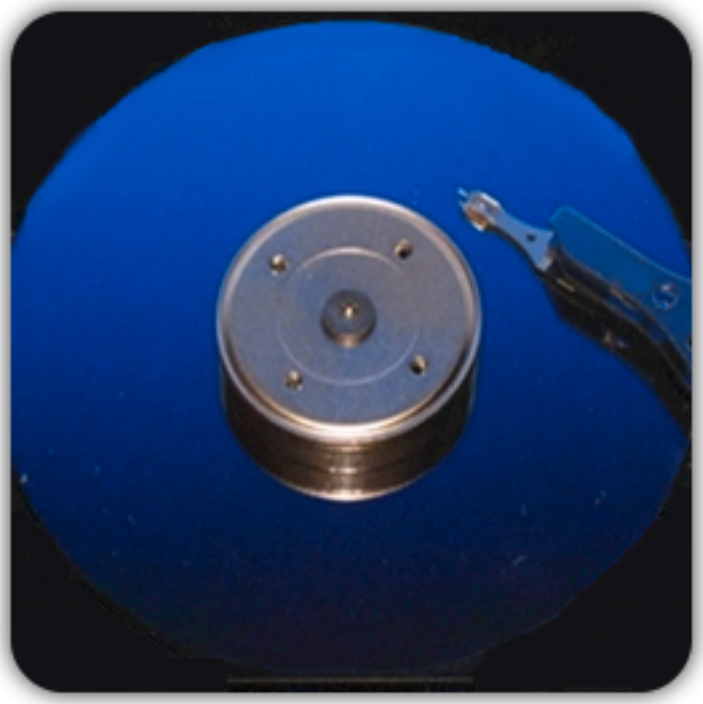

Advanced Drive and System Testing with *Scannerz for Mac OS X*

Software and Computer Systems Company, LLC
Technical Note
Updated October, 2014

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Legal Information

Overview

This document is intended to illustrate how to use *Scannerz for Mac OS X* to perform system, hard drive, and SSD testing to identify problems that will range from the simple and straightforward to those that are much more difficult to isolate. Many people think *Scannerz* is a drive testing application, probably because the vast majority of problems *Scannerz* detects are related directly to surface defects on hard drive platters or bad blocks in an SSD. However, *Scannerz* is not simply a hard drive testing tool, it's properly described as *fault detection software*. Surface scan problems are simply one of the faults *Scannerz* is capable of detecting.

Scannerz uses the progress of a surface scan over media (the surface of a hard drive or the blocks in an SSD) as a reference to help isolate problems with a system. Media related problems are always repeatable until corrected. For example, if a bad sector exists on a hard drive starting at the byte location 34,359,738,368 with respect to the start of the drive, it will remain at that exact same location unless corrected. If on the other hand, *Scannerz* detects problems (or faults) that occur inconsistently with respect to the progress of the scan, then they usually lie somewhere else in the system. Other products on the market often miss faults completely, or in some case misidentify them as media problems when such problems don't exist.

With the introduction of *Scannerz* Version 1.7 and beyond, *Scannerz* introduces a new mode known as *Diagnostics Mode*. With *Diagnostics Mode* the user will be able to do the following:

- Confirm the existence of bad sectors on a hard drive or bad blocks on an SSD.
- Confirm the existence of weak sectors on a hard drive.
- Detect seek problems with a hard drive.
- Detect data corruption occurring between the drive and the system
- Detect memory problems and system bus faults
- Detect and identify abnormally long operations such as head parking events and timeouts.

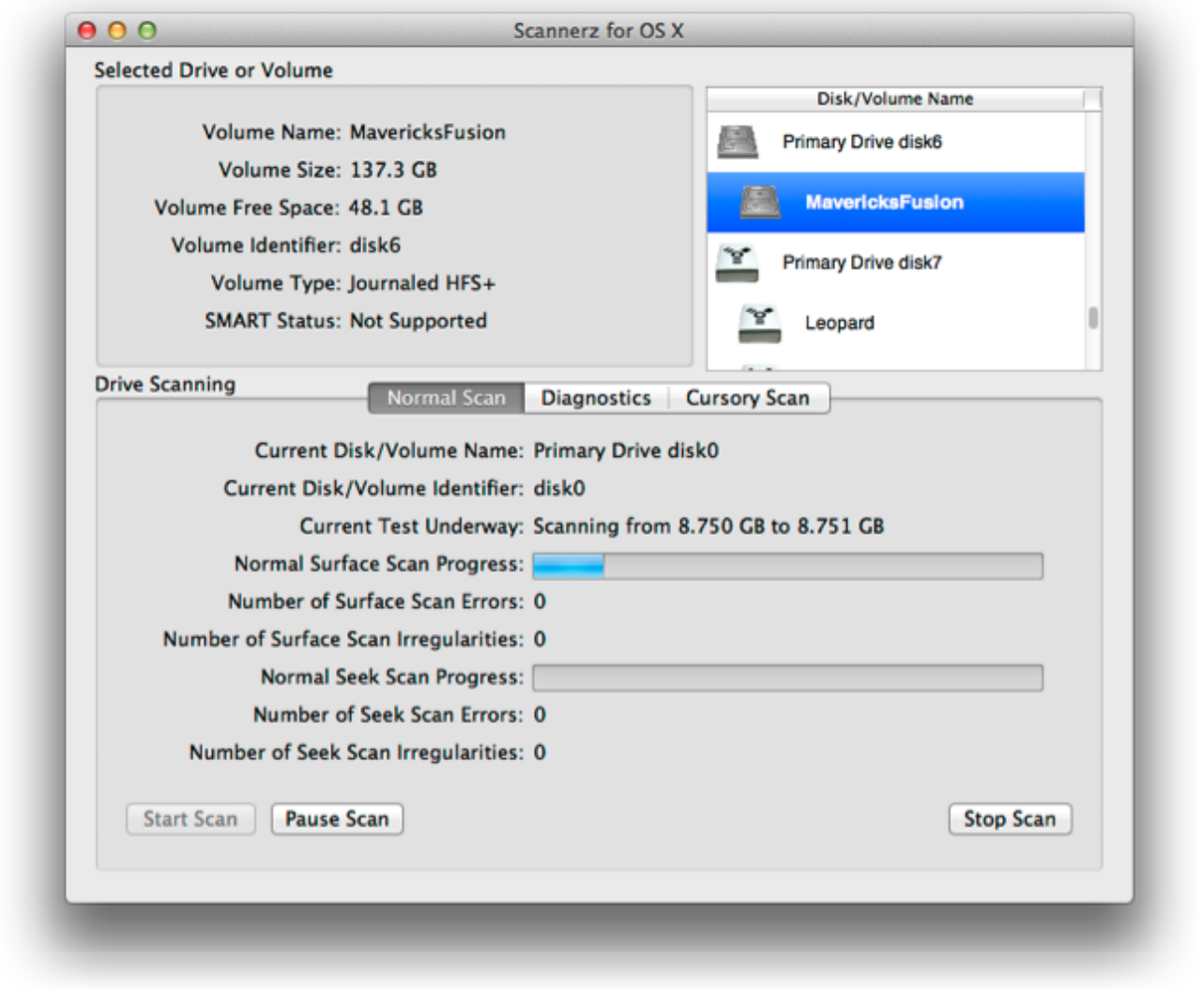
- Help isolate possible cable and connector problems

Scannerz is not intended to simply tell you whether a drive or SSD has problems, it's been designed and packaged to help users find the root cause of problems. As you'll see during the rest of the document below, many problems may manifest themselves with symptoms similar to drive problems and yet have nothing to do with the actual drive itself.

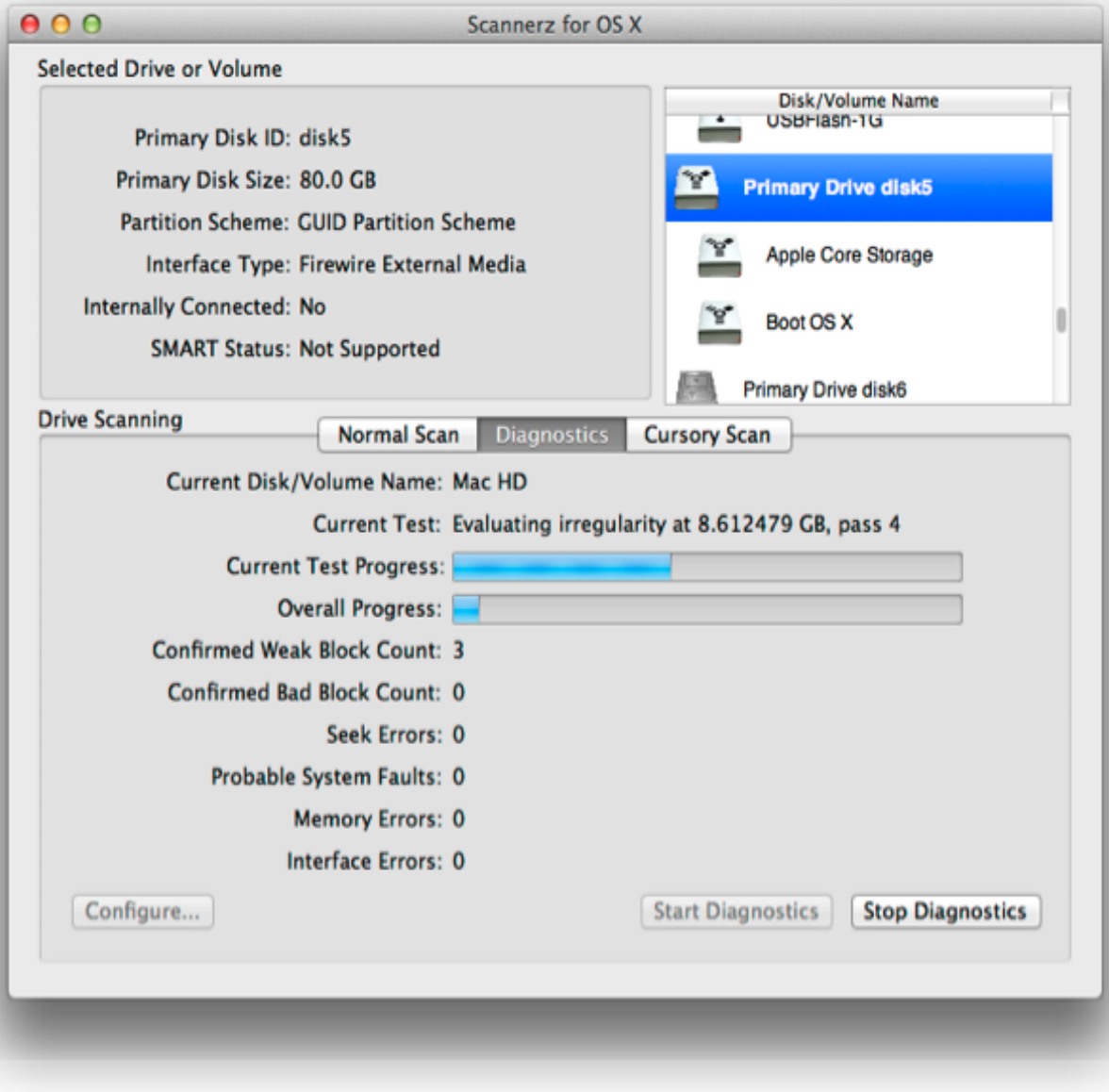
The Testing Process

The common way to use *Scannerz* is to perform a *Normal Mode* test on a drive or system, and if *Scannerz* has flagged some problems or areas of concern, use *Diagnostics Mode* to evaluate them. In some cases, such as excessive data corruption or system lock ups, *Diagnostics Mode* may be used directly without the need for a *Normal Mode* test.

For reference, the following screen shots show *Scannerz Normal Mode* and *Diagnostics Mode* interfaces.



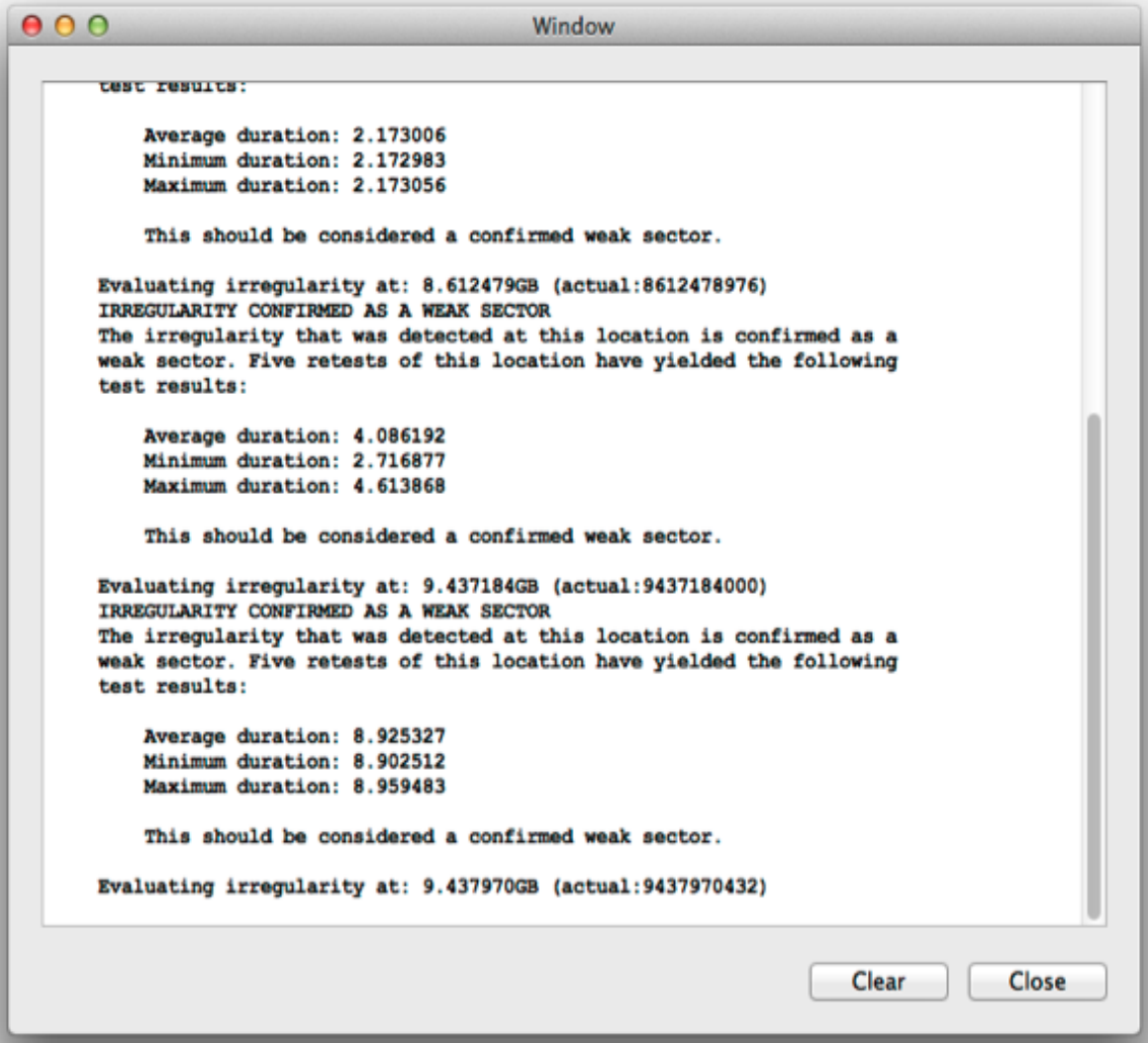
A surface scan test underway in *Normal Mode*



***Scannerz* in *Diagnostics Mode* performing tests on a weak sector**

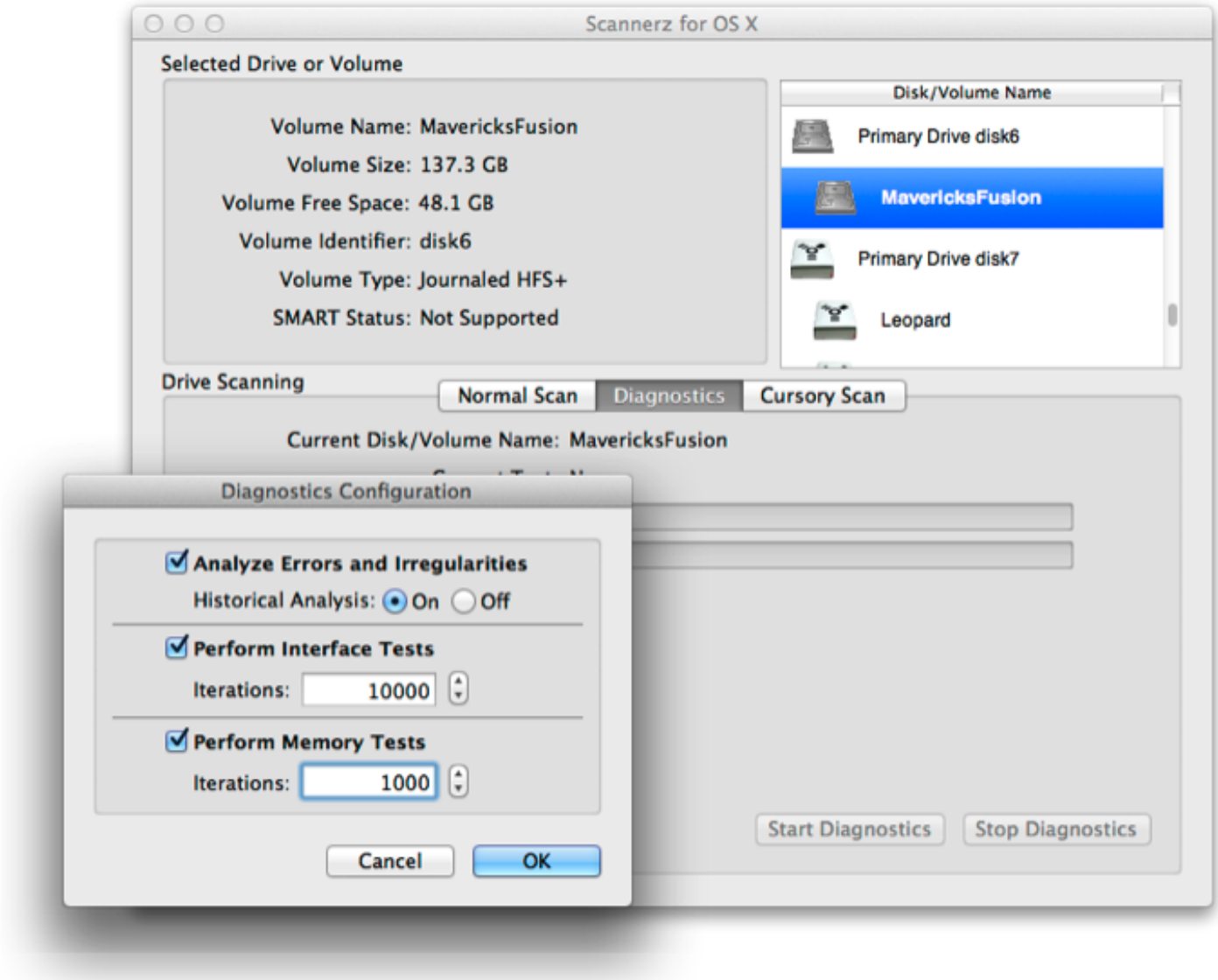
Most *Diagnostics Mode* tests are only needed if a *Normal Mode* test indicates there's a problem, or the system is experiencing erratic behavior. *Diagnostics Mode* tests are selected by the user with *Scannerz* performing the actual data analysis.

The screenshot on the next page illustrates the logging window that may optionally be brought up during a *Diagnostics Mode* session. The logging window in this case is illustrating the confirmation of weak sectors on a drive.



The Logging Window may be brought up in any tests to provide details about tests. In this screen capture, *Scannerz* is in *Diagnostics Mode* and evaluating a drive with some obvious problems.

The screenshot on the next page shows test configuration for *Diagnostics Mode* tests. Details regarding test setup and configuration are describe in the users manual.



Diagnostics Mode **tests may be configured to analyze errors and irregularities detected in previous tests, perform interface tests, and perform memory and system bus tests.**

A Note About Using a *Phoenix Boot Volume* for Testing

Scannerz includes a product named *Phoenix*, which can create what's called a *Phoenix Boot Volume* and perform volume cloning. We strongly recommend creating a *Phoenix Boot Volume* on a secondary volume, or creating one on a 32GB (or larger) USB Flash drive. In the creation of the boot volume, all SCSC products will be transferred, as will the core operating system. Third party applications and user folders will not be copied into a *Phoenix Boot Volume*, but *Phoenix* can clone entire systems as well, if needed. This volume may become invaluable in the future if your system ever experiences a crash rendering the original boot media unusable. Note that some older PowerPC based systems cannot easily boot from a USB device.

Sources of Problems with a System and How *Scannerz* can Isolate Them

Performance and functional problems with a system can often be traced to one of the following:

- Bad sectors/blocks on a hard drive or SSD
- Weak sectors on a hard drive
- Intermittent connections
- Data corruption
- Memory defects/System bus problems
- System timeouts
- Drive timeouts/excessive head parking
- Lack of memory
- Lack of free space on a drive
- Excessive MDS (Spotlight and Time Machine) indexing
- Software problems

The list above is not a list of every possible problem on a system, but rather a list of the most likely problems one may encounter.

Bad sectors/blocks on a hard drive or SSD will be flagged during a *Normal Mode* test using *Scannerz*, and confirmed using *Diagnostics Mode*. The symptoms of the problem(s) will depend on how active the faulty region of the media is. If the problematic area is in the boot code of the drive, the system may fail to boot. If it's in an application file, the file may fail to load. Both hard drives and SSDs are capable of remapping bad regions to "spare" regions if they exist.

Weak sectors should generally only occur on a hard drive. A weak sector is a damaged, but readable sector. It typically takes a fairly long time (often seconds) for the drive to read such a sector. A weak sector in a hard drive will be identified as an irregularity in a *Normal Mode* test, and confirmed as a weak

sector in *Diagnostics Mode*. Symptoms are long periods of spinning beach balls any time the sector is encountered by the system. A weak sector can be every bit as problematic as a bad sector.

Intermittent connections may be detected in *Normal Mode* tests as errors, irregularities, or both. An intermittent connection is typically found in an I/O cable but may be caused by faulty connectors as well, and even cracked or marginal logic board traces. Unlike bad or weak sectors, these problems never correlate to the progress of the surface scan with any degree of consistency. When *Diagnostics Mode* is used to evaluate data from a *Normal Mode* scan that contains this type of problem, it will flag the problems as being potential system faults. Putting the system into *Diagnostics Mode* and performing prolonged interface tests on the unit will likely expose the problem as probable system faults may be registered by *Scannerz* during interface testing.

Data corruption occurs when data being transferred between a drive or SSD and the system is corrupt. The symptoms will be files that are garbage filled and often the need to repair the media using Disk Utility's "Repair Disk" mode to correct the inevitable indexing problems. This type of problem may or may not be detected in *Normal Mode* testing, depending on the cause. It will be detected in *Diagnostics Mode* testing and registered as an interface error. This problem will most likely occur in external drives that are either under-powered or have failing stages in their conversion of data between a hard drive and an external interface. This is a critical error, especially if the drive is a backup drive.

Memory defects and system bus problems are two totally different things, but they are both evaluated in *Diagnostics Mode* using the Memory Test option. If a system has memory problems such as bad memory, incompatible memory, or poorly seated memory, *Scannerz Diagnostics Mode* will show this as a memory error. These may or may not show up in *Normal Mode* tests as intermittent faults. System bus problems will likely show up as intermittent irregularities or errors in a surface scan, with the exception that they will occur during all tests on all devices. This will be because the faults are on the logic board, not a device such as an external or internal drive.

System timeouts, drive timeouts, and prolonged head parking events can be caused by a drive or the system. Timeouts will be detectible and identified in *Scannerz Diagnostics Mode* because such events typically have no correlation

to surface scan progress but they occur with roughly identical durations, such as +/- a few tenths of a second. If the timing event occurs only during tests on a specific drive, then the drive is to blame. If the problems occur regardless of what drive is being tested, it's likely caused by a logic board problem. The most likely cause of such a logic board problem is poorly seated or loose heat sinks on the logic board. Some low power drives designed as backup drives may exhibit this behavior by design - that's apparently just the way they work.

Lack of memory and lack of free drive space cannot be detected by *Scannerz*, but they can be detected by a tool included with *Scannerz* named *Performance Probe*. Lack of free drive space is the more critical of the two because the system will be unable to swap memory to and from the drive. Aside from causing excessive bottlenecks, in extreme cases, this may cause the system to shut down or lock up. A lack of memory is most often caused by too many applications running at a time, or the system simply doesn't have enough memory to adequately run even the core operating system. If there's too little memory, you will likely experience very slow loading of applications, long delays in application execution, excessive swapping, very high CPU utilization, and large changes in the size of the swap files.

Excessive MDS indexing can be notorious for slowing a system down. MDS, which stands for meta data server, is used by both *Spotlight* and *Time Machine* to index drives on the system. *Scannerz* once again, can't monitor it, but it does have a provision to unload the MDS process from running while a test is going on. *Performance Probe*, which is included in the *Scannerz* package, will likely indicate high CPU and I/O utilization, and if load monitoring is enabled, a series of processes that start with the letters “mds” will likely be at the top of the CPU consumers. We offer another product named *SpotOff* which can be used to control MDS indexing, and a free MDS monitoring tool named *Spot-O-Meter*, which may be obtained from our web site

Software problems cannot be checked with *Scannerz*, but if there are bad kernel extensions present it can tend to skew not only some of *Scannerz* test results with a fair number of false irregularities, but may bottleneck the system, cause slow boot ups, and possibly system crashes. By instruction, you're supposed to stop all applications from running while *Scannerz* is performing a test, however there may be things going on that you're unaware of. For this reason, *Scannerz* also includes the applications named *Performance Probe* and

FSE or *FSE-Lite* (depending on the package.) Please visit our web site for more information about these products.

How to Test With *Scannerz*

As stated previously, the normal way to use *Scannerz* is to perform a *Normal Mode* test, end to end on the drive or volume you wish to evaluate, and proceed with *Diagnostics Mode* tests if *Normal Mode* tests found errors or irregularities. Many people check their systems periodically using *Normal Mode* simply to confirm that their system and drive are in good working order. Even in the event there are no problems, it may be wise to run tests on both the memory and interface in *Diagnostics Mode* simply to confirm that everything is OK. *Diagnostics Mode* tests of the interface and memory may also be needed if you're having erratic system problems, but a *Normal Mode* test made no indication of problems. The rest of this document will focus on problems and how to identify and isolate them.

Diagnostics Mode has three test options which are illustrated in the configuration dialog of *Scannerz* above. The dialog allows the user to select three different types of tests. The *Analyze Errors and Irregularities* option will access test data from a *Normal Mode* scan and evaluate it. It has an optional parameter to perform an historical analysis (or not), with an historical analysis evaluating all data acquired during testing since the original tests were performed on a given device (recommended). If this option is “Off” then only the data from the last *Normal Mode* test will be performed. The *Perform Interface Tests* option will exercise the entire interface between the media and the hosting system. The *Perform Memory Tests* option will evaluate the system memory and system bus for possible problems. The interface and memory tests do not require data from a *Normal Mode* scan, since they are intended to be used when problems have already been detected.

The *Analyze Errors and Irregularities* Option

When the option to analyze errors and irregularities is selected, the following will be identified if present:

- Bad blocks or sectors

- Weak sectors

- Timeouts and excessive sleep events

- Abnormally long irregularities, which usually point at a system problem of some sort

In reality, if problems are found, the majority of them will likely be repeatable, directly associated with the progress of the scan on the hard drive or SSD, and manifest themselves as bad blocks/sectors, weak sectors, or a combination of both. Dealing with and possibly correcting them is detailed in the users manual for *Scannerz*.

If *Scannerz* identifies possible timeouts, it will be necessary to determine if they're being caused by the system or the drive. This can usually be accomplished by using another scan target, such as a USB flash drive or another, different external drive as the target and then performing interface tests on that drive for a fairly long period of time (for example, increment the interface test counter to a fairly high value like 1000.) If the timeout is being caused by the system, they will continue to occur on each and every drive tested. If they are associated with the original drive, they will only occur when *Scannerz* is testing that particular drive. If the cause of the timeout is the system, either there are some very intrusive and dysfunctional kernel extensions in the system, or the logic board has problems. Drive timeouts may be caused by controller resets, firmware bugs, overly aggressive head parking, or (believe it not) apparently by design on some low power drives. Timeouts never correlate to the surface scan progress.

Abnormally long irregularities with inconsistent durations will be called out in *Diagnostics Mode* as a potential problem. The presence of such irregularities typically indicates an intermittent connection of some sort. They will not correlate to the progress of the surface scan, indicating the media on the drive or SSD is not the problem. These are not timeouts, because timeouts will always have relatively consistent durations. An example of such an event might be irregularities detected with durations of 10.33 seconds, 5.21 seconds, and 8.91 seconds. Intermittent problems of this nature typically vary widely in duration and at random with respect to the surface scan progress. Problems of this nature may be evaluated and possibly isolated using interface tests using a technique known as "Path isolation." Path isolation is described in a later section of this document (scroll down to find it.)

The *Perform Interface Tests* Option

This is the primary option used to evaluate intermittent (erratic) problems with systems as well as to identify possible corruption between the system and the media. The evaluation of erratic intermittent errors and/or irregularities was described in the preceding paragraph and will be detailed in more depth later in this document (path isolation.) This leaves data corruption, which is an extremely serious problem.

If interface tests are performed on a volume and interface errors are found, it indicates that the data being transferred between the system and the storage medium cannot be trusted. This is particularly important if the drive exhibiting the problem is a backup drive.

To illustrate this type of problem, suppose you saved a file to a hard drive or SSD that contained the sentence "My dog has fleas." If you re-read the file from the drive or SSD and what you get back is "M*&dog~has fleas " this is data corruption. Clearly the data sent to the storage device and what was received are not consistent.

When tests are run using *Scannerz* in this mode and this type of error is detected, it will increment the field "Interface Errors" (see the figure titled "*Scannerz* in *Diagnostics Mode* performing tests on a weak sector" above to see the field.) Even a single instance of this error should be taken seriously. This type of problem will eventually cause indexing problems which will become evident by notices that the drive needs to be repaired with *Disk Utility*. Eventually, the drive may be rendered "read only" or may even be marked as unusable by the system. If this was a backup drive (the one that's supposed to be reliable) this is obviously a very serious problem, since it implies the backup data may very well be corrupt.

The *Perform Memory Tests* Option

This option differs from all other test options in *Scannerz* in that it doesn't utilize I/O between the system and a drive. This is essentially designed primarily to expose system faults, load the CPU, memory, and system bus, and verify memory contents. During this test it is not uncommon for the system to run an higher than normal temperatures, and cooling fans may kick on or increase

their speed.

If an error is detected in this test, the field in the user interface named "Memory Errors" will increment. If errors are consistent, as in they repeat each time an iteration of the test is performed it indicates a likely problem with memory. For example, each time an iteration of the memory test is performed, and you get three errors every time, it indicates that the memory itself has a problem. If the memory errors are erratic, appearing occasionally but inconsistently, it implies that either the logic board has problems or something connected directly to the logic board such as an Airport card, RAM, bluetooth card, keyboard, or trackpad (to name a few) may either be poorly seated, malfunctioning, or improperly connected. Do not assume the logic board is dead and needs to be replaced without first investigating all possibilities.

Using Path Isolation to Identify System Problems

Using *Scannerz Diagnostics Mode* interface testing option, isolating intermittent and erratic problems can be greatly simplified using a technique know as *path isolation*. Intermittent and erratic problems are often difficult to trace and can cause side effects nearly, if not identical, to bad sectors or blocks on media. It should be noted that the problems detected to qualify for this type of evaluation should be inconsistent errors during surface scan tests or irregularities detected with durations greater than 3 seconds.

The most likely causes of intermittent errors and/or irregularities, in order of likelihood, are the following:

1. External I/O cables and connectors
2. Damaged connectors on the logic board used to connect external drives
3. Damaged connectors on the interface boards of external drives
4. Internal drive cables and connections
5. Poorly seated logic board components such as Airport cards, internal cables, RAM, etc.
6. Damaged RAM chip connectors on the logic board
7. Cracked logic board traces (most prevalent on laptop computers)

From the list above, items 5 and 6 should become evident using the memory/system bus testing option previously described, and won't be dealt with in this section.

More obscure, but possible causes of intermittent errors and/or irregularities are the following:

1. Power supply problems
2. Intermittent faults inside an external hard drive enclosure
3. Intermittent faults on an actual hard drive or SSD itself
4. Intermittent faults inside another system component, such as a keyboard or trackpad
5. Thermal sensors on the logic board or drive

From the list above, items 1, 4, and 5 should become evident using the

memory/system bus testing option previously described.

A path is said to be *isolated* when inconsistent errors and/or irregularities are isolated to a single path.

Note the following important points:

A. Many older Macs use a USB “hub” controller chip, and if problems exist with connections between this chip and the system’s I/O controller, it’s likely problems will show up on all USB ports and devices connected to it. This is actually a logic board problem. You may also encounter problems with other devices connected to this chip, such as the keyboard or trackpad. If possible, obtain a block diagram of your logic board to see if it fits into this category.

B. If there’s a problem related to the internal hard drive support circuitry, such as a cable, and the internal drive is being used as the boot drive, errors and/or irregularities will likely show up on all tests of all I/O ports. The best way to verify this is to use another, external boot drive, such as a *Phoenix Boot Volume*, and launch tests using the internal hard drive as the target. If the problems end up being isolated to the internal hard drive, then the path should be considered isolated to that path. Internal hard drive cable problems, especially on laptops, should be considered the most likely cause of such problems.

C. Mac Pro’s, Power Mac’s, and some MacBook Pro’s and aluminum PowerBooks use I/O cards that host several I/O ports. If there’s a fault in the cable connecting the I/O card to the logic board, errors and irregularities will likely show up on tests of ports associated with these cards, but not on any other ports in the system.

D. Power supply problems are rare on laptops, but may be more likely in desktop units assembled and sold between 2002 and 2010. This is because of a “capacitor plague” that existed in this time frame. The market was apparently flooded with poor quality capacitors that would lose their filtering capacity and allow spikes into the circuitry of a system. In some cases such spikes or transients may cause chips on the board to reset, or see data as invalid and enter a cycle of retries. Eventually the capacitors will fail completely causing the

unit to malfunction. Laptops typically don't use capacitors of this type because they're too large to fit on the logic board. Problems of this nature will appear very erratic and system wide.

E. If, during the process of path isolation, all problems are pointing at the logic board as the source of the problems, you should not assume the logic board is bad. Poorly seated or loose connections in the logic board may be the cause of the problems. Common problems are loose or improperly seated RAM chips and Airport cards.

F. During the process of path isolation, particularly on externally connected devices, remember that the cable itself is a possible source of problems. For example, if you're having USB problems, and you test each and every USB port using a device with a faulty USB cable, you might assume your problems fit into those described in item A above, when in fact the cable is causing the problem. USB ports can be tested with a USB flash drive as well as a hard drive, although their slower response may introduce a few more false irregularities.

G. True logic board faults are most likely to exist in iBooks, Titanium PowerBooks, Aluminum PowerBooks, plastic MacBooks, MacBook Air's, and MacBook Pro's without machined aluminum housings. These systems are susceptible to logic board flexing which can in turn create cracks in logic board traces. This doesn't mean problems can't occur on other systems, it's just not as likely.

Path isolation is performed as follows:

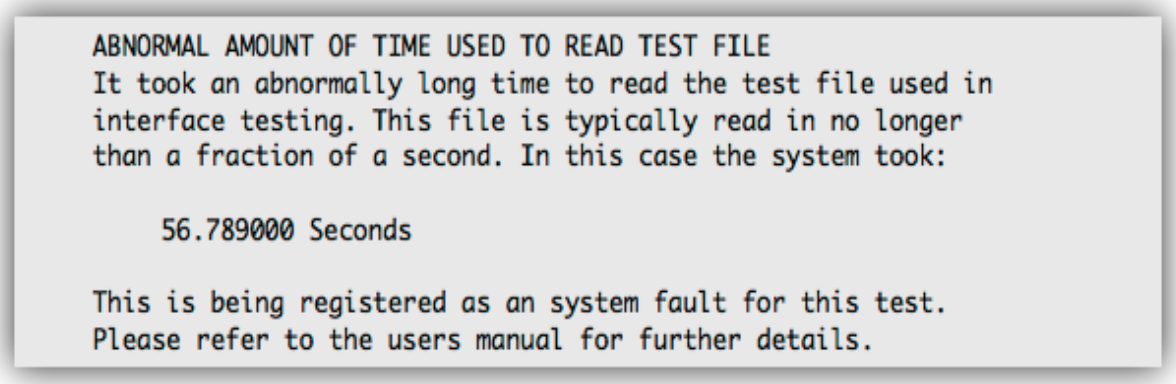
1. A *Normal Mode* scan is performed on a device, and errors and/or *significant* irregularities have been detected. These types of results will not be confirmed as weak blocks or sectors during *Diagnostics Mode* re-evaluation of the *Normal Mode* tests. *Diagnostics Mode* will likely log messages using one of the formats as shown on the next page:

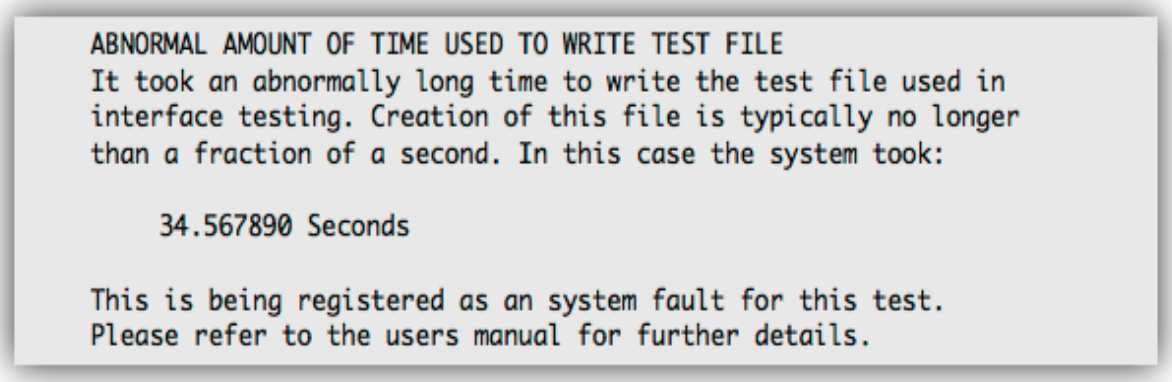
```
POSSIBLE SIGNIFICANT INTERMITTENT PROBLEM
Scannerz has reevaluted the media at this location and
found no problems. However, the orginal irregularity lasted:

         20.231161 Seconds

This isn't normal. It's possible there are intermittent system
disconnects occurring from bad cables, connectors, or logic
board faults, short periods of head parking (hard drives only),
or there's a software problem (usually incompatible kernel
extensions.) If not selected, you may wish to consider performing
extensive interface and/or memory/system bus tests to determine
whether this is a reoccurring event.
```

```
ORIGINAL ERROR IS NO LONGER PRESENT
Scannerz has re-tested this region and found no problems. Either
the bad blocks have been mapped re-mapped by the controller or
the problem is a system problem which is causing random I/O errors.
You may be able to detect random I/O errors using the diagnostics
interface testing option if they're occurring.
```

2. Select *Diagnostics Mode* and a volume on the drive where the problems were encountered. Set the increment for testing fairly high (such as 1000). Select only the option to perform interface testing as the only option. Click on the "Start Diagnostics..." button.

3. If the unit is external, while the test is running, see if moving the cable around, particularly near the junction between the cables and connectors can induce faults. If the drive is internal and you can open it up and gain access to the drive cables, the same can be done using a non-conductive probe. You will be looking for *Scannerz Diagnostics Mode* to detect faults, which will yield messages similar to the following:





When messages similar to those above occur, you will know that your system is experiencing system faults. If the problems can't be correlated specifically to a cable, it's possibly a cracked trace either on the logic board, logic board connectors, or inside a drive housing if it's an external drive.

4. Boot from an alternate source from that used in step 1, using a completely different type of port. Pay close attention to points **A.**, **B.**, and **C.** above and make sure that the alternate boot source you're using is not a shared port from the same I/O card or ports feeding from the same interface circuit.

For example, if the original test was done using an internal drive with a SATA interface, use another boot volume such as a *Phoenix Boot Volume* using a USB interface. If the original test was done using a USB based *Phoenix Boot Volume*, then boot from the internal SATA drive you normally use to boot the system. Launch *Scannerz* from that, and re-perform the *Diagnostics Mode* tests as identified in step 2 above to test, at a minimum ***both*** the alternate boot

source as well the original boot source. *It's highly recommended that you perform tests of this nature on as many I/O ports as possible, preferably all I/O ports.* The idea is make sure the problem is isolated only to a single data path.

5.The test results should fall into one of the following categories:

Inconsistent errors and irregularities are present in all tests. This implies there's a problem with the logic board or devices connected to the logic board. Improperly seated Airport cards or RAM can often cause this. In most units the RAM can be reseated, but isolating other connections will most likely require opening the unit up. It's also possible there may be a supply regulation problem. T

The problems are isolated to a single path. This is the most common result, and in 9 out of 10 cases, it will be cable or connector related. In this case, the problem will need to be subjected to sub-isolation as described below.

The problems appear on a group of I/O ports. This is typically a condition found in items **A.** and **C.** above. If it's item **C.** it's most often the cable connecting the I/O port to the logic board. In item **A.** it indicates that the USB Controller/hub chip has problems of some nature, and this is a logic board problem.

The problems disappear completely. This occurs when the test wasn't performed properly, there's a problem that is beginning to surface that isn't exhibiting problems consistently enough to be detected, or there's a problem with a process running in the system. This can also happen when there's a cable problem and the test is being performed with the cable in a position where full contact is being made in an intermittent break.

Resolving Problems with Inconsistent Errors and/or Irregularities

If the results indicate that the errors and/or irregularities are present in all tests, it implies there's something wrong with the logic board, or something connected to the logic board. We recommend proceeding by attempting to start doing the easiest things first before going into more intense work. For example, re-seating the RAM. In some rare (very rare) circumstances an auxiliary device, such as a printer may be causing problems, and it might be

wise to see if problems go away if other devices are removed.

If this doesn't provide positive results, the unit will need to be opened up, and all internal items reseated and inspected for damage. If the unit uses an internal supply with large capacitors, the supply should be checked for capacitor bloating and signs of other failure. You may very well need to replace the logic board if this type of condition exists.

If the problems are isolated to a single path, you will need to determine the exact cause of the problems. In most cases, it will be either a cable, connector, or poorly seated cable in the path.

It is not uncommon for the connectors on the logic board leading to external I/O devices, such as USB and FIreWire ports to develop cracks at the junction between the logic board and the connector if subjected to lateral impact or strain. The connector plugging into these ports can effectively act almost like a lever which can, in a sense, "amplify" the amount of strain being placed on the actual connectors. All tests, regardless of the device tested on this port will exhibit the exact same intermittent behavior. The only solution in this case is to either replace the logic board or not use the port. Similar problems can exist on external drive enclosures, and generally the only solution will be to replace the interface board in the housing.

Any cables found to be defective, whether internal or external, will need to be replaced. External cables tend to malfunction near the connector ends. Always check the seating of cables and in the case of external cables, check the inside of the connectors for possible contamination by a foreign substance.

If the problems exist on a group of I/O ports, the problem may be cable or logic board related. If you have a unit as described in item **C.** above, then the most likely culprit will be the cable connecting the I/O board to the logic board. Attempt to reseat the cable first to see if the problems clear up. If they persist, attempt replacing the cable with a known good one. If this fails, then there's unrepairable damage either to the I/O card or damage to the logic board path that connects to the cable. The option will be to replace the faulty components or simply not use the ports associated with the bad path.

If you're using an older unit that uses a USB controller/hub chip as described in

A. above, this is logic board damage and the only option will be to not use the ports or replace the logic board. However, confirm that the problem exists on a host of devices. For example, if you were to test 2 USB ports with the same device and cable, it's quite possible the device or cable could be defective, thus leading you to think that all USB ports are bad when in fact it's the device being used in testing.

If the problems can't be replicated there are several possibilities. The first is to ensure that the test is being conducted properly. *Scannerz* requires that no other applications other than the core operating system be running. If this condition hasn't been met, the tests should be considered invalid.

If the test was conducted properly, use *Activity Monitor* and *FSE* or *FSE-Lite* to confirm there are no other, hidden applications running. It may be necessary to open the log files for the system and see if there are any tell-tale signs of malfunctioning applications, start up items, or faulty kernel extensions. It may be helpful to reboot the system in safe mode to see if the problems clear up.

Finally, if there's a problem that's just beginning to surface, problems may only show up once in a while. If the problem is due to a true fault, it will eventually get worse, not better (they never get better!) We would recommend monitoring the system and paying attention to see if these currently rare events can be correlated to a specific device or activity. When problems associated with actual faults in the system are in their initial stages of development, they may be difficult to isolate and frustrating to deal with.

Sub Isolation of a Problem Associated with a Specific Path

If the problems have been traced to a specific path, the actual source of the problem should be isolated. In the vast majority of cases, cables, failing connectors, or poorly seated connectors will likely be the cause. Much of this is nothing more than common sense and basic logic, but it may take a little thinking to isolate the actual cause of the problems.

To isolate this problem, first visually inspect the cables and their connectors for any signs of damage or contamination and repair, replace, or attempt to clean as needed. If there are no obvious visual signs of problems, attempt reseating

the cables to see if the problem clears up. If this doesn't work, replace the cable with one that's known to be in good working order.

If none of these attempts clear up the problem, you need to start to consider the possibility that the logic board, an external enclosure (if the path is to an external drive), or possibly the drive itself has problems. The most likely culprits will be the connectors on the logic board, or those on the interface connector of an internal or external hard drive. The only way to really evaluate this is to swap the external or internal unit with a known good, working unit. If the problems continue, the logic board is to blame, otherwise the internal or external drive is to blame.

If the problems are traced to the logic board, the unit can be run from an external drive, so it isn't necessarily the end of the unit. Be advised that if problems exist with an external drive, the drive inside that unit may be in perfect working order if the problems are associated with the drive enclosure instead of the drive itself.