



Inspired Innovation

White Paper

Understanding and Applying the Concept of White Box Testing

April 2006

Spirent Communications, Inc.

15200 Omega Drive
Rockville, MD 20850 USA

Spirent Communications
26750 Agoura Road
Calabasas, CA 91302 USA

Email: sales-spirent@spirentcom.com

Web: <http://www.spirentcom.com>

Americas

+1 800.927.2660

Europe, Middle East, Africa

T: +1 800.SPIRENT
+818 676.2683

Asia Pacific

T: +852 2511.3822

Copyright

© 2006 Spirent Communications, Inc. All Rights Reserved.

All of the company names and/or brand names and/or product names referred to in this document, in particular, the name “Spirent” and its logo device, are either registered trademarks or trademarks of Spirent plc and its subsidiaries, pending registration in accordance with relevant national laws. All other registered trademarks or trademarks are the property of their respective owners.

The information contained in this document is subject to change without notice and does not represent a commitment on the part of Spirent Communications. The information in this document is believed to be accurate and reliable; however, Spirent Communications assumes no responsibility or liability for any errors or inaccuracies that may appear in the document.

Understanding and Applying the Concept of White Box Testing

Contents

Introduction4

Getting Started with White Box Testing6

Spirent’s White Box Testing Solution7

White Box Benefits10

Spirent Products10

About the Author11

Introduction

Today's market demands products with feature-rich software sets integrated seamlessly with reliable, high-performance hardware. To meet market requirements, single function appliances are being integrated into multi-function, multi-layer products, which in turn raise the bar on the complexity curve of existing data communication systems.

Network Equipment Manufacturers (NEMs) and service providers, who use the equipment, have three primary concerns:

- Reliability
- Time to market (of products / services)
- New technologies (enabling new service offerings)

To achieve reliability, these products must be tested. As these devices have become more complex, the testing task has become increasingly time consuming and expensive. So much so that it can dramatically affect time to market. Looking at the traditional testing process (figure 1), test engineers spend the greatest amount of time diagnosing issues to make sure they can repeat, understand and properly document the issue, so it can be fixed by development. In short, the 80/20 rule for data communications testing is that test engineers spend 80% of their time troubleshooting 20% of the total test cases.

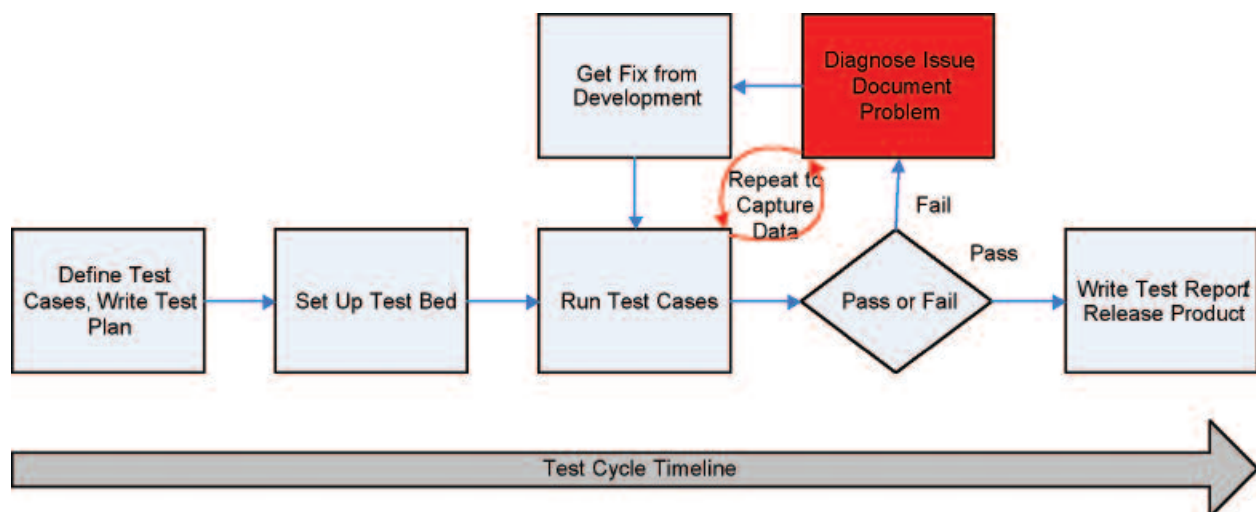


Figure 1: The Traditional Testing Process

One of the primary reasons troubleshooting consumes so much time is because it takes numerous rerunning of a test case to capture all the data required to effectively diagnose the issue. Test cases have to be repeated many times so engineers can capture information from the Device Under Test (DUT) or System Under Test (SUT) and correlate it to the test equipment, which greatly impacts test efficiency. One way to address this challenge and reduce time-to-test is to implement white box testing.

The terms “black box” and “white box” are fairly common in software testing. Black box testing usually refers to functional testing where the detailed internal process of the device or system under test is not known by the tester. The tester focuses on testing the basic input and expected output of the test case. If the expected results are not achieved in the test case, then the tester begins a long process to investigate the problem and would need to involve development to resolve the issue. White box testing—also referred to as “glass box”, “clear box” or “open box”—is fundamentally different than black box. With white box testing the tester has specific knowledge of the internal process of the device or system under test. Specific test cases are developed to exercise and verify internal functions and achieve specific results. These methodologies also apply to testing computer network equipment, including bridges, switches and routers.

Testing computer network equipment is typically broken into software, hardware and system level testing with most of the effort focused on system level testing. Usually development performs some basic unit/feature acceptance testing before passing on to system test. During system test, a combination of features is enabled and exercised together.

Which is better, black box or white box? In most cases the answer is that both are necessary. White box testing leads a tester to bias test cases to focus solely on potential design issues. Black box testing focuses on testing the functional specification without respect to the internal design. Both approaches are valid and necessary, but white box testing is needed to do any troubleshooting of results from a black box test. Implementing white box testing (figure 2) streamlines the testing process by helping to isolate and identify the issue, so the test engineer can document the problem and get it fixed. Without this process, every issue found during testing can significantly delay the diagnosis and resolution.

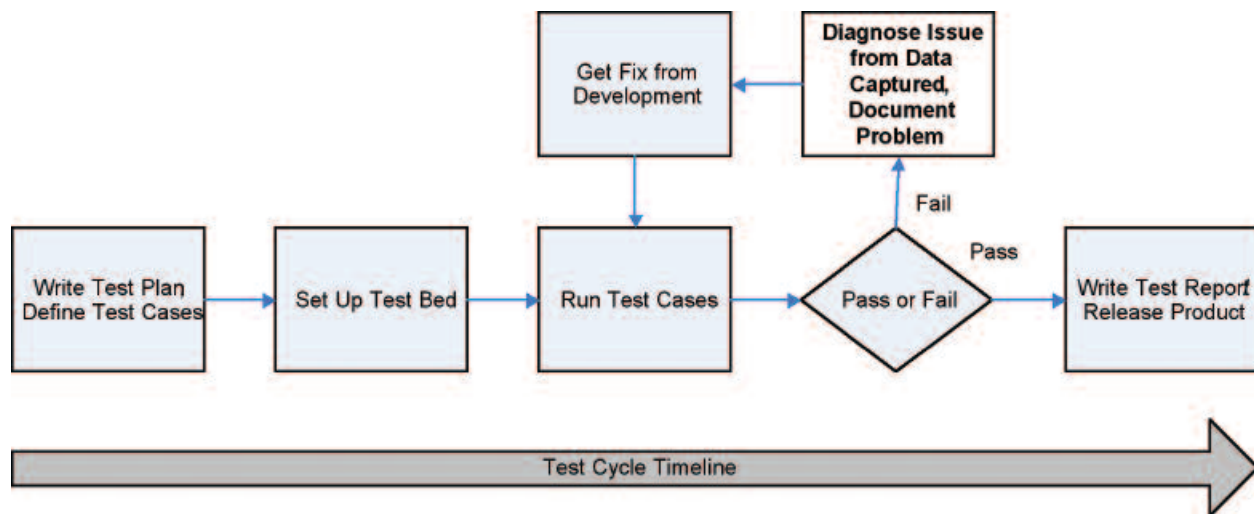


Figure 2: Testing Using White Box Concepts

Getting Started with White Box Testing

Many testers today perform mostly black box testing. Most of the test cases are functional tests, and specific results are desired.

There are two problems with this method:

- Test cases can pass even if there are errors within the DUT that are not captured.
- When there is a failed test case, engineers typically spend a significant amount of time repeating the test case and investigating the issue.

This is where white box testing changes the game. White box testing can be used to interact with the device or system under test during the test to capture and verify output and states at various intervals. Since the information is captured during the test, the tester does not need to keep repeating the test case to duplicate the error.

There are two main approaches to implementing white box testing today:

- Test engineers manually control the test equipment and manually configure and verify the device or system under test.
- Using automation, the test engineer writes a script that controls the test equipment and interacts with the device or system under test.

Both of these approaches are inefficient. The manual approach is tedious and it is difficult to time the interaction and capture the appropriate data. The second approach, automation is effective, but manually entered test cases are extremely time consuming to create and difficult to troubleshoot when they fail.

Spirent proposes a new implementation of an old concept— a hybrid solution, where the test equipment has the ability to call external events, typically scripts, to verify output/state at known points during the test and validate specific expected conditions.

A key benefit to this solution is the Spirent test application has over 80 events in the scheduler to create real-world, functional test, and negative test cases to fully exercise a device's capability. This capability can be used in the GUI, which provides graphical results, easy troubleshooting and the ability to interactively control the test equipment. In addition, the same schedule can be executed in an automated environment.

This approach is the most effective in comparison and can be used in conjunction with manual testing and automation.

Spirent's White Box Testing Solution

White box testing can perform many tasks. Here are some of the most common uses:

- Apply an initial configuration to a DUT/SUT
- Clear counters and get to a know state
- Run commands to verify state/feature functionality
- Run commands to verify counters are working properly
- Run commands to monitor resources like CPU and memory utilization
- Change the configuration like applying an ACL, QoS, or routing policy
- Run clean up scripts to re-configure the DUT/SUT

Spirent has found a way to overcome the inherent challenges of white box testing. Spirent's test scheduler has the capability of calling external events at any specific point during the sequence of events.

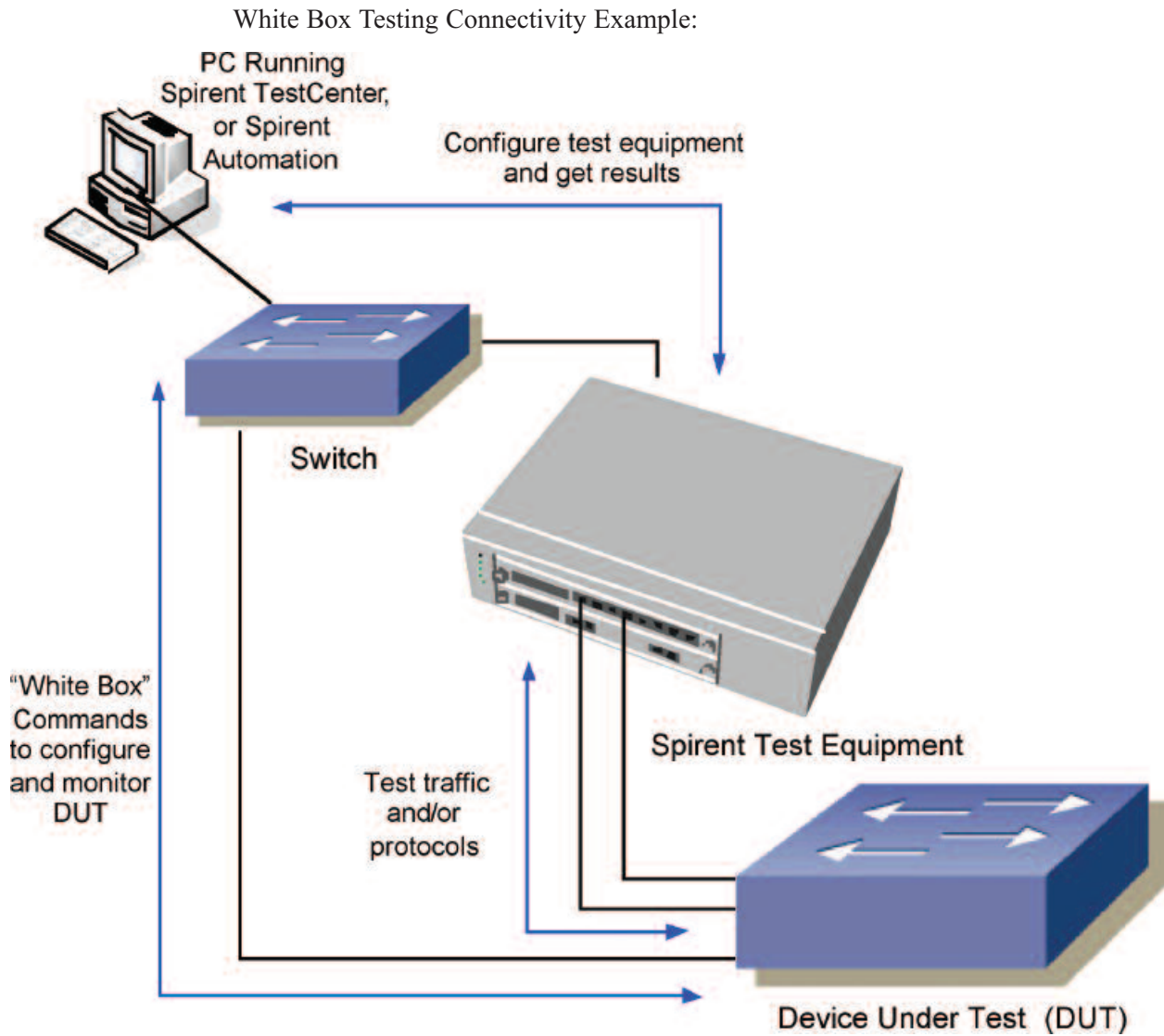


Figure 3: White Box Testing Connectivity

Here is a simple BGP route flap example:

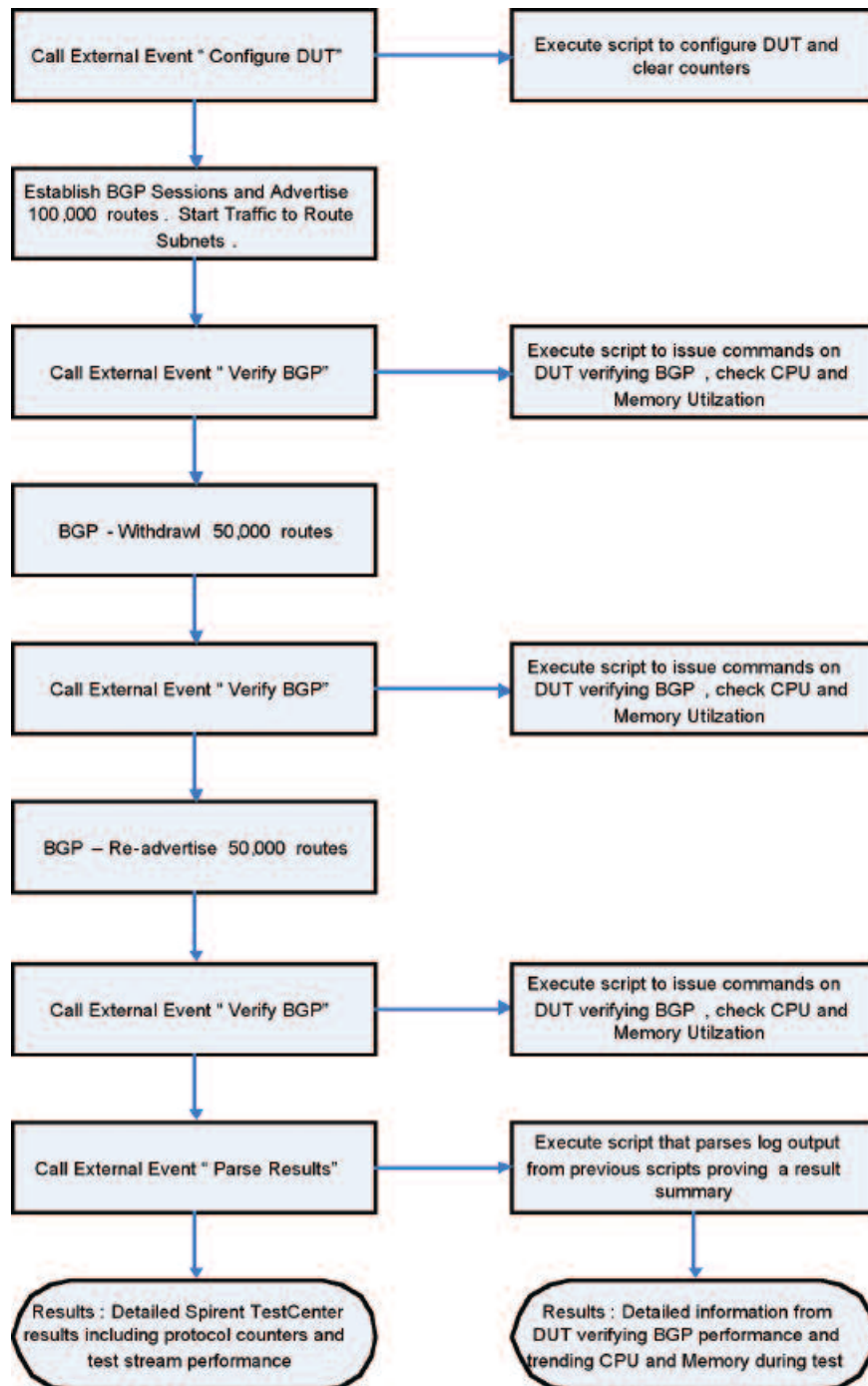


Figure 4: Example Test Scheduler Sequence of Events

As seen in this example, the DUT/SUT is configured and then examined throughout the test case to capture data and verify state. At the conclusion of the test case, the GUI has captured all the statistics, and the scripts have captured all the information about the DUT. Without this capability the test engineer would have had to manually issue the commands on the DUT and try to time it properly to verify and capture the same information as the white box example.

To take this concept a step further, it can be automated so that a wrapper script calls the Spirent API to start the test, and a parser script extracts the appropriate data from the .csv and scripts at the conclusion of the test.

White Box Benefits

White box testing provides the following benefits:

- Helps testers find more issues (bugs)
- Dramatically reduces time to test by reducing the number of repeated test cycles needed to run to duplicate or investigate an issue
- Improves the overall quality of products tested
- Provides more repeatable, consistent test cases
- Reduces time to market

White box testing improves test efficiency over current best practices. New test cases, and better test cases, can be rapidly created and run without user intervention.

Spirent Products

White box testing capability is available on Spirent TestCenter release 1.20. Basic functionality is available in the base package:

Part Number	Description
BPK-1001A	Packet Generator and Analyzer Base Package

Spirent Global Services offers several white box testing services that include a recommended start-up assistance solution that expedites learning the process and concepts of white box testing. Add one of these service options and increase your productivity today:

Part Number	Description
SVC-6034	White Box Test Service - 1 Day Remote Start-up Assistance
SVC-6036	White Box Test Service - 2 Day Remote Training and Customer Specific Scripts.
SVC-6038	White Box Test Service - Custom Requirements

Contact your local Spirent sales representative for more information.

About the Author

Mike Haugh



Inspired Innovation