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Improving SAS Customer Intelligence Solution Performance with Oracle SPARC SuperCluster
Executive Overview................................................................. 1
Introduction ................................................................................. 2
  SAS Grid Computing and Oracle SPARC SuperCluster .......... 3
  SAS Data Integration and Oracle SPARC SuperCluster ........ 4
  SAS Marketing Automation and Oracle SPARC SuperCluster..... 5
 Oracle SPARC SuperCluster Technology................................. 5
  Key Benefits of Deploying SAS Marketing Automation on the SPARC SuperCluster ................................................. 6
  Oracle SPARC SuperCluster Configurations ......................... 6
Built-in Virtualization for Simplified SAS Application Solution Consolidation ................................................................. 8
High Availability Features that Keep SAS Application Solutions Running 9
 Oracle SPARC SuperCluster Performance Results .................. 10
  SAS Grid Computing and SAS Data Integration Performance on Oracle SPARC SuperCluster ........................................... 10
  Performance Results for Oracle SPARC SuperCluster with SAS Grid Computing and SAS Data Integration .................. 11
  SPARC SuperCluster Provides the Best Performance Results for SAS Marketing Automation .............................................. 12
Conclusion .................................................................................. 13
For More Information ................................................................. 14
Increasing the Performance of SAS Customer Intelligence Solutions with Oracle SPARC SuperCluster

Executive Overview

SAS Marketing Automation enables organizations to rapidly create, modify and execute marketing campaigns, getting them quickly out the door in an automated, traceable and repeatable manner. As such, the system running your SAS Marketing Automation can have a significant impact on getting the maximum value of your software investment, so the deployment strategy is a critical consideration.

Getting campaigns to market faster than your competitors can mean the difference between exploiting a window of opportunity or being too late to market. And it’s not just about time to market, it’s also about being able to fine-tune a live campaign rapidly, based on multiple market channel data in order to increase revenue and market share by optimizing customer interactions and improving the overall customer experience.

Oracle’s SPARC SuperCluster is the optimal deployment choice for SAS Marketing Automation software. This powerful and integrated system delivers the following key advantages for SAS Customer Intelligence Solutions:

- It enables execution of campaigns in hours rather than days or weeks, allowing you to respond to market opportunities and conditions before your competitors
- The SPARC SuperCluster’s Oracle Exadata Data Storage cells and Sun ZFS Storage Appliance enable SAS to analyze massive amounts of inbound marketing channel data rapidly in order to quickly deploy and fine-tune campaigns for maximum customer reach and market penetration
- It reduces risks associated with deploying marketing campaigns by testing and validating campaigns prior to deployment into real-world markets
- Dramatically decrease marketing campaign execution costs for a superior and demonstrable return on investment.

Deploying SAS Customer Intelligence application solutions with Oracle SPARC SuperCluster enables rapid response to market dynamics, grows an organization’s customer base, creating a positive trend for business growth.
Introduction

To increase revenues, organizations are looking for customer opportunities that they can turn into additional revenue to improve bottom-line profits. In the new world of marketing, savvy customers continue their migration from purchasing products at brick-and-mortar stores to using the internet to research and purchase products. They might also return to the online storefront to indicate their level of satisfaction with the purchased product. All of these interactions can be a valuable data source for an organization to gain knowledge about product acceptance, product quality, and market conditions. This inbound marketing channel data has literally exploded into “big data” and is presenting a challenge in how to process the data and formulate targeted campaigns that can produce higher revenue.

Marketing automation allows marketing organizations to quickly respond to market conditions with targeted campaigns that can drive additional bottom-line revenue. Putting together effective campaigns traditionally has been a complex and time-consuming effort. This resulted in marketing campaigns that were slow to market and were often ineffective in identifying potential customers and opportunities that would result in revenue. Deploying SAS Customer Intelligence application solutions with Oracle SPARC SuperCluster can help organizations deploy marketing campaigns faster with a higher return on investment.

![Marketing Automation Diagram](image)

Figure 1. Marketing Automation Dynamics achieved on Oracle SPARC SuperCluster with SAS Customer Intelligence solutions.

SAS Customer Intelligence solutions are a suite of invaluable marketing automation tools that enable organizations to transform data into actionable marketing intelligence so that effective marketing campaigns can be realized quickly. The steps towards business intelligence knowledge discovery are illustrated in Figure 1, which also shows key elements that SAS Customer Intelligence solutions provide during the process.

Figure 2 shows a broad view of the marketing campaign process and where SAS Grid Computing, SAS Data Automation, and SAS Marketing Automation fit into the lifecycle. SAS Grid Computing and SAS Data
Increasing the Performance of SAS Customer Intelligence Solutions with Oracle SPARC SuperCluster

Automation are tools used in the inbound part of the cycle for gathering data and storing it appropriately in data marts using Oracle Database on the Oracle SPARC SuperCluster. SAS Marketing Automation is used on the outbound part of the lifecycle to drive marketing campaigns. The SPARC SuperCluster provides the technology infrastructure to support the entire lifecycle. SAS application solutions such as SAS Grid Computing, SAS Data Integration, and SAS Marketing Automation with Oracle SPARC SuperCluster are an easy-to-deploy, cost-effective, and high-performing solution that enables effective, revenue-generating marketing campaigns.

Figure 2. The marketing automation process with Oracle SPARC SuperCluster and SAS Customer Intelligence solutions.

SAS Grid Computing and Oracle SPARC SuperCluster

SAS Grid Computing is an application solution that provides critical capabilities during the initial phases of the marketing automation process. This initial phase is a compute- and storage-intensive process called Extraction, Transformation, and Loading (ETL). Figure 3 provides an overview of the ETL phase.

During ETL, SAS Grid Computing and SAS Data Integration work together effectively as inbound channel data is assimilated into Oracle data marts on the SPARC SuperCluster. When SAS Grid Computing is deployed on the SPARC SuperCluster, it manages the SAS application solution environment by performing workload balancing, prioritizing jobs, providing high availability with built-in SAS application solution failover, performing parallel processing, assigning resources, and monitoring. This works exceptionally well with the compute resources available on the SPARC SuperCluster, which includes up to four SPARC T4-4 servers from Oracle on which SAS Grid Computing can distribute SAS workloads. The built-in virtualization features of the SPARC SuperCluster can subdivide the hardware servers into a larger number of logical domains, which act as virtual machines that can be used by SAS Grid Computing to further distribute SAS application solution processes. These SPARC SuperCluster features coupled with SAS Grid Computing accelerate
compute and storage processes to provide faster turnaround for SAS application solutions, such as SAS Data Integration, during the ETL process.

**SAS Data Integration and Oracle SPARC SuperCluster**

SAS Data Integration is the main tool for transforming data from the inbound channel data store into high-quality, usable data suitable for processing by SAS Marketing Automation. Transforming data from numerous data sources during the ETL process is resource intensive. SAS Data Integration can process this data faster on the SPARC SuperCluster because of the powerful integrated computing and storage infrastructure embedded in the architecture. In addition, to further improve ETL performance throughput, the high-performance storage infrastructure in the SPARC SuperCluster includes a high-speed InfiniBand network fabric that provides interconnectivity between the SPARC T4-4 servers and the Oracle Exadata Storage Servers as well as the Sun ZFS Storage Appliance(s) from Oracle.

*SAS Data Integration has a highly flexible access methodology that facilitates comprehensive access to a diverse set of systems and platforms where the inbound channel data is located. These kinds of data are easily integrated and processed using Oracle’s Sun ZFS Storage Appliance, which provides high-performance, shared read-write using innovative technologies explained later in this paper. SAS Data Integration subsequently stores the data in Oracle Database data marts located on the Oracle Exadata Storage Servers.*

*SAS Marketing Automation can also execute queries faster on the Oracle Exadata Storage Servers because of a massively parallel architecture and Exadata Smart Flash Cache. The Oracle Exadata Storage Servers and the integrated architecture of the SPARC SuperCluster dramatically accelerate I/O operations and network throughput to provide high-performance Oracle Database processing for applications such as SAS Data Integration.*
SAS Marketing Automation and Oracle SPARC SuperCluster

SAS Marketing Automation is the core of the marketing automation suite of solutions from SAS. As shown in Figure 4, it is while using SAS Marketing Automation that campaign criteria are formulated, the actual customer intelligence embedded in the Oracle Database data marts is analyzed, and campaign alternatives are found. User dialogues are used to input customer opportunity criteria for a marketing campaign and subsequently, compute- and database-intensive workloads are produced to seek campaign-marketing alternatives. The SPARC SuperCluster can accomplish this faster than alternatives because of powerful compute resources and large memory, which facilitate quicker turnaround. Powerful database query assistance is built into the Oracle Exadata Storage Servers. Turnaround is so dramatically improved that campaigns can be analyzed and tested iteratively before delivery into real-world markets. This is accomplished with SAS Marketing Automation through a rapid execution cycle, a simple and easy deployment, and a high-performance computing and storage infrastructure that is a highly available and scalable platform.

Figure 4. Oracle SPARC SuperCluster and SAS Marketing Automation formulating marketing campaigns.

Oracle SPARC SuperCluster Technology

The SPARC SuperCluster has superior computational performance and is easy to deploy, taking the pressure off of IT organizations while reducing the cost of acquisition, installation, and deployment. It is a complete, factory-assembled enterprise infrastructure that eliminates complexity while reducing the time needed to get from concept to actual deployment of SAS Marketing Automation. The prebuilt and pretested SPARC SuperCluster runs a complete Oracle hardware and software stack, eliminating the need for complex, multilayer, multivendor hardware configurations. Because the entire environment is engineered and optimized to work together, IT organizations can easily and rapidly deploy the SPARC SuperCluster with SAS application solutions such as SAS Grid Computing, SAS Data Integration, and SAS Marketing Automation.
Key Benefits of Deploying SAS Marketing Automation on the SPARC SuperCluster

Validated and supported by SAS Institute, the SPARC SuperCluster deployed with SAS application solutions such as SAS Grid Computing, SAS Data Integration, and SAS Marketing Automation addresses IT concerns by providing an innovative way to accelerate deployment and reduce operational costs.

- **Simplified and accelerated SAS deployments.** The SPARC SuperCluster deploys rapidly and simplifies system administration and infrastructure management because it is a single, pre-engineered, pretested, and preintegrated enterprise infrastructure that avoids the issues that often surface when integrating multivendor, multisystem, multiapplication environments. This improves productivity and ultimately lowers TCO.

- **Consolidated infrastructure.** Typical deployments of SAS application solutions are distributed across a sprawling network of servers, increasing operational costs. With the SPARC SuperCluster, SAS application solutions such as SAS Grid Computing can easily improve productivity and accelerate SAS application solution execution time. This is because the SPARC SuperCluster is a single high-performance, highly available system where SAS application solutions such as SAS Data Integration and SAS Marketing Automation can be deployed or consolidated to take advantage of the powerful compute and storage infrastructure. Built-in, no-cost, low-overhead virtualization technologies isolate SAS workloads for easy consolidation. SAS Grid Computing can also take advantage of the virtualization and fine-grained resource control available with the SPARC SuperCluster. The entire SAS application solution landscape can be easily consolidated while providing high service levels on this single, powerful platform.

- **Low-risk migration.** SAS application solutions certified on Oracle Solaris 8, 9, 10, and 11 can run simultaneously on a SPARC SuperCluster system without modification. SAS application solutions—especially SAS Marketing Automation, which uses Oracle Database extensively—can run within a virtualized environment so that previous versions of the Oracle Solaris operating system or Oracle Database can run in production environments alongside test environments based on an upgraded software infrastructure. This helps ensure progressive and controlled migration to the latest technology from Oracle.

- **Accelerated performance.** The SPARC SuperCluster is designed around Oracle’s most innovative and highest performing enterprise compute, storage, and networking components, including SPARC T4-4 servers, Oracle Exadata Storage Servers, the Sun ZFS Storage Appliance, and Oracle’s Sun Datacenter InfiniBand switches.

- **Resilient infrastructure.** Out of the box, the SPARC SuperCluster system delivers a resilient infrastructure for SAS application solutions by eliminating any single point of failure and providing proven and tested failover mechanisms.

**Oracle SPARC SuperCluster Configurations**

Available in half-rack or full-rack configurations, the system leverages innovative Oracle technology—combining the computing power of Oracle’s SPARC T4-4 servers, the performance and scalability of Oracle Solaris, and the optimized database performance of Oracle Database 11g accelerated by Oracle Exadata Storage Servers, with a high-bandwidth, low-latency InfiniBand network fabric—into a
scalable, engineered system that is optimized and tuned for consolidating enterprise applications. All components within the SPARC SuperCluster system, including SPARC T4-4 servers, Sun ZFS Storage appliances, and Oracle Exadata Storage Servers, are interconnected over a fully redundant InfiniBand fabric. Built-in virtualization enables consolidation and ensures applications are isolated from one another and remain highly available, virtually eliminating resource contention and service disruption. All SAS application solutions, such as SAS Data Integration, SAS Grid Computing, and SAS Marketing Automation, along with the Oracle Database software can be consolidated on to the system, eliminating much of the integration effort and deployment time typically associated with clustered solutions.

The core components of the SPARC SuperCluster—servers, storage systems, networking components, and operating system—provide many unique technical advantages to SAS application solutions.

- **Oracle’s SPARC T4-4 Servers.** These servers are designed with performance and consolidation in mind. Ideal for resource-intensive SAS applications, each SPARC T4-4 server includes 32 CPU cores in four SPARC T4 processors, two solid-state disks, and a massive 1 TB memory footprint. The compact five rack unit (5RU) height provides increased computational density for consolidated SAS application solution deployments.

- **Oracle Exadata Storage Servers.** Oracle Exadata Storage Servers deliver extreme database performance to SAS applications in a highly available, highly secure environment. Optimized for use with Oracle Database, Oracle Exadata Storage Servers employ a massively parallel architecture and Exadata Smart Flash Cache to accelerate Oracle Database processing and increase the speed of I/O operations. Intelligent software enables Oracle Exadata Storage Servers to quickly process database queries and return only the relevant rows and columns to the database server. Pushing SQL processing to Oracle Exadata Storage Servers reduces database server CPU consumption while using significantly less bandwidth to move data between storage and database servers. Oracle Exadata Storage Servers return a query result set rather than entire tables, eliminate network bottlenecks, and free up database
server resources. As a result, users often see a 10x performance increase when scanning and analyzing data.

- **Oracle’s Sun ZFS Storage 7320 appliance.** Providing 60 TB of disk capacity for shared file systems, the Sun ZFS Storage 7320 appliance uses flash-enabled Hybrid Storage Pools to accelerate SAS application response time by automatically placing active data in flash drives that offer very low response time. The easy-to-use DTrace Analytics technology optimizes performance with minimal intervention and powerful storage controllers run multiple data services, increasing efficiency and deployment flexibility, which is especially valuable during the ETL process. Oracle Solaris ZFS and self-healing technologies provide superior data integrity, while cluster failover and flash-based write caches ensure the high availability of data for SAS application solutions.

- **Oracle’s Sun Datacenter InfiniBand Switch 36.** Oracle SPARC SuperCluster is built around an InfiniBand fabric for rapid exchange of data among the cluster components. The high-speed, low-latency InfiniBand fabric utilizes a pair of redundant (leaf) Sun QDR InfiniBand Switches to interconnect all SPARC SuperCluster components: SPARC T4-4 servers, Oracle Exadata Storage Servers, and Sun ZFS Storage 7320 appliances. Another InfiniBand (spine) switch interconnects the two leaf switches and provides InfiniBand ports for expansion.

  The Sun Datacenter InfiniBand Switch 36 is designed specifically for application clusters comprising Oracle rackmount servers and storage systems, and it delivers the extreme scale, application isolation, and elasticity needed to consolidate and virtualize core SAS application solutions.

- **Oracle Solaris.** Optimized for SPARC T4 servers, Oracle Solaris delivers high performance, massive threading and batch processing, and high I/O rates, which are critical to the most demanding SAS applications. Scalability enhancements, enhanced kernel data structures, and library optimizations enable the platform to support diverse, larger-scale SAS workloads. In addition, integrated server, storage, and network virtualization and resource control mechanisms support the vertical and horizontal scalability and optimized utilization needed for consolidating high-demand SAS application solutions and growing data sets.

**Built-in Virtualization for Simplified SAS Application Solution Consolidation**

Virtualization enables Oracle SPARC SuperCluster to further distribute SAS application workloads and thereby efficiently use as much of the available computing power as possible. As illustrated in Figure 6, built-in virtualization technologies isolate SAS application solution workloads supporting consolidation of the entire SAS application solutions landscape within a single platform. Since the SPARC SuperCluster architecture can be extended using Oracle VM Server for SPARC, SAS Grid Computing can further distribute and parallelize SAS application solution workloads within the SPARC SuperCluster. Government institutions, analytical firms, financial institutions, and marketing organizations can securely and effectively consolidate SAS applications using these technologies. For these consolidated environments, SPARC SuperCluster offers protection of sensitive data and high availability for applications, while its built-in virtualization technologies provide the flexibility to dynamically shift system resources to where they are most needed.
Increasing the Performance of SAS Customer Intelligence Solutions with Oracle SPARC SuperCluster

- **Oracle VM Server for SPARC.** Oracle VM Server for SPARC (previously called Sun Logical Domains) is a built-in firmware-based hypervisor that supports multiple virtual machines, called domains, on a single system. The hypervisor allocates subsets of system resources (memory, I/O, and CPU) to each domain, isolating each Oracle Solaris instance and SAS workload to a virtual machine with dedicated resources. Built-in virtual machine snapshot and cloning capabilities help to speed virtual machine configuration and migration, enabling faster provisioning when growth in SAS application solutions occurs, especially during consolidation of SAS application and server resources.

- **Oracle Solaris Zones.** Using flexible, software-defined boundaries, Oracle Solaris Zones (previously known as Oracle Solaris Containers) are a lightweight virtualization technology that creates multiple private execution environments within a single Oracle Solaris instance. SAS applications running within zones are completely isolated, preventing processes in one zone from affecting processes running in another. Oracle Solaris Zones support fault isolation, feature extremely fast boot times, and can be configured to instantly restart SAS applications. Because zones make it easy to prioritize applications and adjust resource allocations, they are ideal for consolidated SAS application solution workloads.

**High Availability Features that Keep SAS Application Solutions Running**

To deliver high availability for SAS applications, Oracle recommends using an architecture whose components are integrated, tested, and validated to work together to reduce the risk of deployment problems, interoperability issues, and unplanned downtime.

The SPARC SuperCluster offers the following:

- **No single point of failure.** The SPARC SuperCluster system provides full built-in redundancy—from compute nodes to storage, network switches to network interface cards (NICs), and power distribution units (PDUs) to power supplies—to support the demands of mission-critical SAS applications.
• **Oracle Real Application Clusters (Oracle RAC).** Often, Oracle RAC is the preferred implementation option to ensure database availability for SAS application solution workloads. Oracle RAC supports the transparent deployment of the database across all four servers within the SPARC SuperCluster system, providing database fault tolerance in the event of hardware failures or planned outages. When Oracle RAC is not implemented, the single-instance Oracle Database can be made highly available using Oracle Solaris Cluster.

• **Oracle Solaris Cluster.** Oracle Solaris Cluster helps ensure the availability of SAS applications by detecting, isolating, and containing failing cluster nodes or specific components, such as NICs, HBAs, networks, and storage.

• **Virtual clustering.** Oracle Solaris Cluster supports virtual clustering, allowing Oracle Solaris Zones to function in the same role as physical cluster nodes. Applications that run within dedicated zone clusters are associated with specific cluster management policies. Agent actions can be layered, such as first trying to restart the service in a different zone before attempting to restart it on a different server.

**Oracle SPARC SuperCluster Performance Results**

Getting results quickly through computing performance is important because it directly influences how rapidly SAS Grid Computing, SAS Data Integration, and SAS Marketing Automation can deliver the bottom-line answers for effective marketing campaigns. When considering an infrastructure such as Oracle SPARC SuperCluster, benchmarks and real-world performance results contribute to answering questions about how applications perform.

**SAS Grid Computing and SAS Data Integration Performance on Oracle SPARC SuperCluster**

The initial phases of the marketing automation process are replete with processing and storage performance challenges. Extracting data from diverse sources, such as different systems and storage types, can be difficult from a performance perspective and can be time consuming. Typically, the ETL process extracts data from inbound marketing channels. Data reduction takes place using SAS Data Integration and complex processes of aggregation. Data reduction can happen serially or concurrently across several processes.

Oracle SPARC SuperCluster with SAS Grid Computing is critical for distributing and, where possible, parallelizing these processes so that ETL can be completed quickly and SAS Marketing Automation can then process the results. The ETL results, which are stored in the Oracle Database data marts, are often substantial and can range from hundreds of thousands of rows to upwards of 300 million rows of data. In many cases, these rows of data have extremely wide attributes and complex interdependencies.
Performance Results for Oracle SPARC SuperCluster with SAS Grid Computing and SAS Data Integration

Shared read-write storage is a common bottleneck during ETL processing. For many storage solutions, the data is accessed over a standard local area network with limited bandwidth, which acts as a bottleneck and becomes a principle barrier to rapid turnaround time.

The SPARC SuperCluster configuration with an additional Sun ZFS Storage 7420 appliance illustrated in Figure 6 was used with SAS Grid Computing and SAS Data Integration to measure performance results during ETL processing. While the Sun ZFS Storage 7320 appliance is used for SPARC SuperCluster system-wide storage purposes, the additional Sun ZFS Storage 7420 appliance was specifically configured to provide a high-performance shared read-write file system.

Figure 7. Oracle SPARC SuperCluster NFS performance results with SAS Grid Computing and SAS Data Integration.

As illustrated in Figure 7, the SPARC SuperCluster provided a peak throughput of approximately 6 GB/sec with shared read-write file systems used by SAS Grid Computing and SAS Data Integration on the external Sun ZFS Storage 7420 appliance. The InfiniBand network fabric with the additional Sun ZFS Storage 7420 appliance accelerated ETL processing and populated the Oracle Database data marts much faster, which provided fast turnaround that improved the overall marketing automation process. The results were so significant that executing the ETL process frequently with updated inbound marketing channel data is possible, which can further improve the fidelity of the marketing campaigns under consideration.

With marketing automation, it’s all about getting results quickly while improving turnaround time in order to get campaigns deployed rapidly. The SPARC SuperCluster is able to accelerate the ETL process best because SAS Grid Computing is able to take advantage of the high-performance SPARC T4-4 computing resources, while SAS Data Integration is also able to process data rapidly utilizing the Oracle Exadata Storage Servers and the Sun ZFS Storage 7420 appliance on the InfiniBand network fabric.
Increasing the Performance of SAS Customer Intelligence Solutions with Oracle SPARC SuperCluster

Figure 8. Oracle SPARC SuperCluster configuration used for SAS marketing automation performance results.

SPARC SuperCluster Provides the Best Performance Results for SAS Marketing Automation

Oracle and SAS Institute jointly tested SAS Marketing Automation with the SPARC SuperCluster and achieved proven and winning results. The bottom-line proof in marketing automation is the number of targeted campaigns created and tested and eventually fielded. The workloads included over 130 compute and I/O-intensive SAS jobs.

Two sets of performance results were compared to verify that the SPARC SuperCluster half-rack configuration, as illustrated in Figure 8, could provide a superior marketing automation infrastructure. A prior set of results was based on a multitiered x86 PC server architecture that had been previously deployed at SAS. The x86 PC environment included three Intel Xeon–based servers each with four processors (X5670, 2.93 GHz) in the compute and middle tiers and a SPARC Enterprise M5000 server from Oracle in the database tier running Oracle Database 10g, all of which had used SAN storage for the SAS workspace and data storage. As shown in Figure 9, this environment finished a sample test for serial campaign execution in 6 hours and 35 minutes, and it completed the concurrent campaign execution test in 4 hours and 21 minutes.

The second set of test results are based on a SPARC SuperCluster half-rack configuration with SAS Marketing Automation deployed as depicted in Figure 8. Each of the SPARC T4-4 compute nodes was divided into two domains with a general purpose (GP) domain running Oracle Solaris 10 for SAS Marketing Automation as well as a database domain running Oracle Solaris 11 and Oracle Database 11g. Workloads were normalized and though the x86 configuration had previously run a maximum concurrency of three campaigns, the SPARC SuperCluster would run a maximum concurrency of seven campaigns. The results shown in Figure 9 show the efficiencies of using the SPARC SuperCluster with SAS Marketing Automation. The SPARC SuperCluster delivered 4x faster execution time for serial campaigns and 8x faster execution time for concurrent campaigns.
Conclusion

Oracle SPARC Super Cluster with SAS Customer Intelligence solutions provide an excellent environment for rapidly creating marketing campaigns that provide a positive trend for customer growth while improving revenue expectations. With Oracle SPARC SuperCluster and SAS Customer Intelligence solutions results include:

- Produce effective campaigns in hours rather than days or week, allowing you to respond to market opportunities and conditions before your competitors.

- Rapidly assimilate massive amounts of inbound marketing channel data that produces effective campaigns faster and create the right mix of outbound marketing channel sources to reach customers and create revenue opportunities.

- Reduces risks associated with deploying marketing campaigns by validating campaigns prior to deployment into real-world markets and the ability to further analyze inbound marketing channel data after deployment to increase customer reach and market penetration.

- Dramatically decrease marketing campaign executions costs through staff efficiencies and reduction in operational expenditures for a superior and demonstrable return on investment.
For More Information

**TABLE 1. ADDITIONAL RESOURCES**

**WEBSITES**

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<thead>
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Increasing the Performance of SAS Customer Intelligence Solutions with Oracle SPARC SuperCluster

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Author: Chris Martin

Oracle Corporation
World Headquarters
500 Oracle Parkway
Redwood Shores, CA 94065
U.S.A.

Worldwide Inquiries:
Phone: +1.650.506.7000
Fax: +1.650.506.7200

oracle.com

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