendor(s) is needed to ensure the successful completion.

IT organizations considering a mainframe re-hosting project should evaluate potential vendors with the above factors in mind. Capable vendors will have a list of reference customers who will testify to their validity and their staff will have demonstrable skills and experience in this area. These should be tested diligently before a project decision is made.

## **Bottom Line**

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**The main goal of a Linux on mainframe project is to utilize spare mainframe capacity by moving new workloads onto the mainframe. But the real long-term cost benefits still have to be proven. Linux on mainframes cannot address existing homegrown online and batch applications and is only suitable for some standard applications that are not mission-critical. A full evaluation of the data center portfolio could establish that the mainframe should not be maintained medium or long-term.**

**It is possible to re-hosting the residual mainframe solutions onto mid-range systems if the project is effectively planned and executed. Organizations should consider re-hosting as an alternative to the Linux on mainframe strategy based on their current and projected support skills, systems availability and long-term data center strategy.**