



## Coverity Maintains Software Integrity of Sun Microsystems' Award-Winning Storage Products

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– Dan Rose, Systems Engineering Manager

### Business Benefits

#### Time to market

25% of defects identified by Coverity would have stalled the product launch if not detected

#### Developer efficiency

< 1% false positive rate across all products with over 2 million lines of code

#### Competitive advantage

Solution of choice for the four-time recipient of Storage Magazine's Quality Award

### Business Overview and Challenge

For customers of Sun Microsystems' long-term storage products, quality is rarely an issue. Sun is a global leader in network computing infrastructure solutions with well-known brands such as Java, Solaris, MySQL, and StorageTek. The StorageTek-branded products, including the T10000 and T9840 tape drives and the SL8500, SL3000, and SL500 tape libraries, are particularly noteworthy as it relates to product reliability and quality.

Product quality and reliability has never been more important to customers given the rising importance of data retention in recent years. With the emergence of regulatory compliance governing information management and the role of electronic information in legal discovery, some companies must keep multiple petabytes of data for several years. To put it in perspective, a petabyte is the equivalent of 125,000 eight gigabyte iPod Nanos. In addition, data and applications must be highly available and accessible. The only cost effective way to manage such a large amount of data is with tape drives and libraries. In addition, the cost of downtime for a customer is measured in the millions of dollars per incident, so when Sun's entire line of tape libraries win Storage Magazine's Quality Award for the past four consecutive years, customers take notice.



Increased cost and risk is not just a problem for Sun's customers, but for Sun as well. Sun's internal cost for fixing a significant problem identified in the field is conservatively estimated at \$100,000 per incident. As a result, Sun always faces the temptation to "over test", but thanks to Sun's highly respected Systems Reliability Engineering (SRE) team, Sun has been able to walk the tightrope of maintaining its award-winning quality without sacrificing time to market. The SRE team developed a fact-based product launch decision capability to give the go/no go decision. Based on years of experience with software development and growth modeling, Sun's storage group can accurately predict the software failure rate in the field. While Sun's position seems envious, Sun realized it could be even more efficient, and it realized the most effective way to achieve this was to find defects earlier in the product development cycle.

According to Dan Rose, Systems Engineering Manager, "the earlier we find defects, the better off we are. We can measure the cost of a bug found early in the design phase in dollars. When that same defect goes undiscovered until system-level testing it costs thousands of dollars, and it only gets worse if it's found after the product is released. If we can eliminate any of the bad costs of quality then we reduce our development costs, and in the process increase our speed and pace so that we can get to market quicker and widen the gap on the competition."

In order to achieve this objective, Sun knew they needed to improve their manual code analysis process, as its inefficiencies not only posed a threat to quality but also impacted developer productivity. For example, with a portion of the code in one of the tape drive programs the development team invested as much time in their test harness as they did in developing the code, doubling the development activity and related development costs. To avoid the inefficiency and risk of manual processes, Sun realized they needed an automated solution to meet the challenge. Taking the advice of Gartner, who cited static analysis as one of the top three initiatives development teams should invest in to improve code quality, Sun decided to evaluate static code analysis solutions.

### **Solution Evaluation**

Sun's storage group evaluated many different source code analysis tools to scan over 2 million lines of Java and C code in its various products and find the bugs that could lead to failures. While there are free Java analysis tools available today, C code is largely embedded code, and is the most critical, highly complex code. Consequently, the reliability and quality requirements for C code are much higher, requiring the static analysis solution to meet these stringent requirements. In addition, Sun needed a single solution to analyze both C and Java code while maintaining low overhead for the developer.

Developer adoption was critical. According to Rose, "if the engineers didn't see value in this tool, we wouldn't be successful." The developers themselves became an integral part of the evaluation, because if they became excited about using the solution then half of the internal adoption objective was already accomplished. In order to get developers excited, the solution had to be able to scale to applications with millions of lines of code to avoid the risk of negatively impacting the development process, systems, and build time. In addition, it was apparent that false positive rates would be an important metric. According to Rose, "the false positive rate has always



been the Achilles' heel of previous static code analysis solutions. A lot of static code analysis solutions find syntax errors and other defects that really don't manifest themselves as defects to the customer. We needed to find the real bugs that, for example, only emerge when our products interoperate with other systems."

Among the static analysis solutions in the evaluation, Coverity Static Analysis was the most robust solution capable of meeting Sun's requirements. The Sun product development teams agreed. When running Coverity, some of the developers' comments included:

"We never would have found that one during test."

"An intensive week-long code review with senior developers might have found one-third of these bugs."

### **Coverity Deployment and Benefits Realized**

Currently, 12 products within the Sun storage group are using Coverity Static Analysis to maintain high software integrity, including a product with 580,000 lines of code. Scans range from nightly to once a month depending on the product. Rapid adoption is partially attributed to the way the solution is leveraged in the development organization. Rose's team is integrated with the development teams so instead of static analysis becoming a policing tool, it's focused on helping to make the developers successful and to improve the probability of success.

With so many different teams implementing the solution, inevitably some of the teams were initially skeptical about the value over free tools and false positives. However, once the teams started using the tool and the solution found some significant issues, they quickly became supporters. They also realized that many of the defects originally thought to be false positives were actually real bugs. Coverity has had less than a 1% false positive rate across all products, increasing developer efficiency by allowing them to focus only on the defects that are real and relevant.

#### **Enhancing the code exception handling process:**

Most of the time customers use Sun's products in a similar way, so certain code paths are heavily used. However, the vast majority of Sun's code is on code paths that are less travelled. The code is necessary for exception handling, which brings the product back into the "happy path" from a seemingly endless series of possible combinations of errors. Because it's difficult to anticipate every possible combination, complete testing of the exception handling code is almost an impossible task. One of the benefits of Coverity's solution is that it doesn't care whether the code is happy path or exception handling in nature. This results in real benefits to Sun's internal process. According to Rose, "we're highly confident that we are doing a much better job at testing, and are feeling comfortable with the exception handling code of our products."

#### **Defects identified and success measurements:**

Some of the defects found by Coverity are the big pain points Sun deals with during system-level test, such as memory leaks and concurrency issues, which bring system-level testing to a halt and are difficult to reproduce. Before Coverity, performing root cause analysis was extremely difficult, but after implementing the solution Sun



realized a significant improvement in product time to market by identifying these issues before they reached system-level testing.

Sun tracks success based upon the developer impact on triage, and resolution time, with metrics such as:

- Number of defects found
- Percent of defects fixed
- Number of open defects
- False positive rate
- Intentional defect rate
- Priority and complexity of the bugs identified
- Number of times/last time static analysis was run

Sun then uses this information to focus on the high-risk modules while monitoring other metrics such as code churn, code complexity, and code coverage. This helps to identify which areas of the code are more troublesome, and enables more effective risk-based testing.

A single development program realized the following benefits within the past year:

- 99% of defects triaged
- 93% of defects fixed
- 0% false positive rate
- 5.6% intentional defect rate

Across all products, 25% of the defects identified by Coverity's solution would have stalled a product launch and delayed Sun's time to market if they were not caught by Coverity. According to Rose, "this is a very conservative estimate because it's the developers themselves that are judging the risk of these defects. Usually that rating is determined by Test/QA, who always has a much higher severity priority rating on bugs than Engineering does. I suspect if Test/QA saw all of the bugs Coverity has found, they would say the percentage is even higher."

### **Improving developer knowledge and coding skills – an intangible benefit:**

Additional benefits of Coverity aren't just the reactions to finding the defects. There are also proactive benefits by improving the knowledge and skill level of the developers. Static analysis creates coding best practices and raises the bar for quality of work within the development organization.

Rose's philosophy and analogy sums it up nicely: "I correlate code development with driving a car. Almost everyone assumes they're an above average driver, but simple statistics say 50 percent of us are below average, and it's no different when it comes to developing software. When driving, there is no consistent, objective real-time



feedback available to tell you when you made a mistake. However, static code analysis comes close to being that instant feedback system to help developers. This feedback greatly improves their craft because they learn what defects they are susceptible to committing. Because they are more aware of that, they are more conscious about the quality of code they're producing."

### Conclusion

In a highly competitive market, companies like Sun constantly need to increase quality and reliability, speed delivery, and reduce costs just to stay even with its rivals. Coverity Static Analysis is a great addition to help not only achieve these objectives, but also surpass them. It has proven to be a tool that can find defects earlier, which reduces development costs and accelerates time to market. Using Coverity Static Analysis also results in higher quality products in the field because there is more complete coverage of exception handling code in testing. Finally, the real-time feedback improves software developers' coding skills resulting in fewer testers needed relative to the number of developers. These benefits help Sun and its already award-winning products to not just stay on par with the competition, but widen the gap between Sun and its challengers.

### About Coverity

Coverity is the trusted standard for companies that have a zero tolerance policy for software failure, problems, and security breaches.

Coverity's award-winning portfolio of software integrity products enables customers to prevent software problems throughout the application lifecycle

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