Linux and Solaris

An Analysis of Two Strategies for Enterprise Operating Systems

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Compares and contrasts the latest Linux and Solaris offerings:

→ **Strategic implications**
→ **Technical features**
→ **Other selection criteria**

This paper provides an analysis that aids in the selection of the most appropriate platform for enterprise environments.

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Executive Summary

There are a number of Linux and Unix operating system platform choices available today for enterprise workloads, an advantage which gives IT executives flexibility and reduces vendor risk. However, this choice also requires careful examination to select the best option among the wide range of proprietary Unix and open source Linux offerings. One of the most contentious today is choosing between Linux and Sun Microsystems, Inc.'s Solaris.

At face value, these platforms seem similar – both may be obtained for "free," both enjoy good availability of support offerings and administrator skills, and both are widely supported by application vendors. However, Robert Frances Group (RFG) believes there are important differences in vendor and community strategies, market position and direction, and technical features that IT executives should consider when comparing these two options.

To assist IT executives in making this decision, RFG examined the following factors for each platform:

- ➔ Vendor and community strategies and interests,
- ➔ Human factors, such as administrator skill sets and costs,
- ➔ Technical feature sets in each option,
- ➔ Benefits specifically applicable to enterprise environments, and
- ➔ User experiences, obtained from past conversations with RFG clients.

As a result of this analysis, RFG believes Linux provides benefits that outweigh those of commercial and open source versions of Solaris in most environments. Sun's open source derivative of their flagship operating system, OpenSolaris, has thus far failed to gain significant community support. Commercial Solaris versions remain a good choice where preexisting Solaris administrator skill sets, SPARC hardware, or Solaris-only applications are deployed. It may also be the right option where other strategic implications are involved, such as partnerships that the organization depends on.

Nevertheless, RFG believes Linux is a better choice for environments where Solaris is not absolutely required, including new workloads, workload migrations, and hardware virtualizations and consolidations. In any environment that can benefit from hardware flexibility and the ability to choose among multiple distribution and support vendors for a product, Linux provides a number of advantages, and RFG believes this describes most enterprise IT departments. IT executives should carefully evaluate both platforms, and select the most appropriate choice that balances meeting current workload requirements against the flexibility to support future expansion, migration, consolidation, and virtualization efforts.

Enterprise Operating System Context

The selection of an operating system for most major enterprises is not made in a "green field" setting, and should incorporate the following factors:

➜ Strategy around how open source software fits into the overall enterprise IT plan

➜ Existing strategic goals already in the process of being addressed

➜ Strength and commitment of original equipment manufacturer (OEM) partnerships, the independent software vendor (ISV) ecosystem, and the diversity, level of maturity, and quality of the open source community

➜ The organization's current hardware and software installed base

➜ Support capabilities and resources of product vendors and communities

➜ Technical resources required to support the future requirements of the business and the IT department

➜ Costs, opportunities, and risks associated with architectural change

➜ The technical differences between the operating systems that could impact business needs.

Within this context, many leading firms are in the process of creating an effective balance between open source and proprietary operating systems. Architects and executives are aiming to build target architectures and solutions that take advantage of the best of private source platforms from vendors with staying power and leverage Linux for many new workload requirements.

Comparing and Contrasting the Options

For most enterprise customers, operating systems are of secondary importance because they enable an organization to run the applications they need. The advancements, characteristics, commitment, and support of the operating system by the vendor/community, however, can greatly affect the behavior of those applications and the costs and risks associated with the organization's resources and technical infrastructure. The factors involved in an operating system's role within the enterprise architecture include both strategic and technical elements.

1. Strategic Factors

It is easy to focus solely on technical differences between operating systems, but strategic factors are often much more important. Flexibility, choice, and the agendas of vendors and communities all have long-term impacts on an organization during the ownership period of its platforms. Flexibility and choice break down into three areas:

➔ Hardware and platform support options, including device drivers

➔ Distribution vendors (providers of the software itself)

➔ Support offerings and models available.

Flexibility and choice have been two of the primary drivers behind the creation and success of Linux. Active community participation in the development process for Linux has yielded broad hardware architecture and device support. Linux is commonly deployed on ATMs, embedded systems, desktop/laptops, mainframes, POS terminals, servers, and supercomputers, which allows for administrator skill set, application, and management process reuse across the enterprise. The ability to run on a wider range of hardware also allows IT executives the flexibility to choose platforms to match the workload independent of an operating system selection. Broad platform support also allows for moving Linux workloads to the best suited hardware architecture (e.g., IBM's Power, System x, and/or System z, whichever best fits the customer's requirements) and provides future-proof portability. Additionally, this capability enables enterprises to consolidate and/or virtualize workloads on the optimal platform of choice without requiring redesigning or rewriting of applications. It also means that IT architects can build target application, data, and infrastructure architectures without having to be constrained by the underlying hardware and operating system variances. This not only simplifies the architecture but enhances productivity through simplification and standardization.

In contrast, Sun released a version of Solaris, OpenSolaris, under the Common Development and Distribution License (CDDL), an open source license that has been criticized for GPL incompatibilities, preventing code sharing with the much

larger Linux developer community. This differential hinders customers from code reuse and sharing with applications built on any Linux distribution. Moreover, these restrictions can prove to be an administrative intellectual property (IP) nightmare for companies that are committed to both platforms.

An additional concern is that, while the product and its source code are freely available, Sun does not endorse the concept of community or "shared" ownership of OpenSolaris, and thus OpenSolaris remains primarily controlled and developed by Sun itself. Solaris has good device support on its core platforms (x86-based and SPARC architected processors), but very limited support for others, including a project to port Solaris to the IBM Mainframe. What this means is that Sun has not certified OpenSolaris on all these platforms. This could result in a lack of support by Sun for problems encountered in these environments by customers. This can lengthen the problem resolution time, causing extended outages and the potential for lost revenues. To minimize these issues, companies that choose Solaris must unnecessarily restrict their hardware architecture choices.

Both platforms are available in a number of distributions from various sources. However, Solaris is commercially available only from Sun, and the few OpenSolaris distributions that have appeared (e.g., Belenix, Nexenta, MarTux, Solaris Express, and Schillix) do not enjoy the level of community support and involvement that popular Linux distributions (Fedora, openSUSE, Ubuntu, Debian, and Gentoo) receive. On the other hand, the distinctions between Linux and Solaris were reduced with Sun's recent announcement of the availability of a Sun Web stack, a fully supported and integrated enterprise-quality AMP (Apache/ MySQL/Perl or PHP) stack for Solaris and Linux operating systems. Thus, applications developed using this stack and be ported and supported on either platform.

Neither platform's community-supported editions can provide long-term feature guarantees, in that the communities that maintain them are not contractually required to support or update them with future releases. However, the more active a community is, the more likely it is to produce patches and new versions in the future. By way of comparison, Linux has more than 3,000 developers contributing to the Linux kernel while Sun claims there are 70 non-Sun engineers authorized for kernel development. On top of this, there is an additional vibrant Linux community around distributions, toolkits, and other upstream projects. Sun cannot boast the same level of activity today and it is highly unlikely that it can reach the same levels within the foreseeable future.

Commercial support is available for both platforms. Solaris support comes directly from Sun, the primary developer of the product. This is a slight advantage for Solaris users because with Linux, there are no guarantees that patches a support provider makes to solve a problem will be incorporated into future versions of the kernel, although it strives to do so. However, in practice, the need

to patch a kernel beyond what is provided by a distribution is rare for users of most common hardware combinations and usually non-existent for certified hardware platforms. Linux has a slight advantage in that customers can select different distribution and support providers, and there are more choices available in this area. Because the distinctions here have been mostly mitigated over the years, RFG believes that commercial support is no longer a significant criterion for customers that select one of the major distributions.

A number of actively maintained commercial and community distributions are available for Linux, some of which address specializations for specific environments. And, when support is required, customers can choose to acquire primary support from a vendor other than the one who provided the distribution and still expect to receive the same or better quality of service. For instance, enterprise support for Linux can be obtained from Red Hat or Novell while Oracle will support Red Hat Enterprise Linux. IBM also supports Linux, just as it does AIX and its other operating systems.

Additionally, there is the strategic issue of investment in the operating system. IBM, Intel, Novell, Oracle, Red Hat and others are heavily invested in the future of Linux. The Linux Foundation and many of Sun's partners are also devoting significant research and development funds into the future of Linux. Conversely, OpenSolaris does not have the same level of strategic commitment from others outside of Sun. This lack of strategic funding will dampen the growth of Solaris on x86, as customers will not find the variety of applications, middleware, and tools available on x86 Solaris as on Linux.

Figure 1. Comparison of Solaris 10 and OpenSolaris

	Solaris 10	OpenSolaris
Development model	Internal	Open source
Release frequency	Years	6 months
License	Commercial	CDDL
Support plans	4	2
Development control	Sun	Sun

It is clear that Sun itself is committed to an open sourced Solaris even though its open source model leaves much to be desired. Additionally, its existing base of customers, ISVs, and skilled administrators can be an advantage in environments with existing Solaris workloads, wherever applications must be supported that are only available on Solaris, or where a single-vendor strategy is a specific objective. RFG believes other environments – including deployments of new workloads, server migrations, refreshes, consolidations, and any environment where choice and flexibility are important – would be better served by choosing Linux.

2. The Human Factor

Moderate cost savings in hardware or software can be undone even by very small changes in recurring administration and training costs, or work inefficiency. It is thus crucial that cost/benefits analyses consider these impacts.

The popularity of both Linux and Solaris has ensured ready availability of skilled administrators for both platforms. Because of Solaris' earlier entry into the market, there are more "senior" level administrators available in the U.S. However, costs are still measurably higher for Solaris administrators than for Linux. Equally important, Solaris does not share the same level of popularity as Linux among younger candidates entering IT departments, such as recent college graduates.

This has led to the supply of Linux administrators increasing more rapidly than for Solaris, yielding higher skills availability and lower cost. In fact, Linux is so popular that it is common for Solaris administrators to teach themselves Linux on their own time, as a valuable job skill. "Popularity" is difficult to quantify in a total cost of ownership (TCO) analysis, but it does have measurable impact on the long-term livelihood of a software product. With an estimated 2 million Linux servers shipping each year and less than 500 thousand Solaris servers shipped by Sun last year, the gap between Linux and Solaris administrators and developers is disappearing. RFG expects Linux will soon have an advantage in all resource dimensions – availability, cost, skill, and talent pool.

TCO studies are a source of much argument, and numerous competing studies have shown that each platform is less expensive than the other. This is surely a good thing for IT executives with tightening budgets! The reality is that TCO studies need to include context, and organizations should perform their own, using outside studies primarily for guidance on methodologies and metrics.

Nonetheless, RFG believes Linux has an edge in this area over Solaris in that a higher supply of lower-cost employees provides at least the opportunity of cost savings and skill set retention, giving IT executives another advantage in meeting their challenges.

3. Price, Performance, and Price-Performance

In discussions RFG has had with its clients, lower costs, price performance, and the lack of dependence on any single vendor are the most frequently cited reasons for this shift from Solaris and traditional Unix platforms to Linux. This is resulting in a bifurcation of choices in today's market: low end commodity server solutions and mid- to high-end consolidation/virtualization solutions. The initial trend in most enterprises has been to pursue the commoditization route, one

application at a time, with Linux being the preferred operating system. The ability to purchase inexpensive hardware from a variety of manufacturers gives an enterprise a great deal of flexibility in planning and budgeting for their workloads, and the ability to capitalize on vendor price competition to squeeze the most out of limited budgets. Unfortunately this results over time in server sprawl and cost inefficiencies.

Uncontrolled growth has caused IT executives to take a more holistic view of the issues. When executives seek to solve the price/performance problem, they end up with a different set of requirements. In these cases, the criteria become availability, flexibility, price/performance, reliability, scalability, and overall system utilization. Under this scenario, executives are able to select a wider variety of platforms – blade servers, mid-range enterprise servers, and mainframes. Here again, Linux has an advantage as it fully supported on all these platform types. Sun, for example, does not certify or support Solaris on all of these platforms; however, there are third parties supporting Solaris on non-Sun servers.

Moreover, system performance continues to increase at a high rate for each of these platforms. Aggressive price competition together with continually increased performance creates a price-performance ratio that is extremely attractive for these systems over the traditional Unix solutions. Thus they are, and will continue to be, popular targets for workload migrations and new deployments. IT departments need to ensure that they address these needs holistically and select an operating system that can help them take advantage of the trends while satisfying user requirements. RFG believes IT executives will find Linux is a better match in most instances, especially where pre-existing Solaris capabilities are not in place or required.

4. Development and Distribution Models

Both Linux and Solaris are actively developed and proven models. Linux receives contributions from more developers than OpenSolaris, but Solaris is developed by a single entity. Critics argue that community contribution provides no guarantee that future versions with bug fixes and new features will be released in a timely fashion. However, this argument applies equally well to commercial products, and to date, Linux has an excellent track record of consistent, high-quality releases. Moreover quality and stability remain as two key planks in the Linux development process.

One advantage to an open source community development model is that the larger base of contributors has led to extremely broad support for hardware architectures and devices. This makes it easier for IT executives to select the most appropriate hardware combinations for each workload without that decision impacting operating system selection. Features that are valuable to one Linux community investor may also apply and benefit others. For instance, code

contributed to Linux by a mobile phone vendor for power efficiency may also help with power efficiency on a server. These factors have also helped with usability where Linux clearly has an advantage over OpenSolaris.

In addition, the wider array of distribution choices for Linux – more than 100 exist, with five commercial options – means there is more likely to be a distribution option that is able to meet an organization's needs. Competition between distribution developers has helped produce higher quality distributions with intuitive installers and management tools, suites and repositories of pre-packaged software, and specializations for desktops, high-end servers, special-purpose systems like kiosks and thin clients, and security-hardened deployments. In addition, some customers may find better support from one distribution vendor over another.

Both platforms are provided under flexible, open source licenses that meet the OSI definition requirements; thus, most organizations should find compliance straightforward. One issue with OpenSolaris, however, is that the CDDL is incompatible with the GPL. This may be a complication for an organization that is leveraging libraries or tools that are licensing under the GPL. Customers need to carefully understand how they are planning to use their licensed components to make sure they are compatible as well as to ensure no legal restrictions were violated.

Finally, commercial support is available for both platforms, and while results of individual cases may vary, RFG customers generally report being satisfied with these options. Linux does have one advantage in its extensive community of helpful users, available via forums, mailing lists, and other sources. While response times through this channel cannot be guaranteed, communities are generally helpful, informative, and responsive. IT executives at organizations where support is largely provided internally, but who wish to occasionally fall back on outside resources without significant added cost may wish to look into this option.

5. Technical Features

For two platforms with as many Unix-based similarities as they share, Linux and Solaris are remarkably different in terms of technical features and capabilities. Rather than comparing every feature, we have presented here a summary of those RFG believes are most critical in enterprise environments, broken into three groups – reliability and scalability, hardware support, and security.

Reliability and Scalability

Solaris, like most Unix platforms, have long had the leadership in reliability and scalability over the younger Linux operating system. However, this differential is

rapidly diminishing and RFG believes that Linux will attain parity in reliability and scalability for most commercial applications and system environments within the next two years. Linux is making gains in this area overall, as well as in certain feature sets that have been hallmark attributes of the older operating system.

Sun provides a performance analysis feature called DTrace, widely regarded as one of the most sophisticated performance analysis tools available today. IT executives should be aware that only expert administrators will get the most value out of this tool, because its use requires administrators to have good knowledge of very low-level system performance metrics. Linux offers alternatives including SystemTap that is just as sophisticated for kernel level insights (but harder to use) and it is improving very quickly to include user space probing capabilities. Both Dtrace and SystemTap also have GUIs that complement the command line tools.

Solaris also offers the ZFS file system, a sophisticated and feature-rich layer that provides administrators with the ability to resize, move, and repair volumes, and perform other tasks easily. In contrast, Linux offers a variety of file systems, such as EXT3 and the forthcoming btrfs, each with characteristics that may be better or worse than ZFS for a given usage. Neither operating system is a clear winner here – ZFS is generally good for nearly all local file system purposes, and is easy to administer, but Linux provides a range of choices that may allow an administrator to select the best option for a specific workload. Linux also has cluster file system capabilities that Solaris requires a third party file system to provide.

Finally, both platforms offer virtualization, although in different ways. VMware, a popular third-party software solution, may be used to host either platform on an x86-architected system. VMware generally provides good performance and excellent management tools, but is not as efficient as hardware-level virtualization such as IBM makes available on the IBM System z and IBM Power servers. One advantage of VMware is that it supports a variety of guest and host operating systems, which may be mixed on a single system including Linux, Solaris and Windows.

Moreover, Linux customers may choose to use Xen, which is open source and included in the Novell and Red Hat Linux distribution by default. Sun offers xVM which is a modified version of Xen for Solaris. Like VMware, Xen creates a separate, isolated "virtual machine."

For additional performance, some hardware vendors offer machine-level virtualization services that specifically support Linux. IBM provides more advanced virtualization features in its System z and Power servers. System z has z/VM, which has been gaining feature enhancements for more than 20 years and can scale to thousands of Linux virtual machine images. Power can both scale and offer high performance and live partition mobility, which allows for swapping

hardware bases without impacting application availability. The IBM platforms are the only ones that commercially support Linux for these advancements; there is no similar capability for Solaris.

Solaris customers offer a more limited set of virtualization features. Solaris Containers uses only a single operating system instance and provides isolation between applications in that instance. This requires fewer resources than a new operating system image than required when using VMware or Xen However, isolation levels are not as high. Upgrades, patches, or resource starvation in the host environment may negatively impact the virtualized instances. Linux also supports containers through a few projects, including linux-vserver and OpenVZ.

In general, in terms of virtualization on x86 platforms, Linux and Solaris are relatively on par. Both platforms offer software virtualization offerings, each with positive and negative characteristics. However, Linux has the unique ability today to offer greater flexibility, reliability and scalability through the use of IBM's enterprise server options.

Hardware Support

Hardware support needs to be addressed from two perspectives: horizontal and vertical scalability. Both the scale-out and scale-up platform alternatives are theoretically capable of more scalability than is typically demanded of them. For instance, Linux is capable of running on and/or supporting many CPUs, but many customers avoid this scenario for three reasons:

1. Large SMP systems are expensive due to their up front costs. Many customers look to Linux during a push to reduce IT costs through the deployment of commodity hardware, so most Linux customers look to less expensive, horizontal scalability commodity servers unless the workload absolutely requires otherwise.

2. Many new deployments of large SMP systems are to support server consolidation, and in these cases the systems are typically partitioned into 0.5-4 CPU instances that run Linux and/or a variety of other operating systems.

3. Solaris has a longer track record of supporting large SMP workloads, and customers who have these requirements feel there is no incentive to migrate.

In the last case, as well as cases where customers have encountered Linux server sprawl, migrating to a scale-up scenario using enterprise servers, such as the Power and System z, can provide cost and resource savings for users. For example, a System z can provide a massively scalable solution, as Linux on z/VM can allow for consolidation and virtualization of thousands of Linux virtual machines. RFG has found that consolidation and virtualization of Linux running on commodity servers to a System z can improve availability, reliability, and scalability while drastically reducing energy, resource, and total ownership costs.

Moreover, Linux supports a wide variety of chip architectures, from Intel's Itanium and x86/x64, Sun's SPARC, IBM's CISC z/Architecture, POWER RISC chips,

Cell BE processor, and many other processor architectures from embedded processors to enterprise servers. Solaris is limited to processors that utilize Intel's or Sun's architectures only.

Security

Operating system security is not a guarantee that the entire system will never be compromised, but it does form an important line of defense. In general, both platforms provide good security features, meet or exceed accepted industry standards for security specifications, and may be readily hardened to comply with corporate security policies. Solaris had a slight edge in that Sun has the financial and organizational resources to spearhead security certification processes. However, with the assistance of corporate and government backers as well as a multitude of vendors, Linux has made good progress in this area as well, and has caught up.

Nonetheless, RFG believes security is a multi-faceted challenge that cannot be addressed through a single feature or characteristic in an operating system. No platform should be considered secure out of the box, and IT executives should develop comprehensive security plans that cover policies and procedures first, then technical considerations. Linux and Solaris provide strong platforms for building a secure environment but customers should look at the flexibility and choice from having multiple vendors providing secure solutions.

Conclusions and Recommendations

Both Linux and Solaris are complete and capable server operating systems, and each has an appropriate role in an enterprise IT environment. RFG believes IT executives should evaluate the following factors when selecting a solution for a given workload:

- ➔ Corporate, technology, and vendors' road maps and strategies
- ➔ Application support, and ISV platform support commitments
- ➔ Human resources – availability, costs, skills, support, training and trends
- ➔ Flexibility, price, and price/performance
- ➔ Availability of desired distribution and support offerings
- ➔ Availability, performance, reliability, scalability and security requirements.

Linux is a better choice for a wider mix of workloads, hardware architectures, and administrator skill sets. Flexibility is crucial in an enterprise IT department, and Linux provides more choice of hardware, distribution models, and support providers without effecting how it is administered or the applications it may run. This allows IT executives to select hardware to match a workload, knowing that it will almost certainly be supported by Linux. Solaris is available on a variety of platforms, but still lags behind Linux in this area.

Nonetheless, Solaris is an extremely capable operating system, and may be a more appropriate choice where existing administrator skill sets and/or high-SMP SPARC workload requirements are found. These environments are also areas where some of Solaris' specific technical features, such as DTrace and ZFS, provide the potential benefits in specific use cases.

Human factors are also important. There are many competent Solaris administrators available today, but Solaris is rarely the first choice for college graduates adding certifications to their resumes. The popularity of Linux has created a larger supply of administrators, driving down their average cost without effecting a company's ability to find highly qualified individuals. It has also helped create an active and helpful community of users, developers, and commercial backers that have given the platform a great deal of momentum.

RFG believes these factors make Linux, along with its wide acceptance, a good selection for long-term ownership for a variety of workloads. IT executives should consider making Linux a strategic operating system standard for organizations except where specific circumstances dictate otherwise.