SCSI*toolbox*™ 32

Bus Analyzer Module User Guide

July, 2007

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Introduction

BAM is a versatile tool used which can capture, display, and analyze trace data from I/O operations sent to storage peripherals. BAM can work with any type of storage interface such as SCSI, Fibre Channel, iSCSI, SAS, ATA, and SATA.

BAM is a software level bus analyzer, which in many cases can serve the same purpose as a hardware based bus or protocol analyzer. It provides a trace view of I/O captured within the operating system. As such it cannot be used to view detailed phase or timing information, but it can provide an accurate trace overview with incredibly detailed trace information.

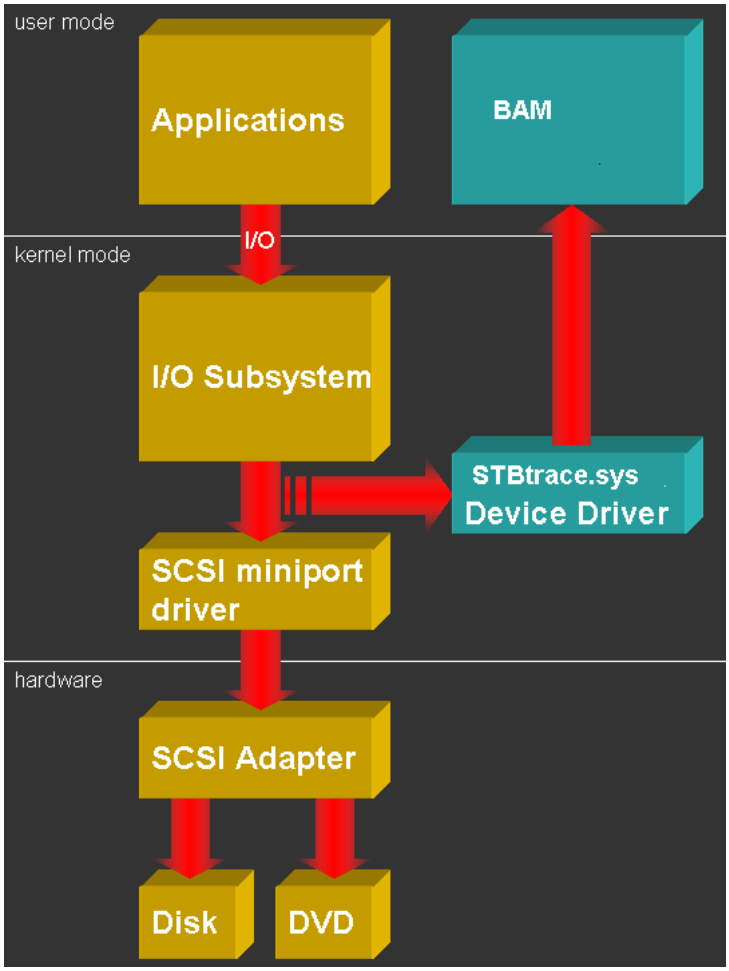
BAM is perfect for viewing commands and data sent between your host computer and your storage devices. It can help you quickly determine if the commands you think are being sent are indeed, as well as confirming that your storage device is responding as expected.

It's highly accurate phase timing can be used to directly measure inter-command latency as well as data throughput and I/O's per second. And its real-time performance display gives you at-a-glance confirmation of command queue depth achieved.

Post capture analysis shows percentage of bus bandwidth being used, performance statistics, and detailed command mix information.

Programmers at SCSItoolbox use BAM daily to confirm that tests are actually sending the commands that we think we are sending, and for troubleshooting strange device behavior. We also use it for driver testing – to test performance as well as regression testing.

BAM utilizes a filter driver to intercept I/O information as it passes between the I/O Subsystem driver layer and the mini-port driver level – as illustrated here:



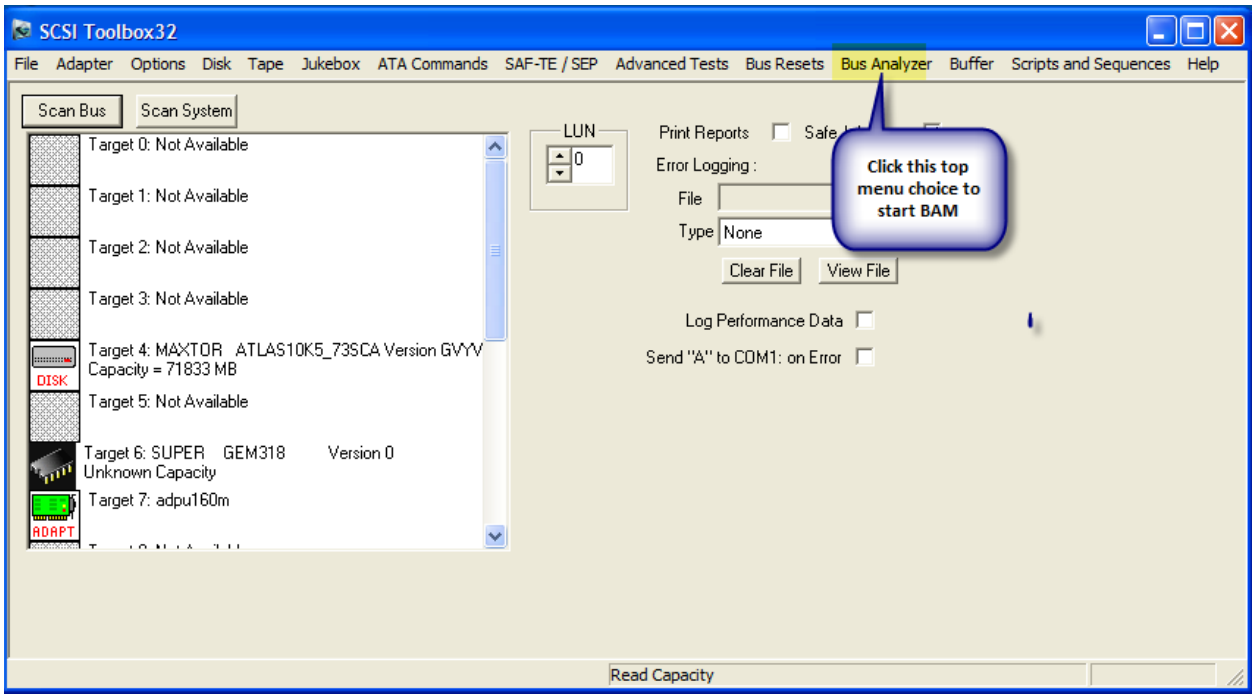
Starting BAM

From the desktop icon

When you install the SCSItoolbox Suite it will place an icon for BAM on your desktop. To start BAM simple double-click on this icon

From within STB32

You can also launch BAM from within SCSItoolbox32 by clicking on the top menu Bus Analyzer choice as show here:



The BAM User Interface

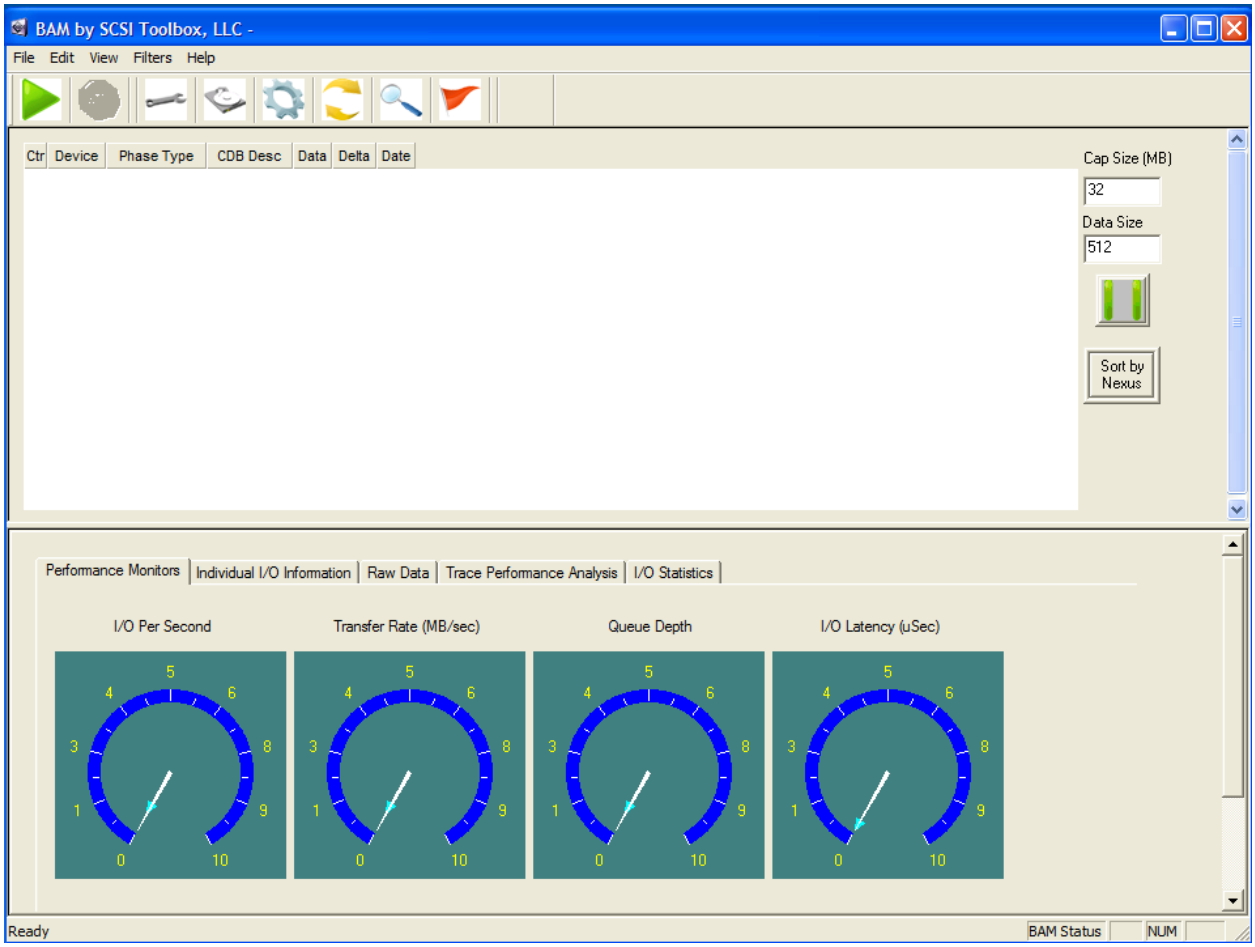
The main screen of BAM is shown below – in this section we will discuss how to :

- Select a device to monitor
- Select which phases to capture
- Select which phases to display on the screen
- Switch between Capture and Performance mode
- Specify a trace buffer size
- Specify how much data per I/O to capture
- Start and stop a capture

Later sections of this manual will describe how to display and analyze the data that you captured.

The Main BAM Screen

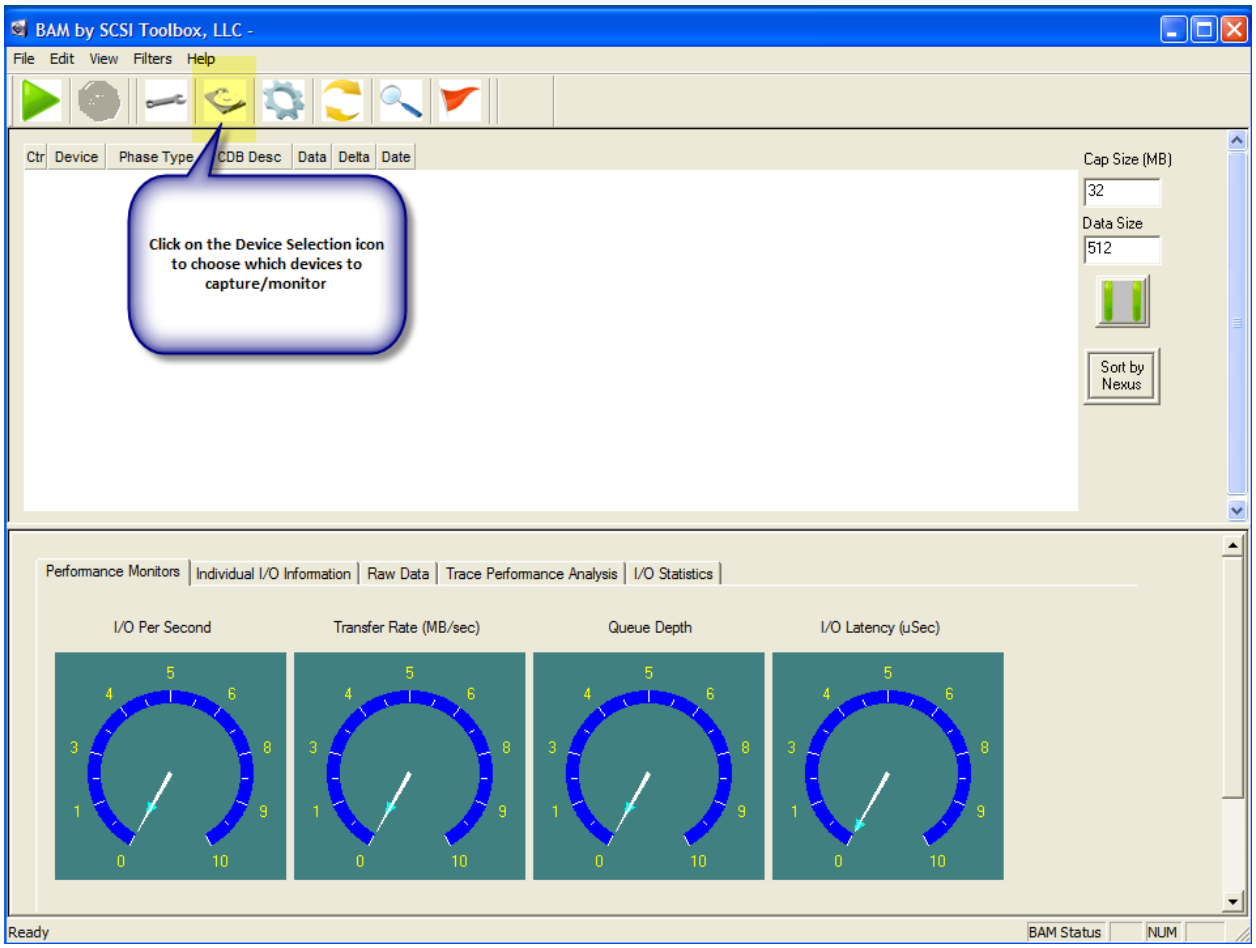
Once you launch BAM you will see the screen below. You will first need to select a device to capture trace data from.



Selecting Device(s) to monitor

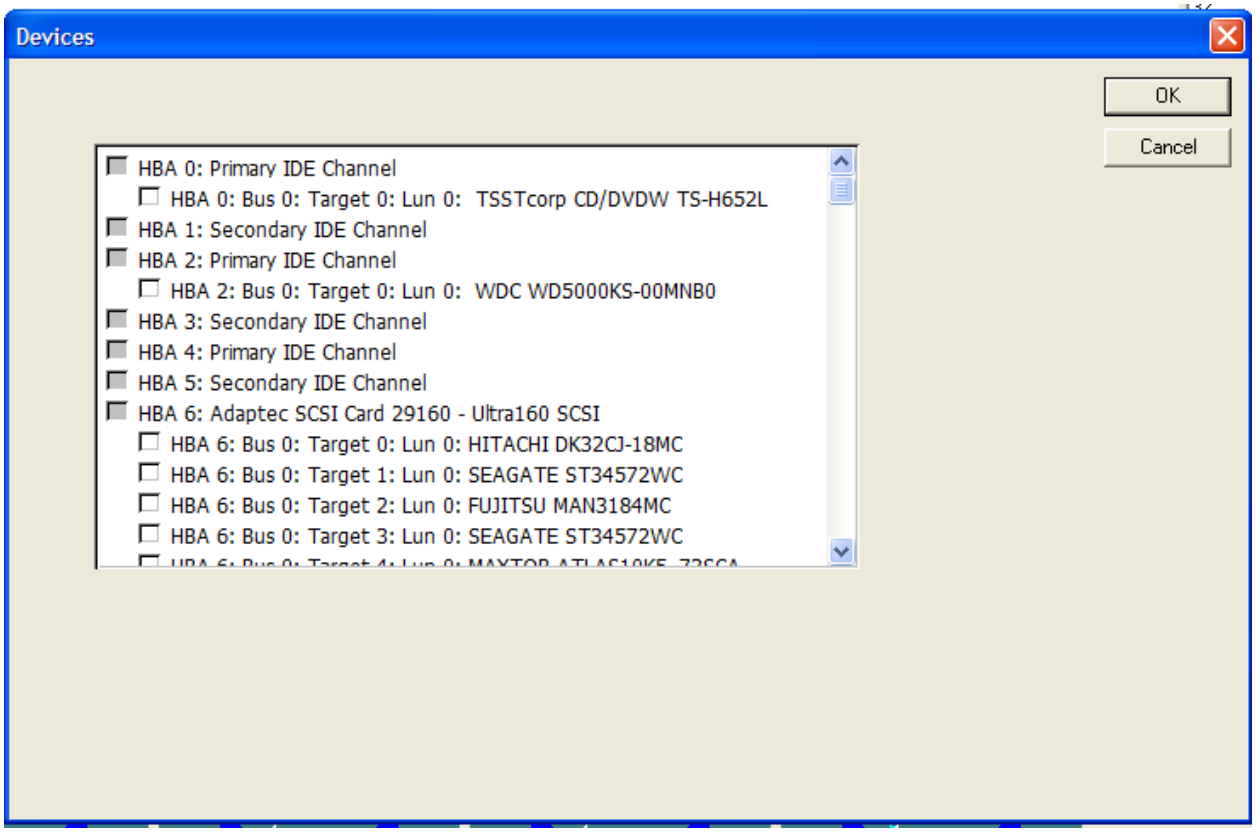
Use the Device icon to select what devices you wish to monitor. Note – in Performance Mode you are only allowed to select one device. Also, if you are planning to record the I/O session for later playback with the SCSItoolbox 32 CDB Sequencer you will also want to select only one device.

Otherwise you may select as many devices as you wish to monitor

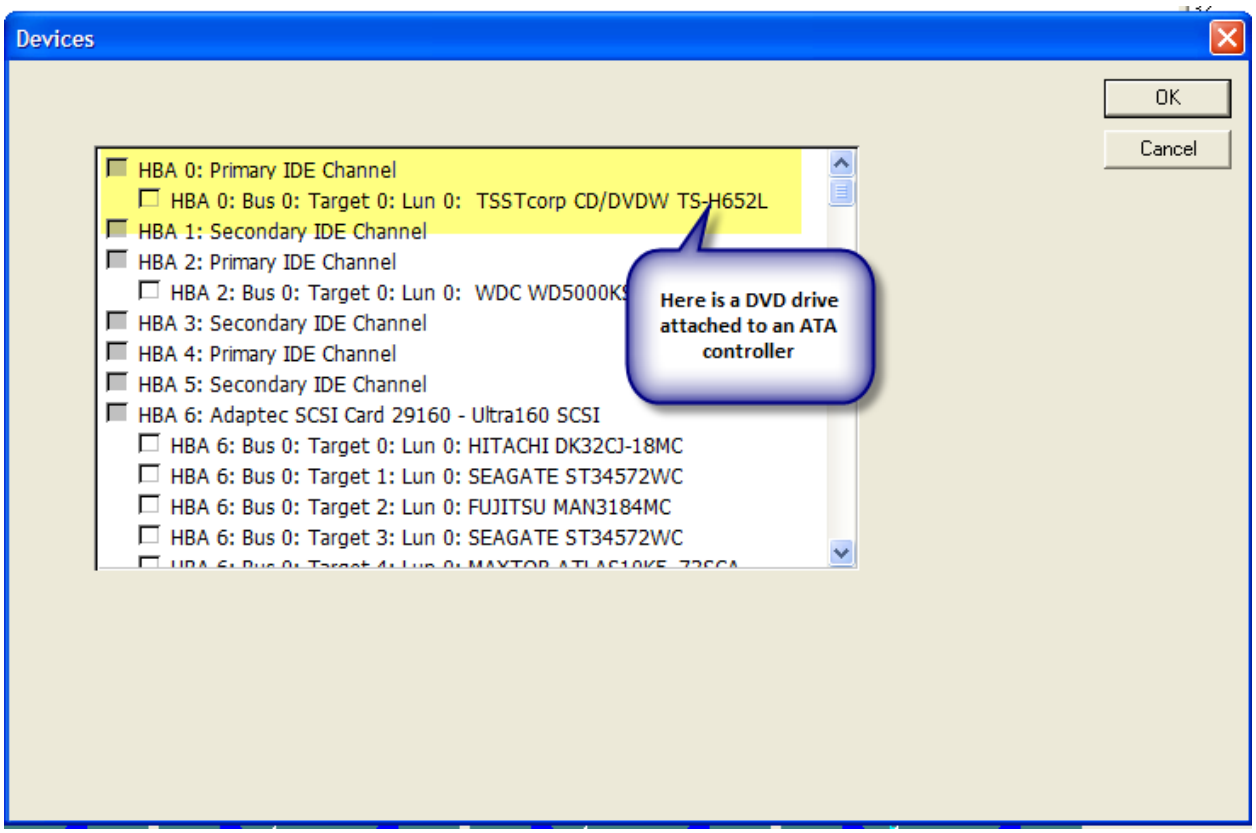


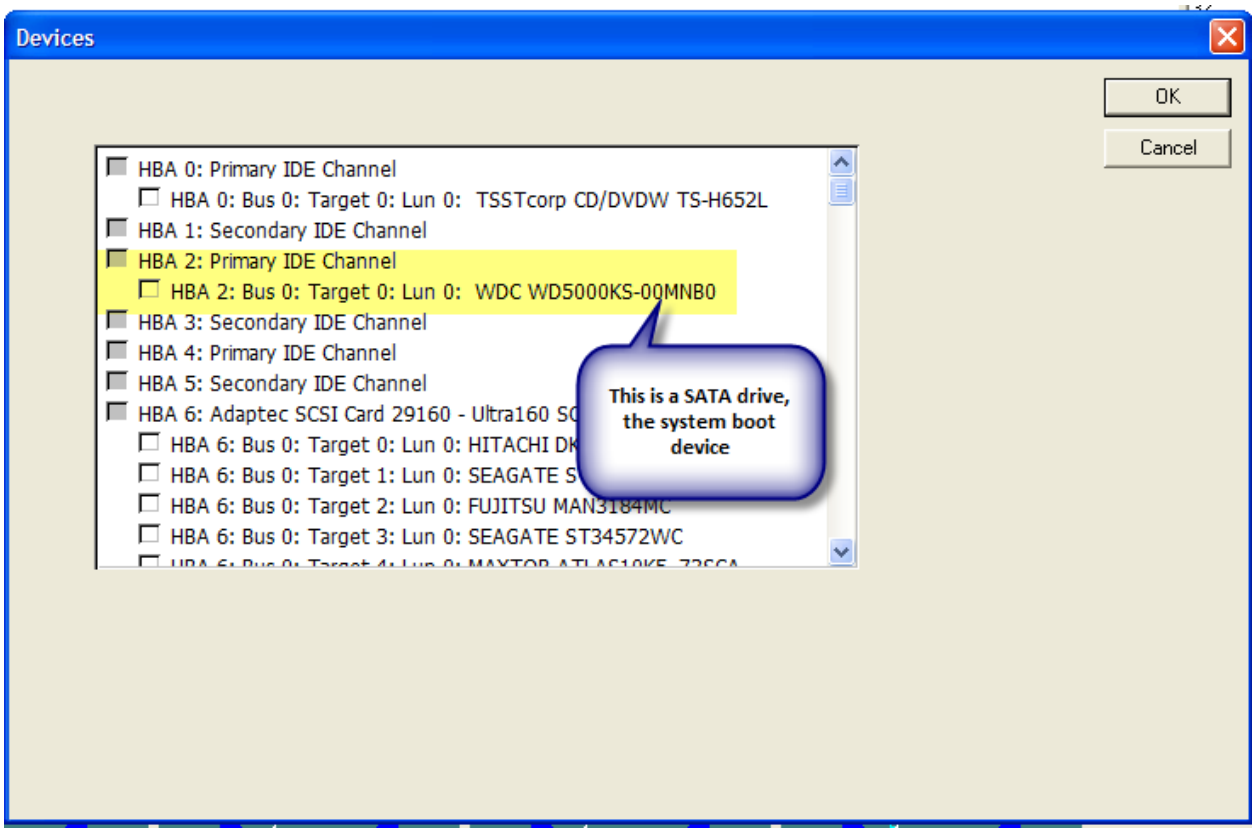
The Device Selection menu

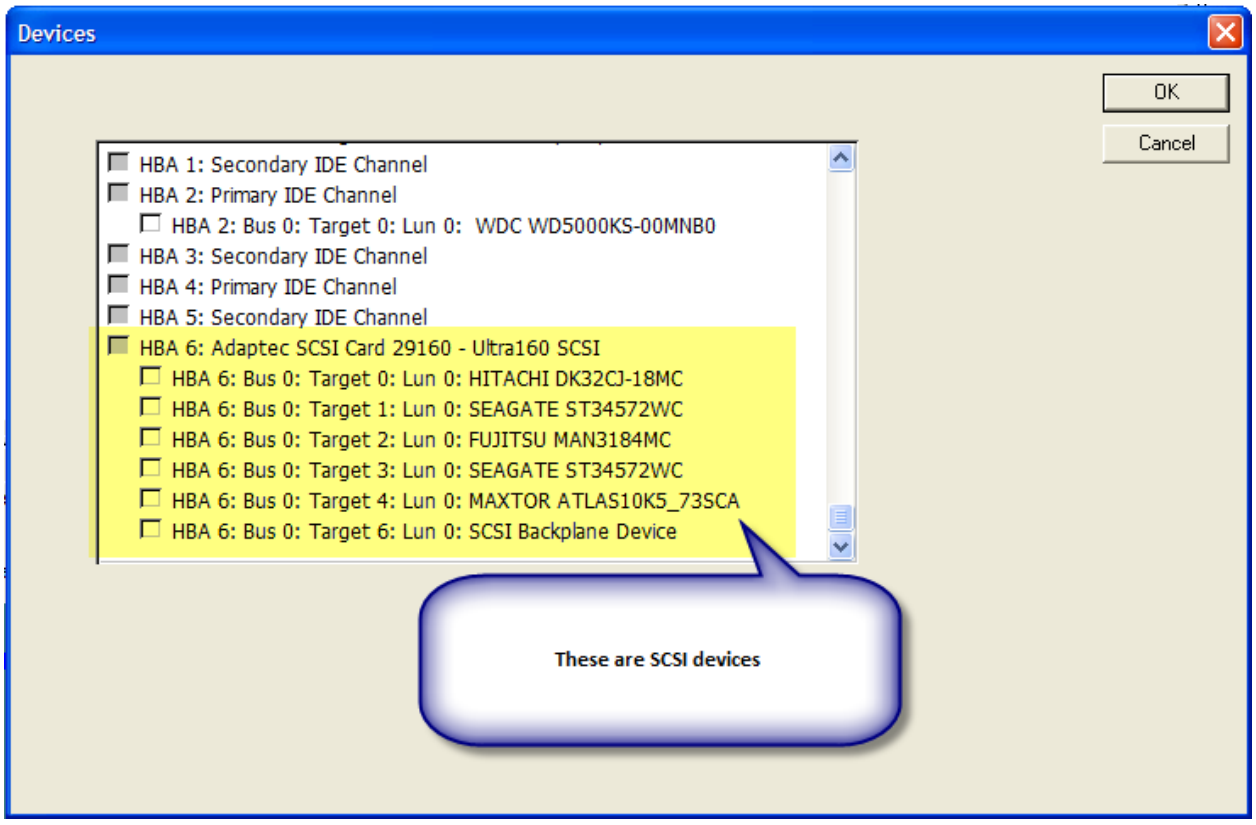
The Drive Selection Menu displays all adapters and devices on your system.



BAM can monitor all types of storage devices on your system – ATA, SATA, SCSI, FC, iSCSI, and SAS, The examples below show various different types of interfaces and devices that BAM has discovered.

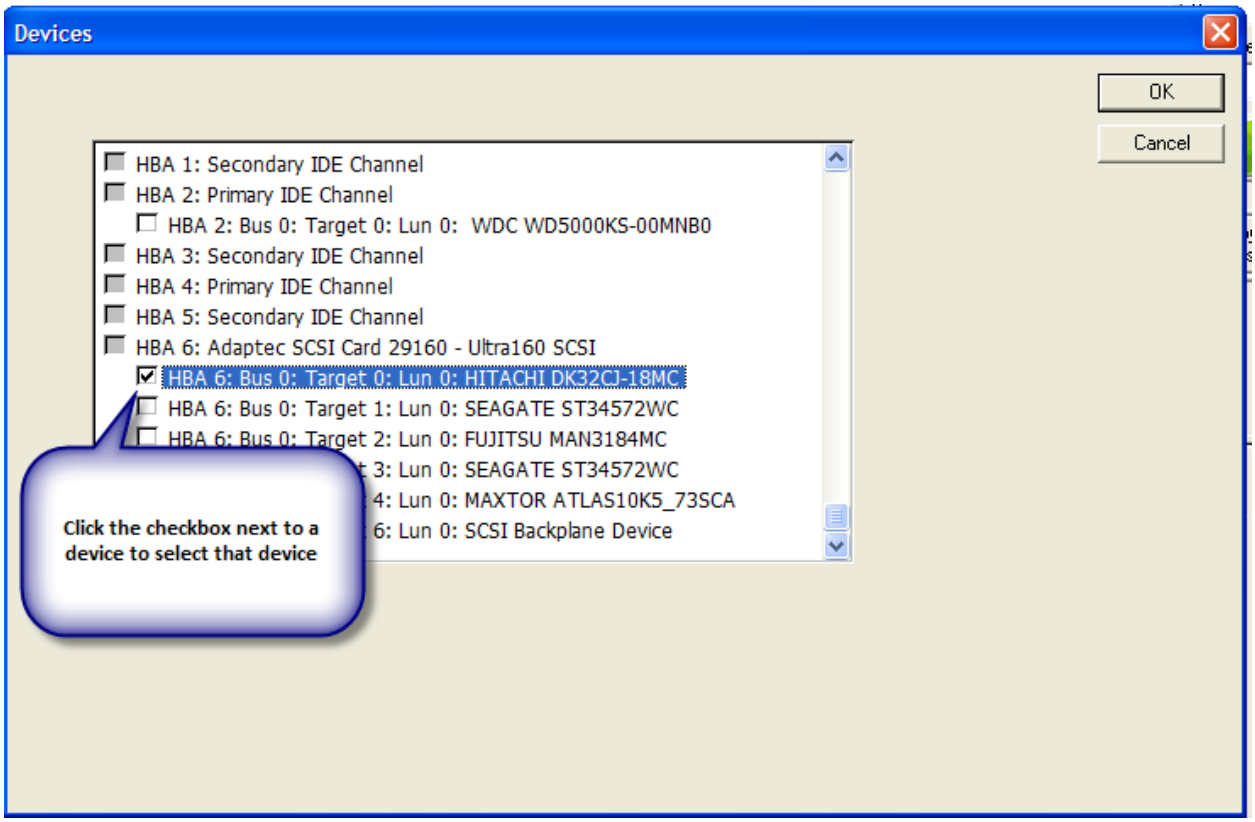



Devices
OK
Cancel
HBA 0: Primary IDE Channel
HBA 0: Bus 0: Target 0: Lun 0: TSSTcorp CD/DVDW TS-H652L
HBA 1: Secondary IDE Channel
HBA 2: Primary IDE Channel
HBA 2: Bus 0: Target 0: Lun 0: WDC WD5000KS-00MNB0
HBA 3: Secondary IDE Channel
HBA 4: Primary IDE Channel
HBA 5: Secondary IDE Channel
HBA 6: Adaptec SCSI Card 29160 - Ultra160 SC
HBA 6: Bus 0: Target 0: Lun 0: HITACHI DK
HBA 6: Bus 0: Target 1: Lun 0: SEAGATE S
HBA 6: Bus 0: Target 2: Lun 0: FUJITSU MAN3184MC
HBA 6: Bus 0: Target 3: Lun 0: SEAGATE ST34572WC
This is a SATA drive, the system boot device



Important point – all storage device types SCSI, FC, ATA, SATA, iSCSI, SAS can be monitored with BAM!

To select the device(s) to monitor simple click the checkbox next to the device.

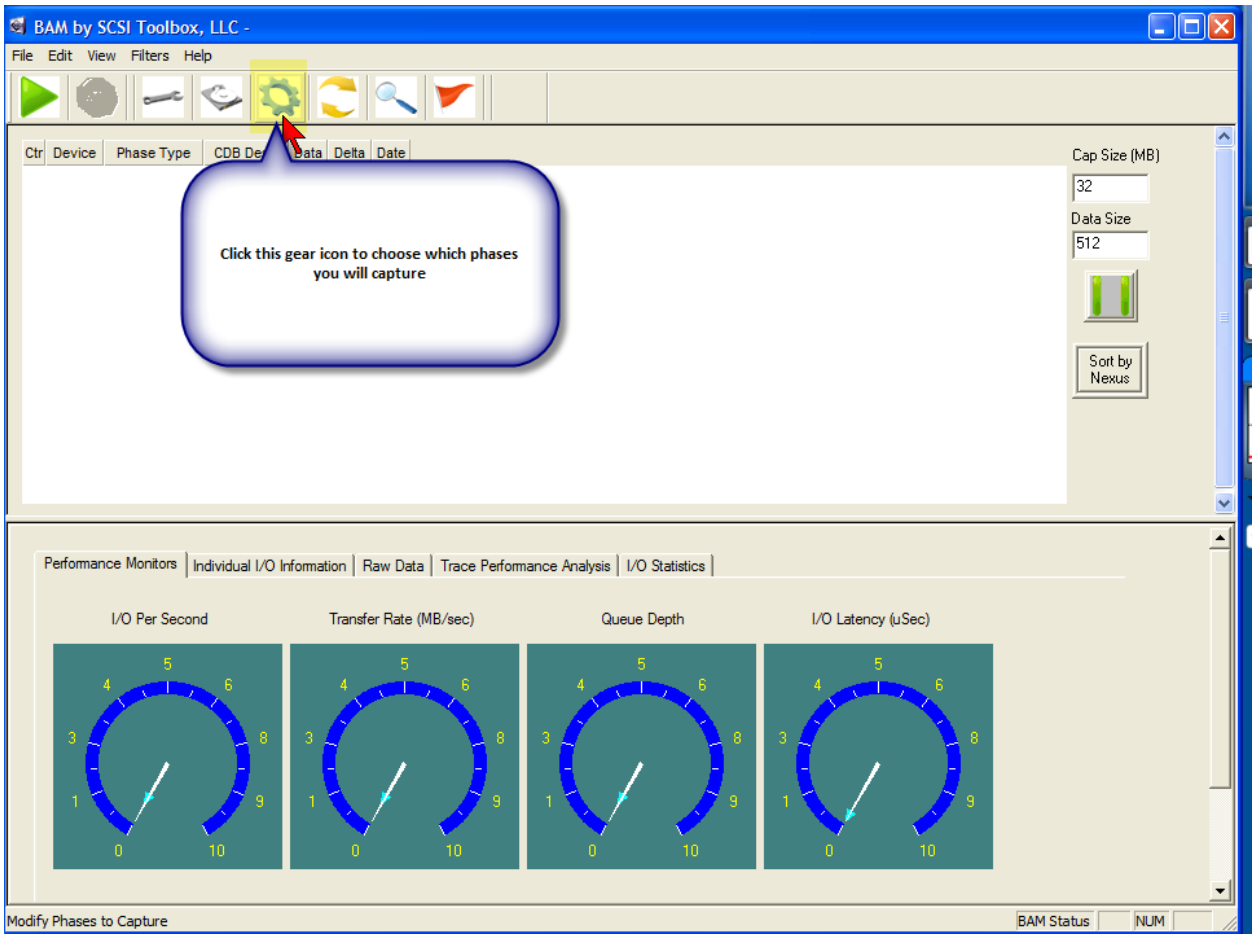


The Phase Selection Menu

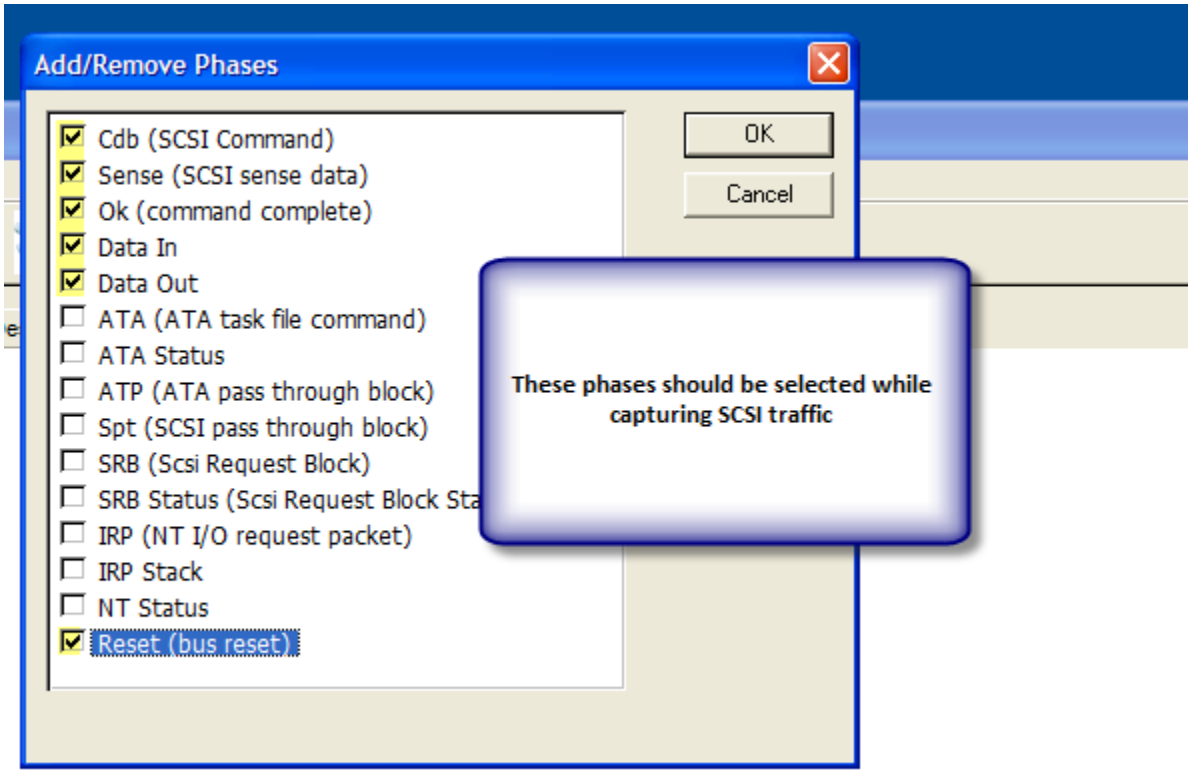
There are several types of phases that can be captured with BAM, from high-level phases such as CDB and DATA-IN DATA-OUT, down to low-level driver SRB phases. A complete command nexus will consist of at least a CDB phase, possibly a DATA IN or OUT phase, and possibly an OK phase if there is not data phase. We recommend you select these phases as a minimum.

We also suggest always leaving the Bus Reset phase choice selected – it can be very informative to see a bus reset occur when you are not expecting it.

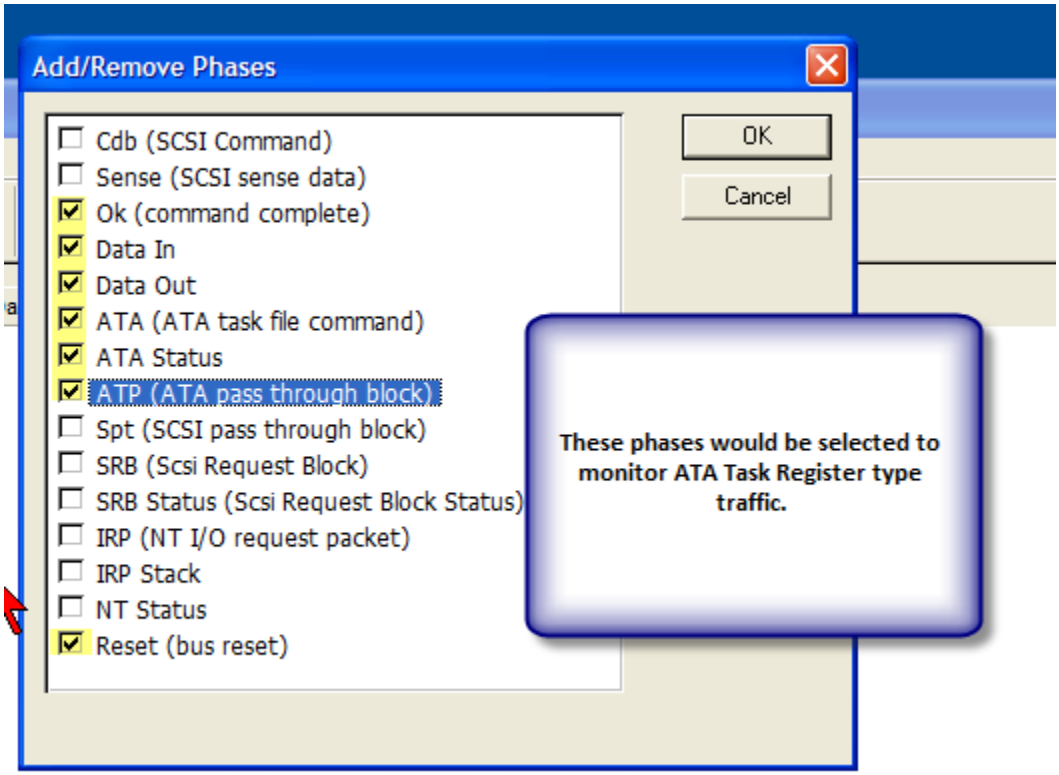
Unless you are doing device driver level testing we do not recommend that you select the Spt, SRB, IRP or NT Status phases.



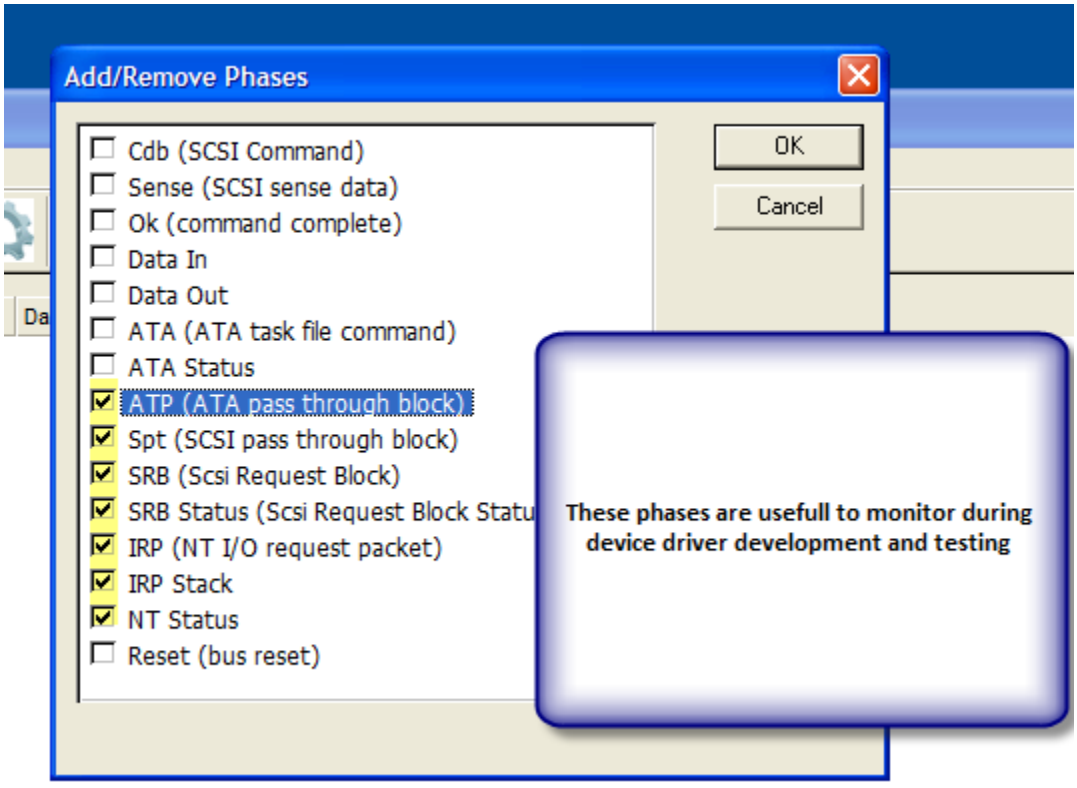
Typical Phase Setup for SCSI capture



Typical Phase Setup for ATA capture

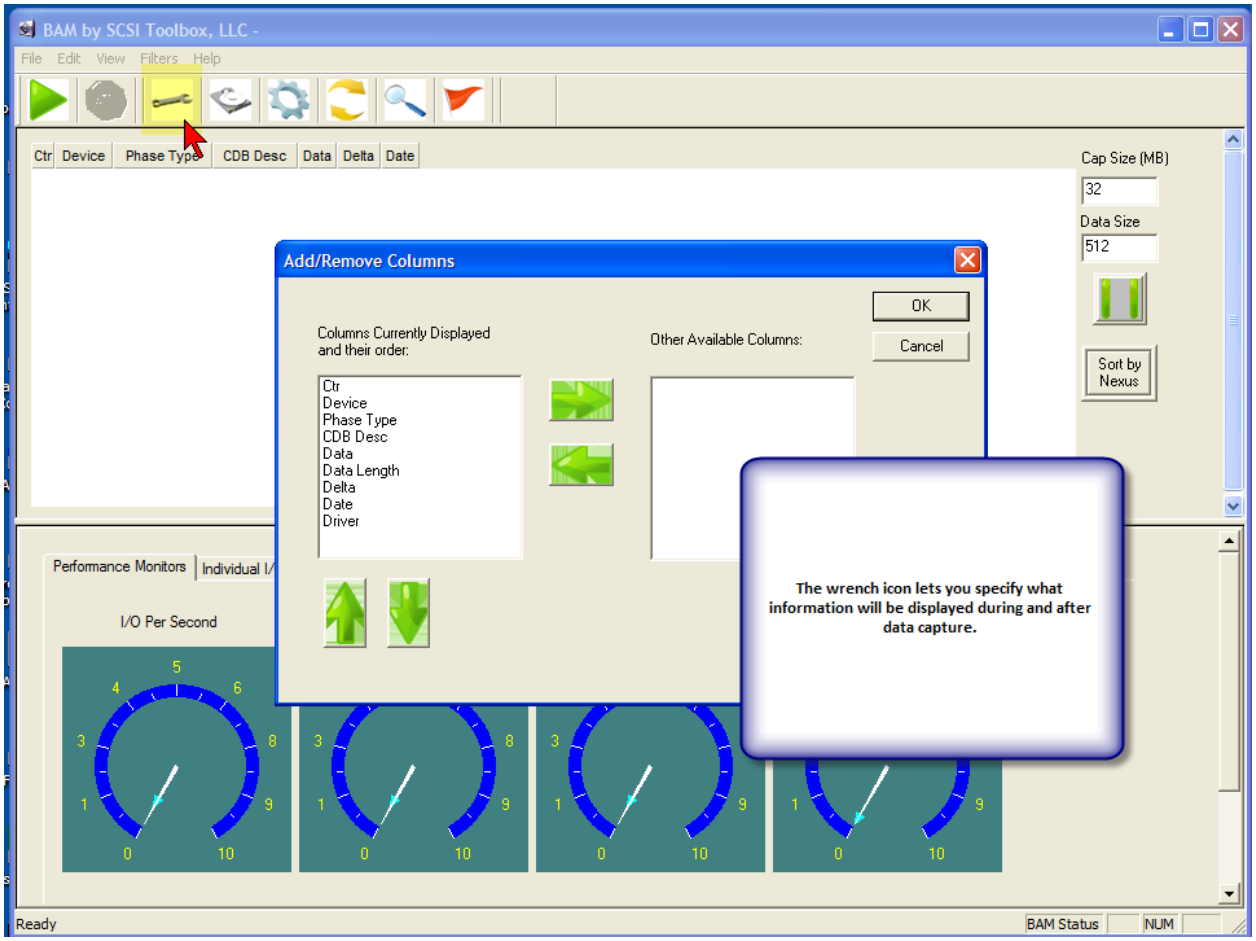


Typical Phase Setup for Driver test capture



Display column setup

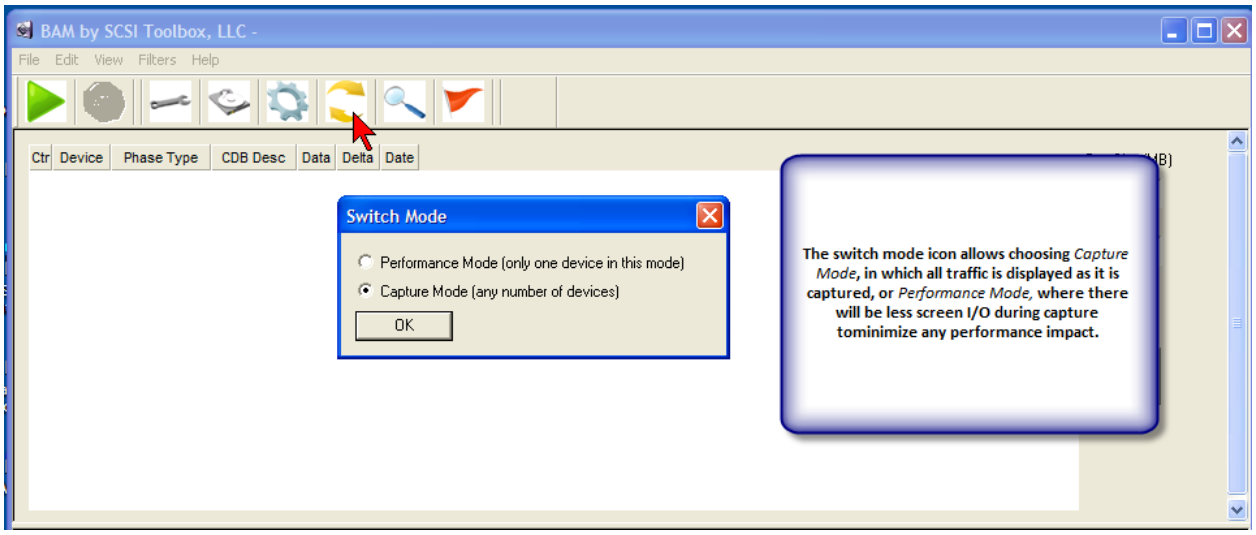
You can decide what columns you want to be displayed in the main screen, and what order they will be displayed.



Switch mode selection

There are two capture modes – Performance Mode does minimal screen I/O to insure that bus throughput is not compromised. In this mode only one devices I/O can be captured at a time.

Capture Mode displays all I/O in real-time as the capture progresses, and in this mode you can capture I/O data for many devices at a time.

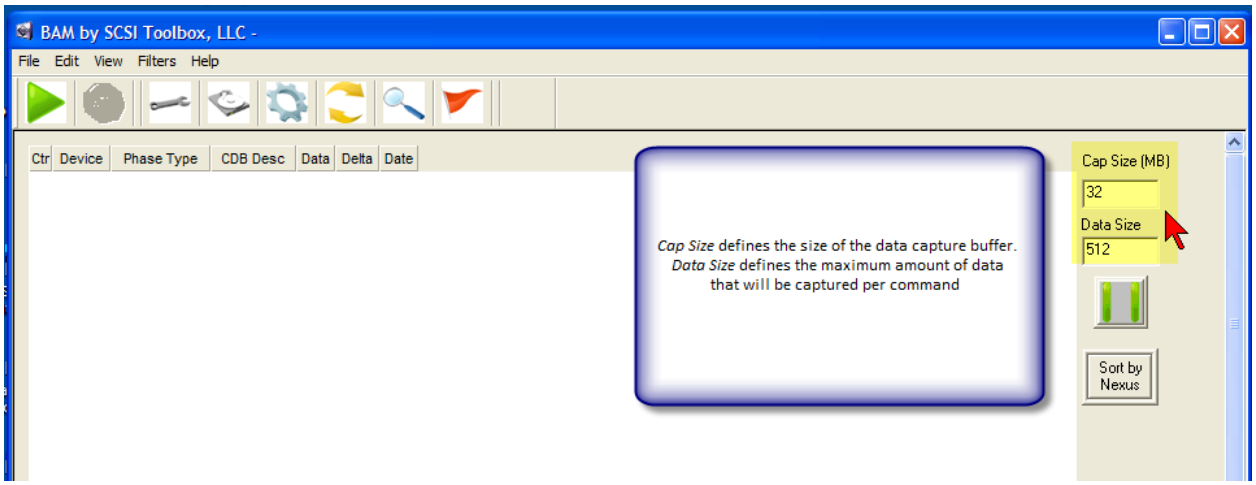


Setting Capture Buffer Size and Data Size per I/O

You may specify the overall size of the BAM capture buffer, and also the maximum number of bytes of data.

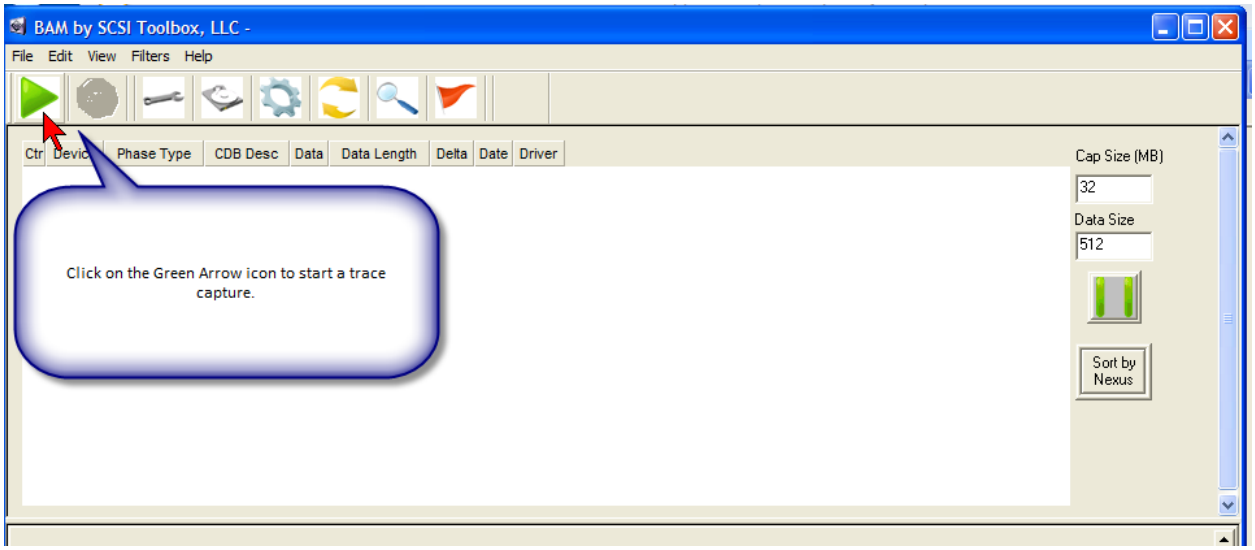
Set the Data Size to be as large as the largest data transfer you will encounter. For working with normal captures a setting of 32 bytes should be sufficient. I you want to capture read and write data to disk you should set this to at least the block size of the disk – the default size is 512 bytes.

The size you set will directly influence the size of saved trace and CDB Sequencer files that you may create.

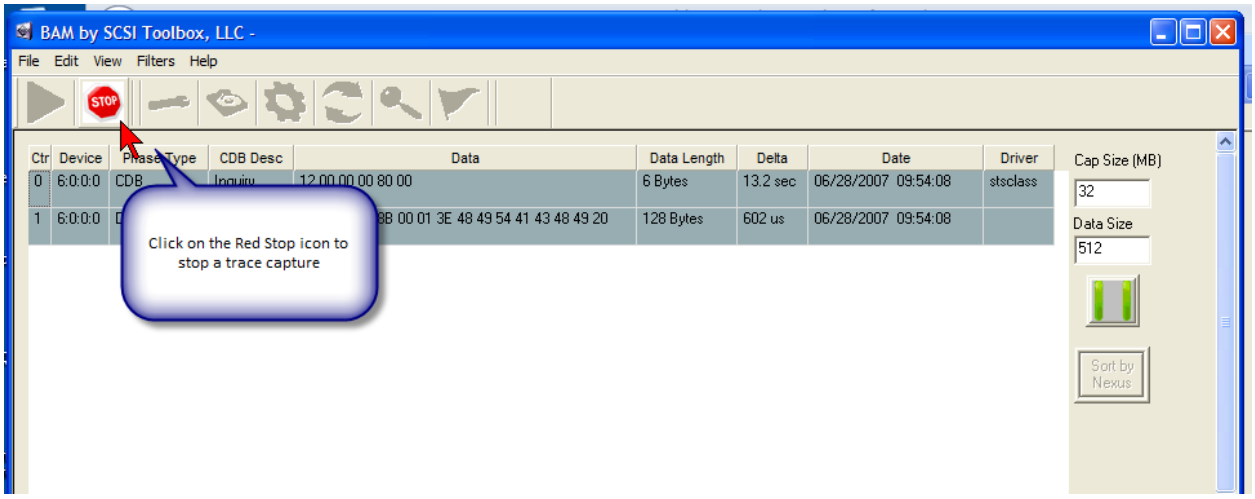


Starting a trace capture

Now that you have set up all parameters to your liking it is time to actually capture trace data. To do this click the green arrow icon to start the capture. Use the red stop icon to stop the capture.



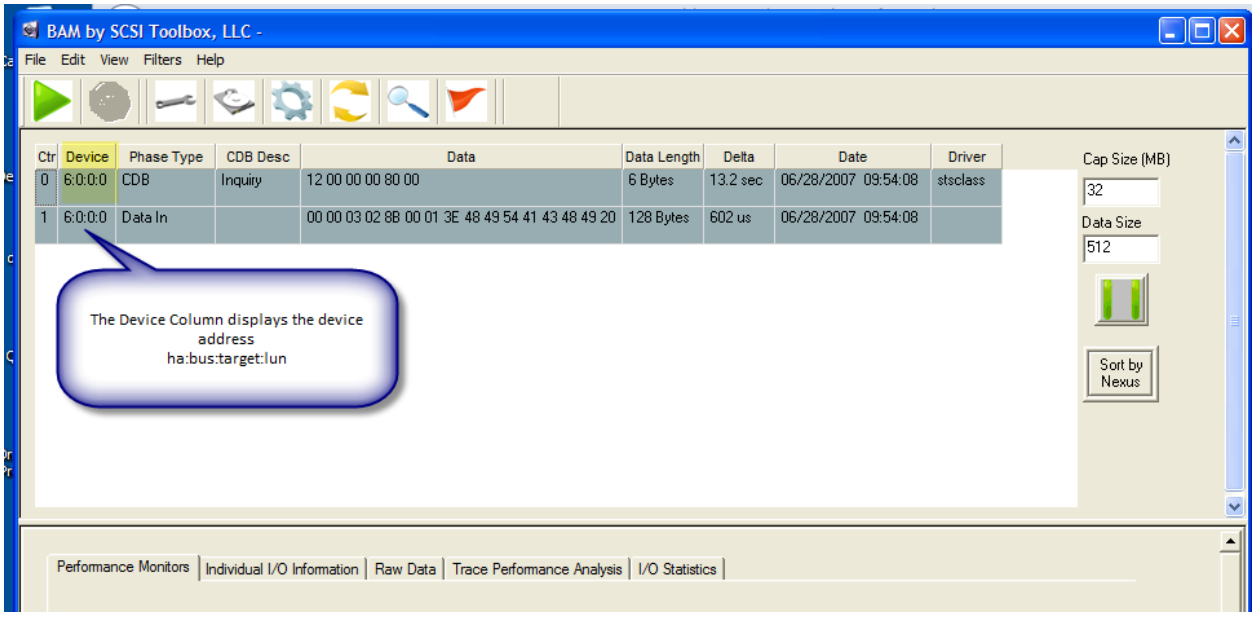
Stopping a trace capture



Explanation of captured data columns

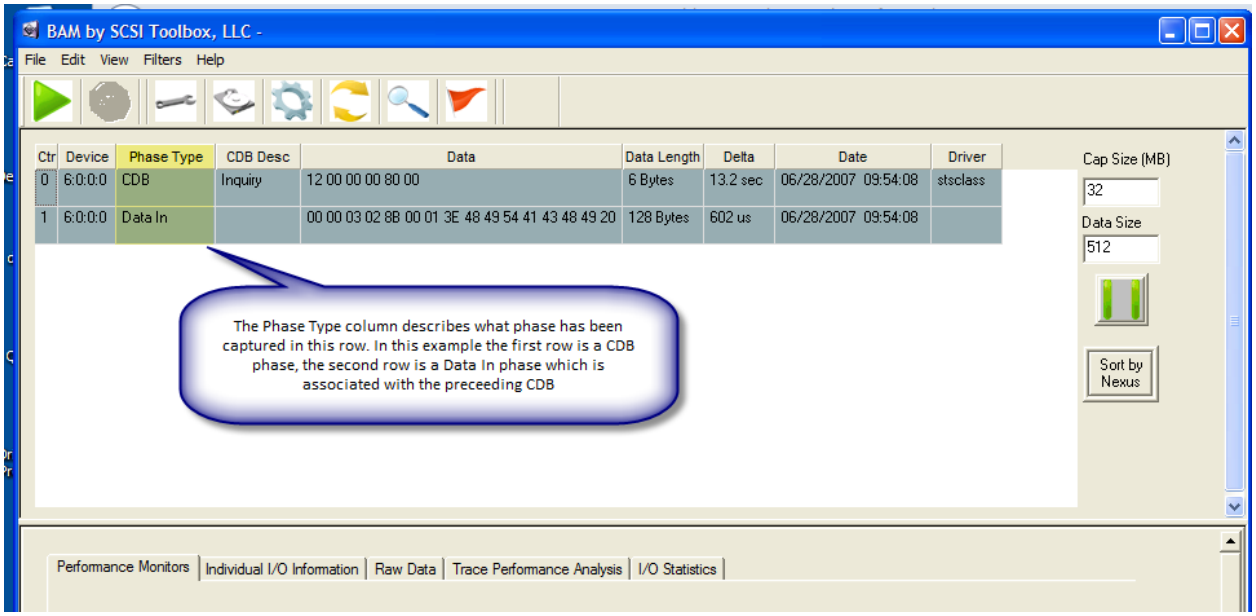
The Device Column

The device address associated with this phase is displayed as ha:bus:target:lun



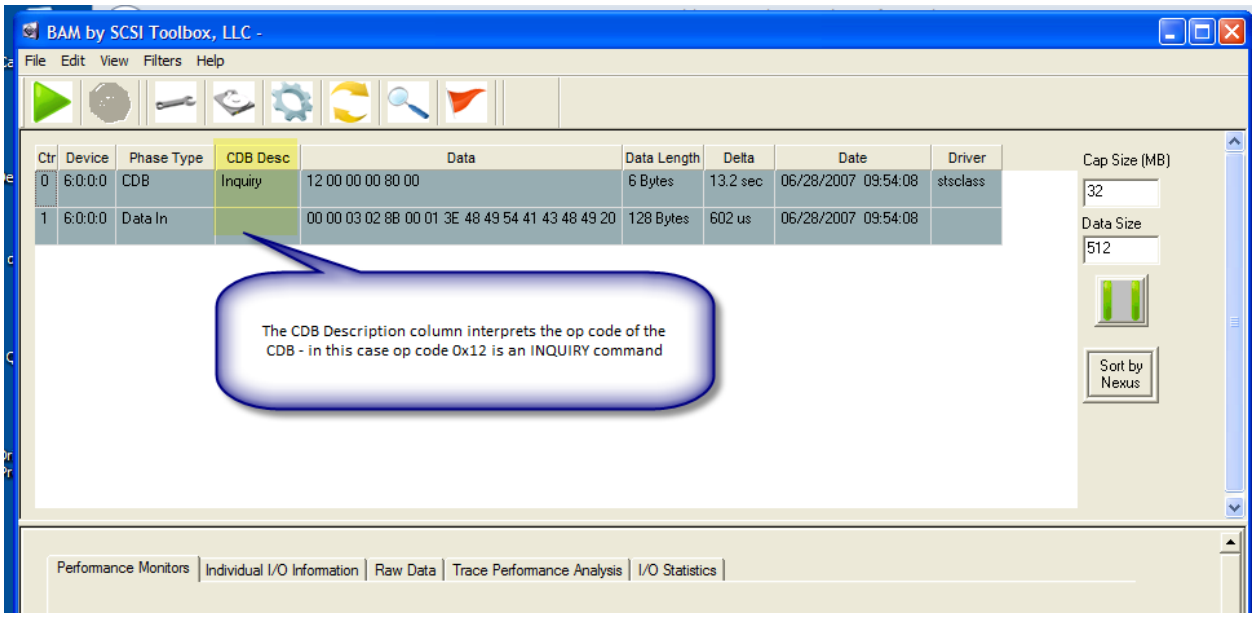
The Phase Type Column

The type of this phase is shown here, such as CDB, SRB, OK, Data In, Data out, etc. Depend on which phases you set for capture.



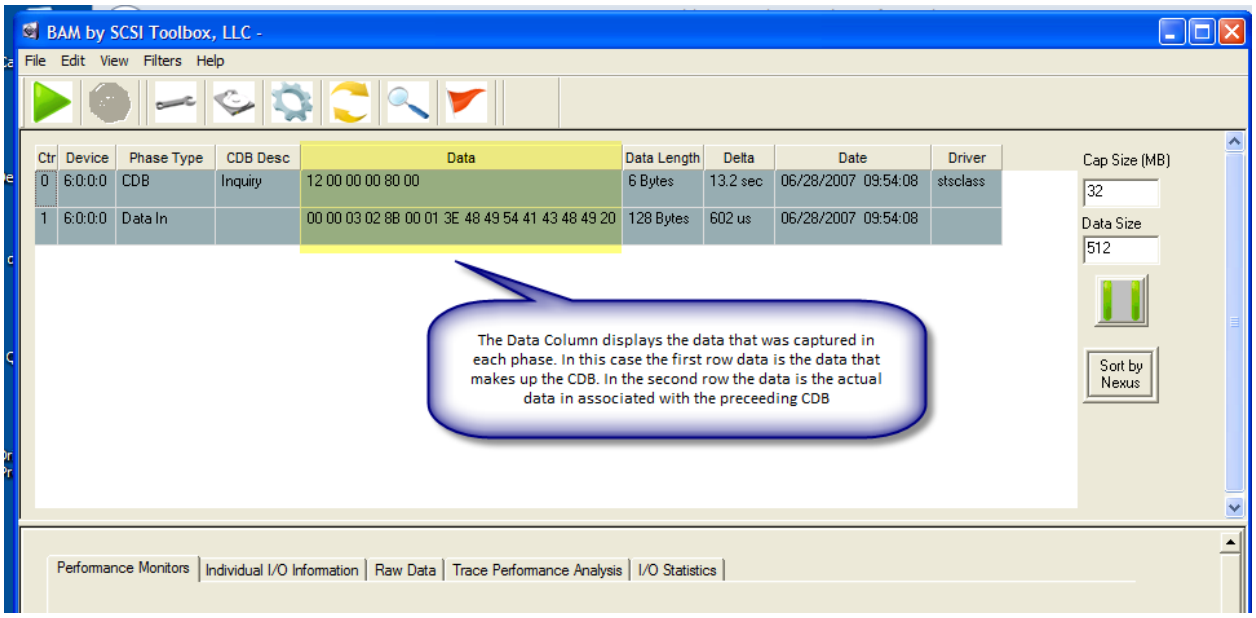
The CDB Description column

The text name of the CDB is displayed here, based on the op code of the CDB data



The Data Column

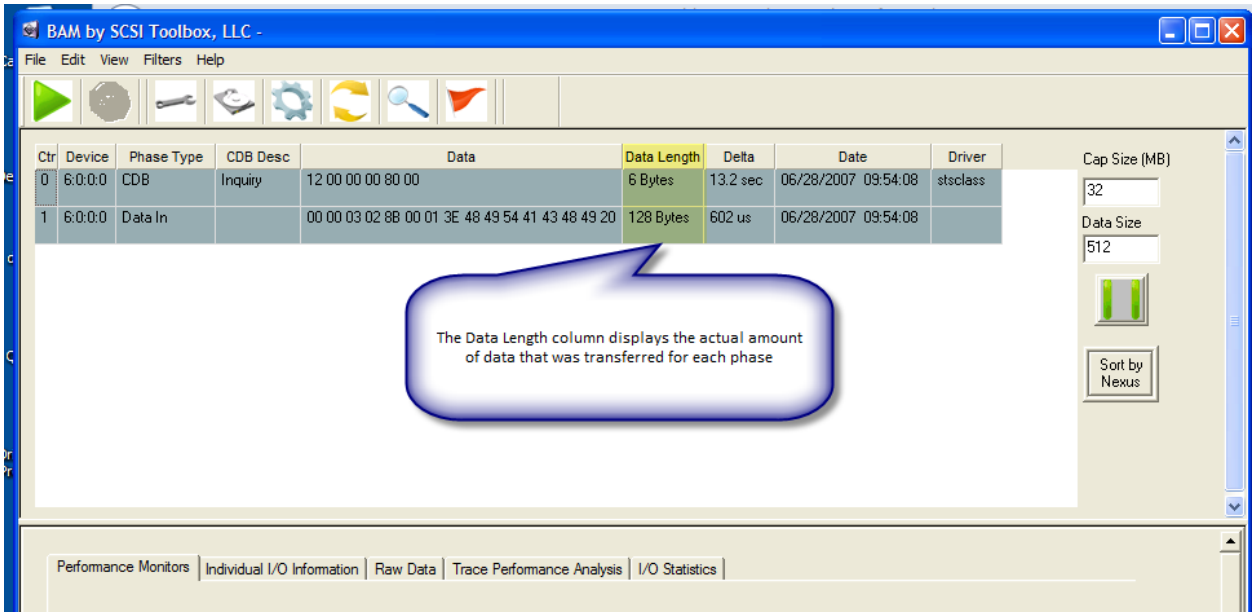
Data associated with the phase type will be displayed here. In the case of this example the first row data is the CDB data, the second row data is Data In phase data. This data will depend on the phase type – CDB, SRB, ATA, Data In, Data Out, etc.



Note that more detail is available by using the ***Individual I/O Information*** tab, which will be explained later.

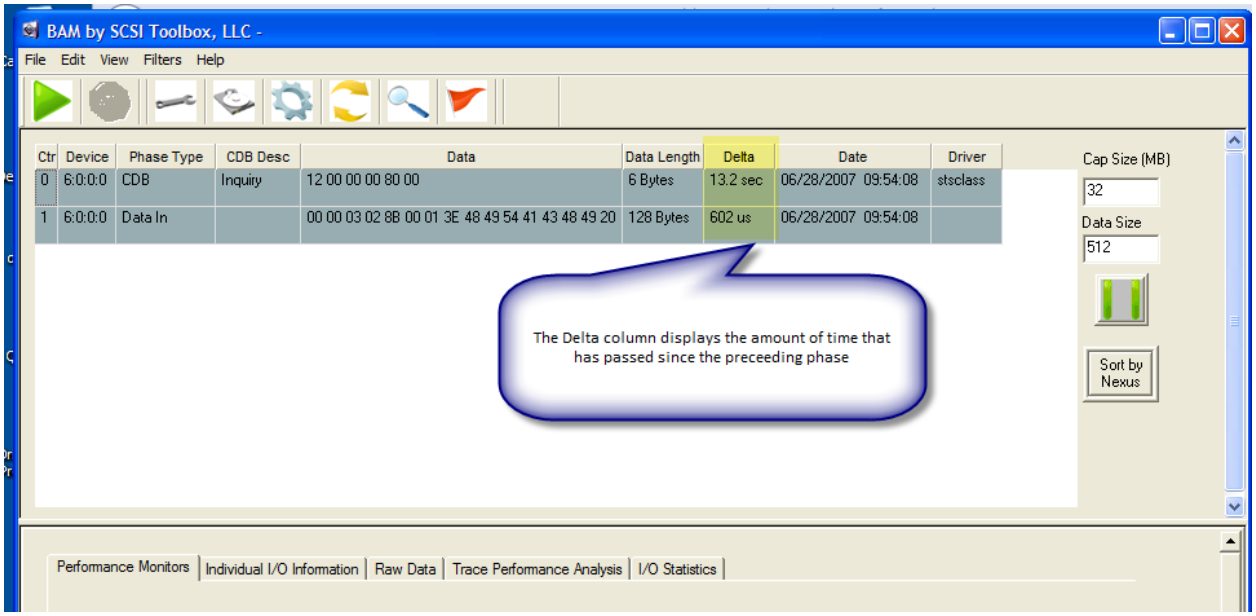
The Data Length column

The actual number of bytes transferred in the phase is displayed here



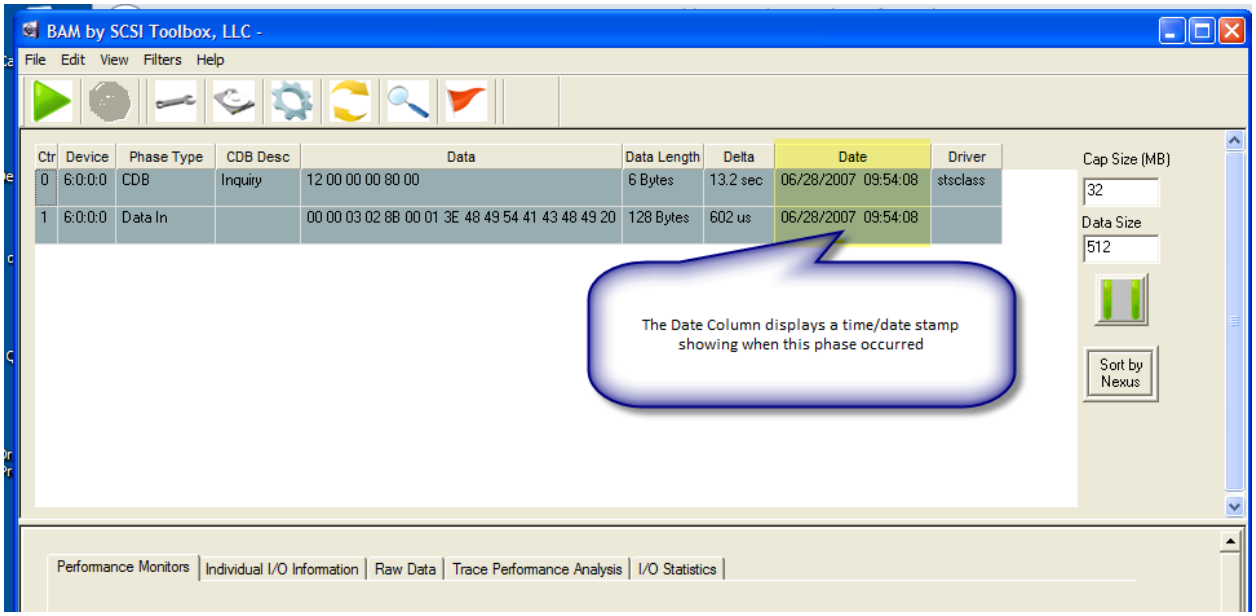
The Delta Time column

The time delta between this phase and the previous phase is displayed here.



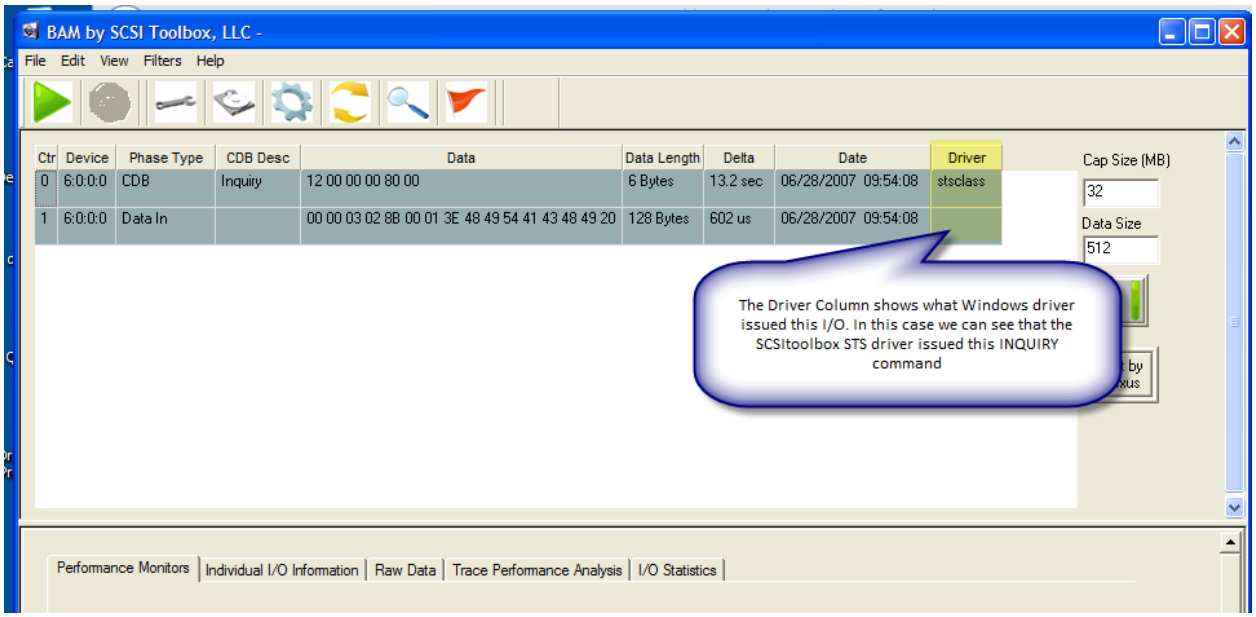
The Date Column

A time/date stamp is displayed here



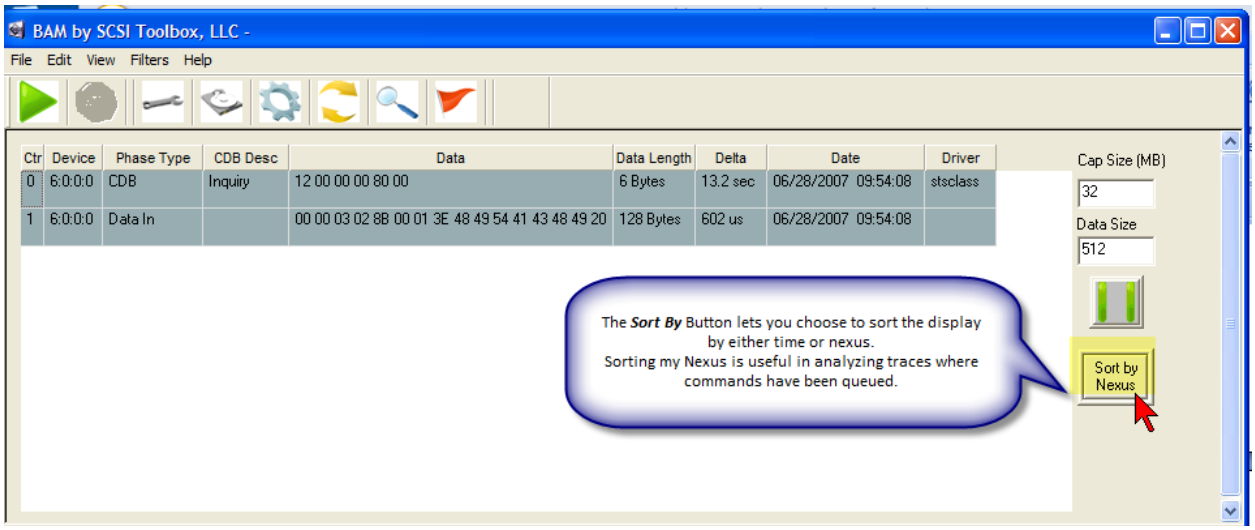
The Driver Column

The name of the Windows driver that generated this I/O is displayed here. This can be very useful to see if the I/O came from a source that you expected it to come from, or is the I/O and “intrusion” by another driver such as plug and play, or a device status monitoring application.



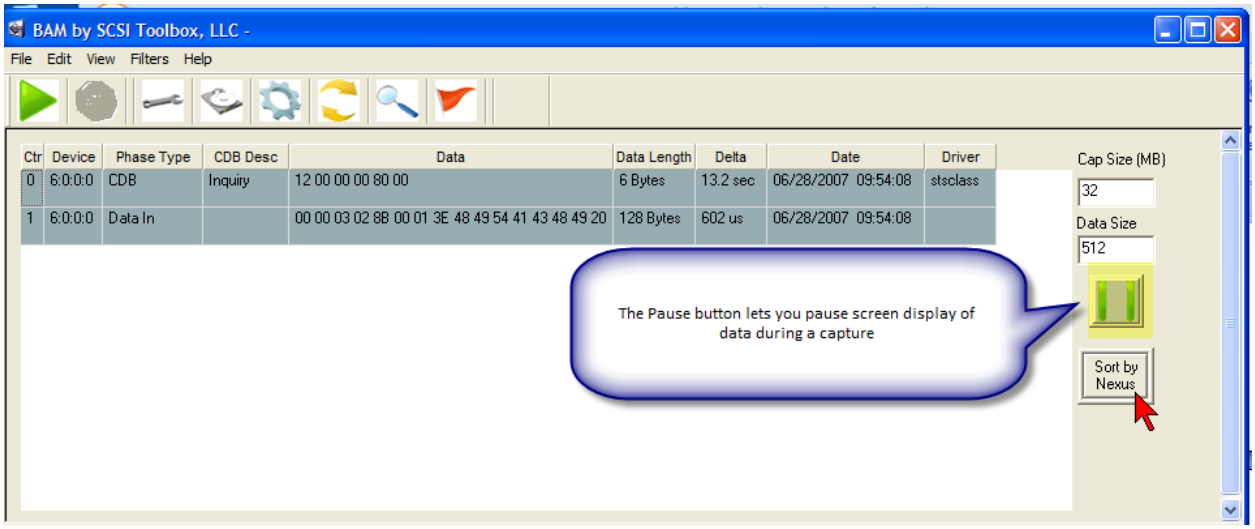
Sort by Time or Sort by Nexus

You can choose to sort the contents of the trace data window either by time (default) or by nexus. Sorting by nexus can be useful when tracing commands and data phases when command tag queuing has occurred.



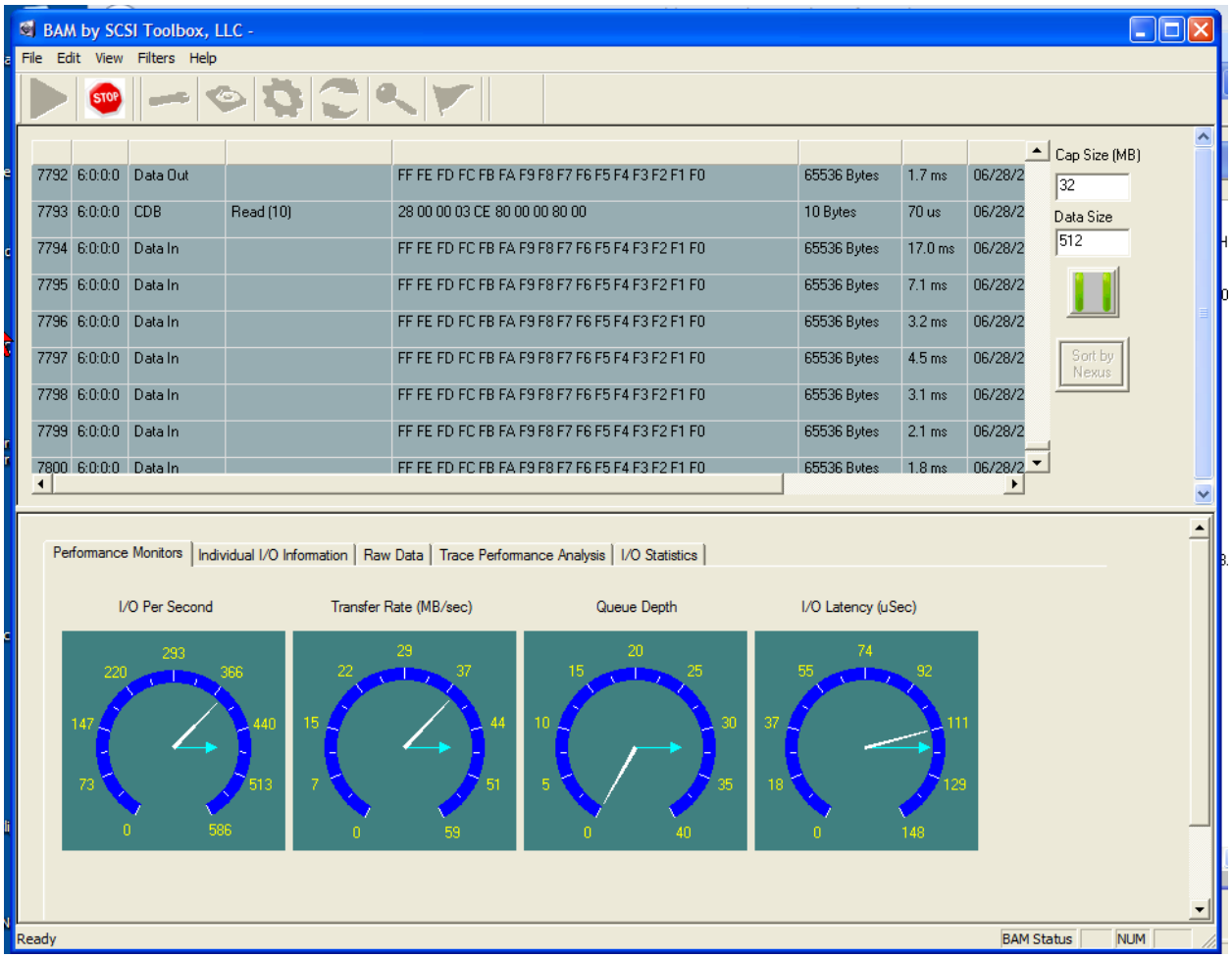
The Pause Display button

Clicking this button will pause scrolling of the trace data display while a trace capture is in progress.



The Lower Screen

The lower section of the main BAM screen is used for real-time performance monitoring during capture, and for detailed post capture analysis.

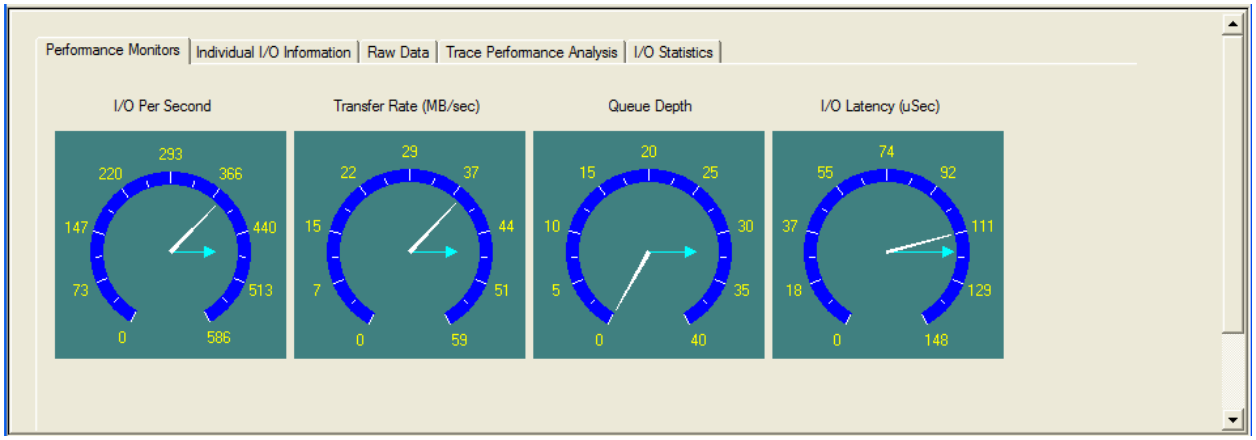


The Performance Monitors

These speedometers show real-time performance information during a trace capture. The smaller blue pointers will record the highest value encountered, while the longer white arrow displays an average value.

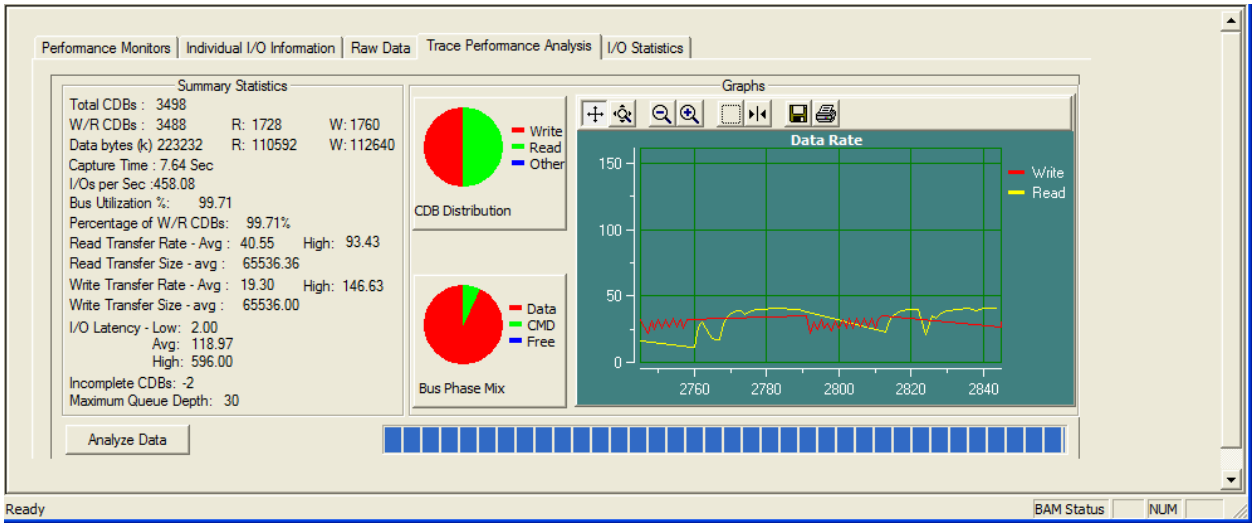
Some things to note in this example:

- During this capture there was a maximum of 32 outstanding queued commands
- The highest (burst) data transfer rate was around 46 MB/sec, the average was 37 MB/sec
- The I/O latency – the time between I/O's was fairly constant



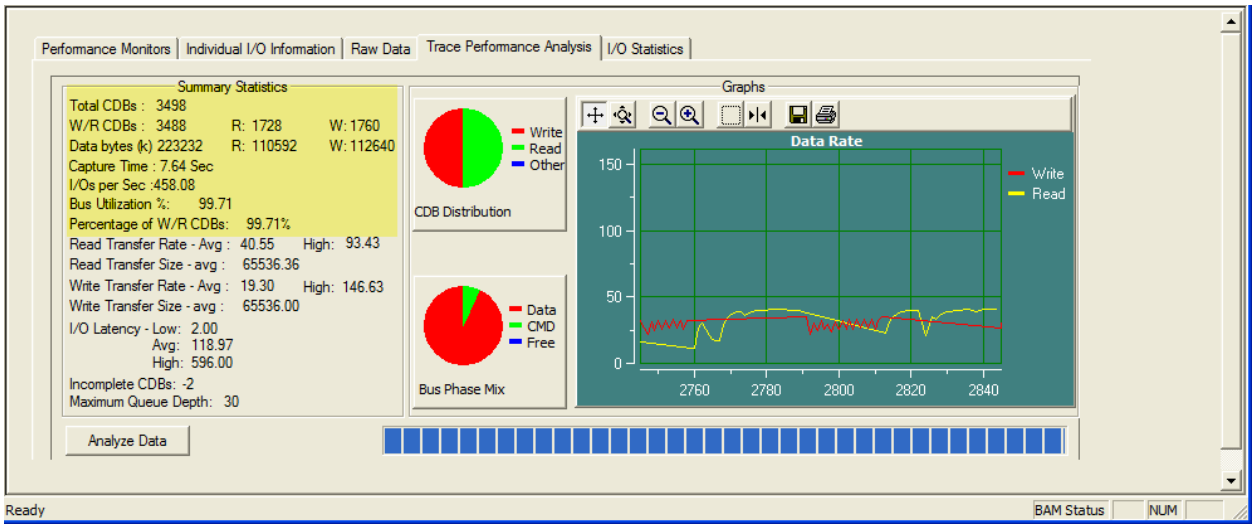
Trace Performance Analysis

This tab displays a summary analysis of the trace capture session. Number and type of commands, bus bandwidth utilization, etc.



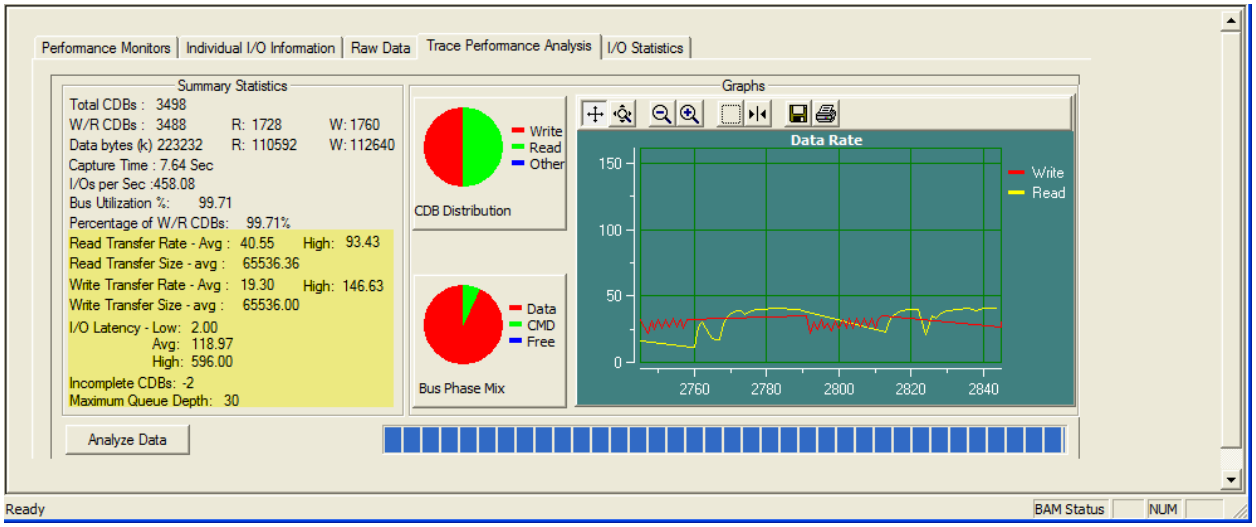
General Statistics

Number and type of commands, how much data was transferred in each direction, number of I/O's per second, bus bandwidth percentage, etc



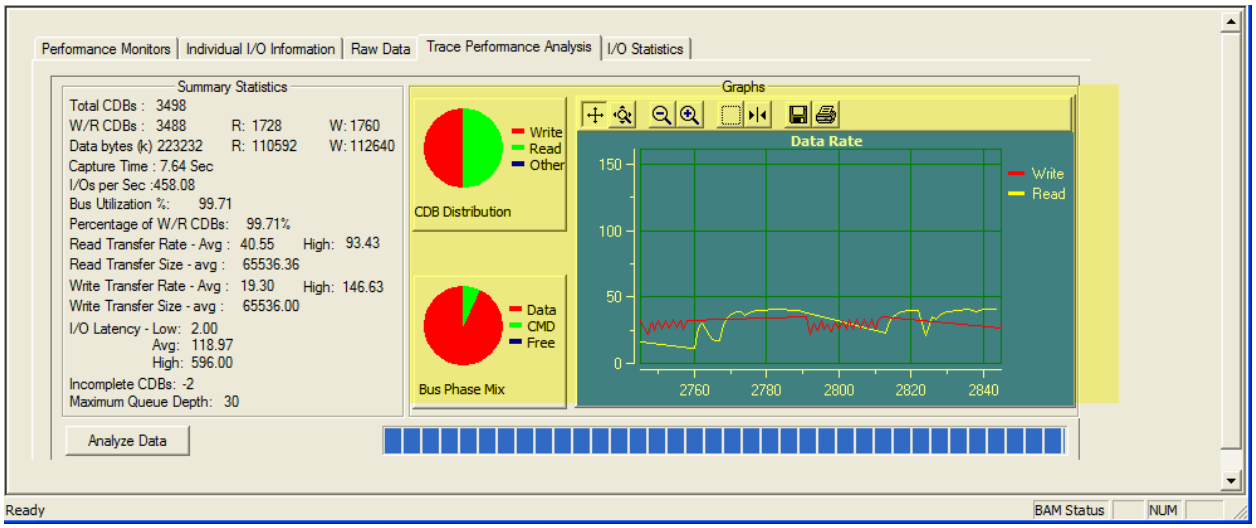
Performance statistics

Data transfer rates for both directions, with average and high transfer rates. Low, Average, and High I/O inter-command latency, maximum queue depth, and number of incomplete commands in this capture.



Graphs

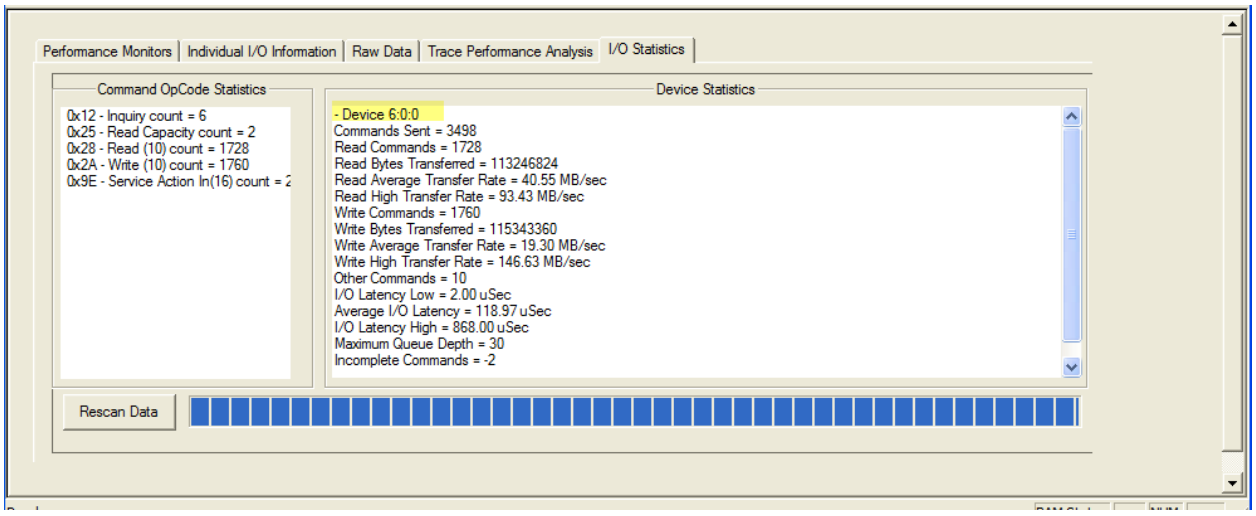
Command type mixture, phase mixture, and read and write transfer rates are graphed



The I/O Statistics tab

A detailed report is collected for each device, showing number of commands, each command that was captured and how many of them occurred, plus transfer rate statistics.

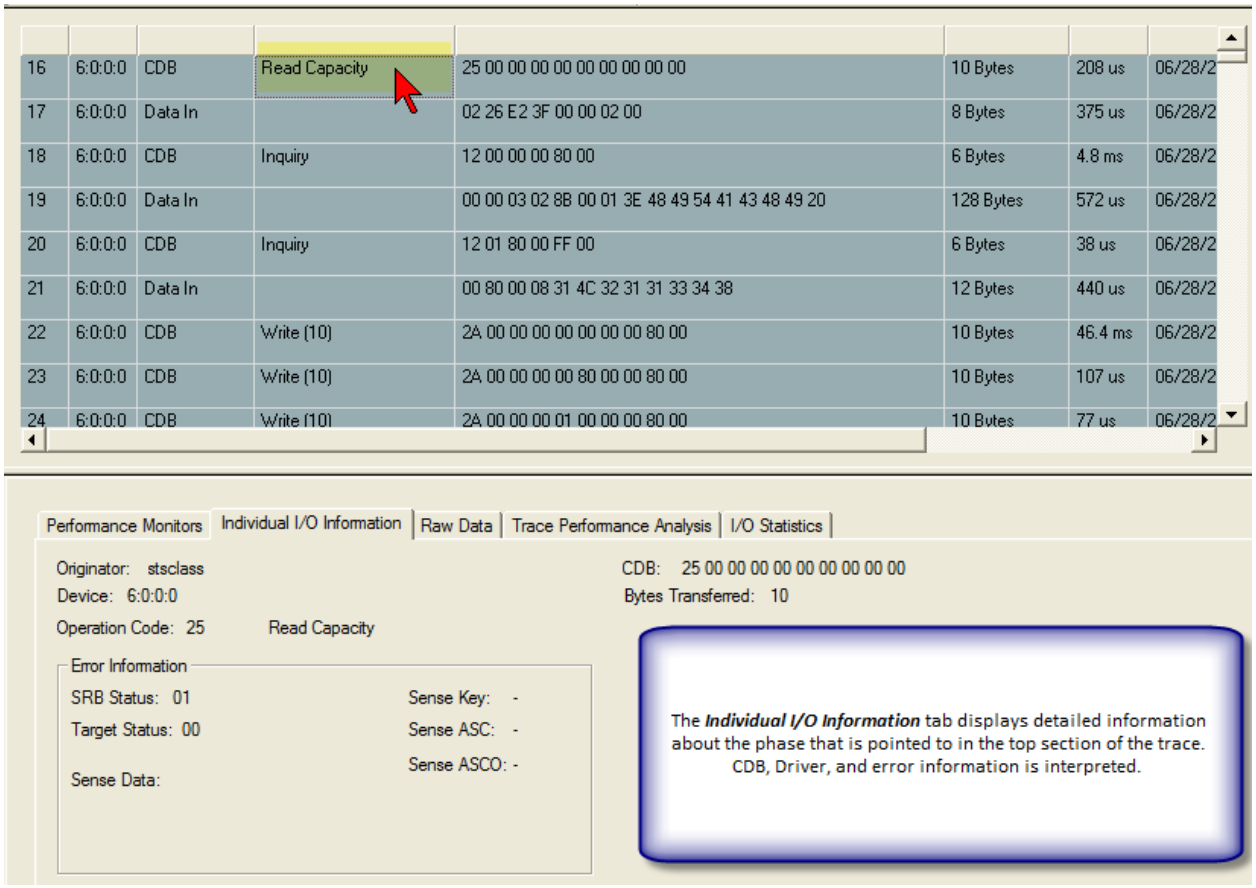
If the trace contains data from multiple drives each drive will have it's own summary – just scroll down to see more.



Statistics for each device are shown – if multiple device data was captured this screen will scroll to show the summary for each device

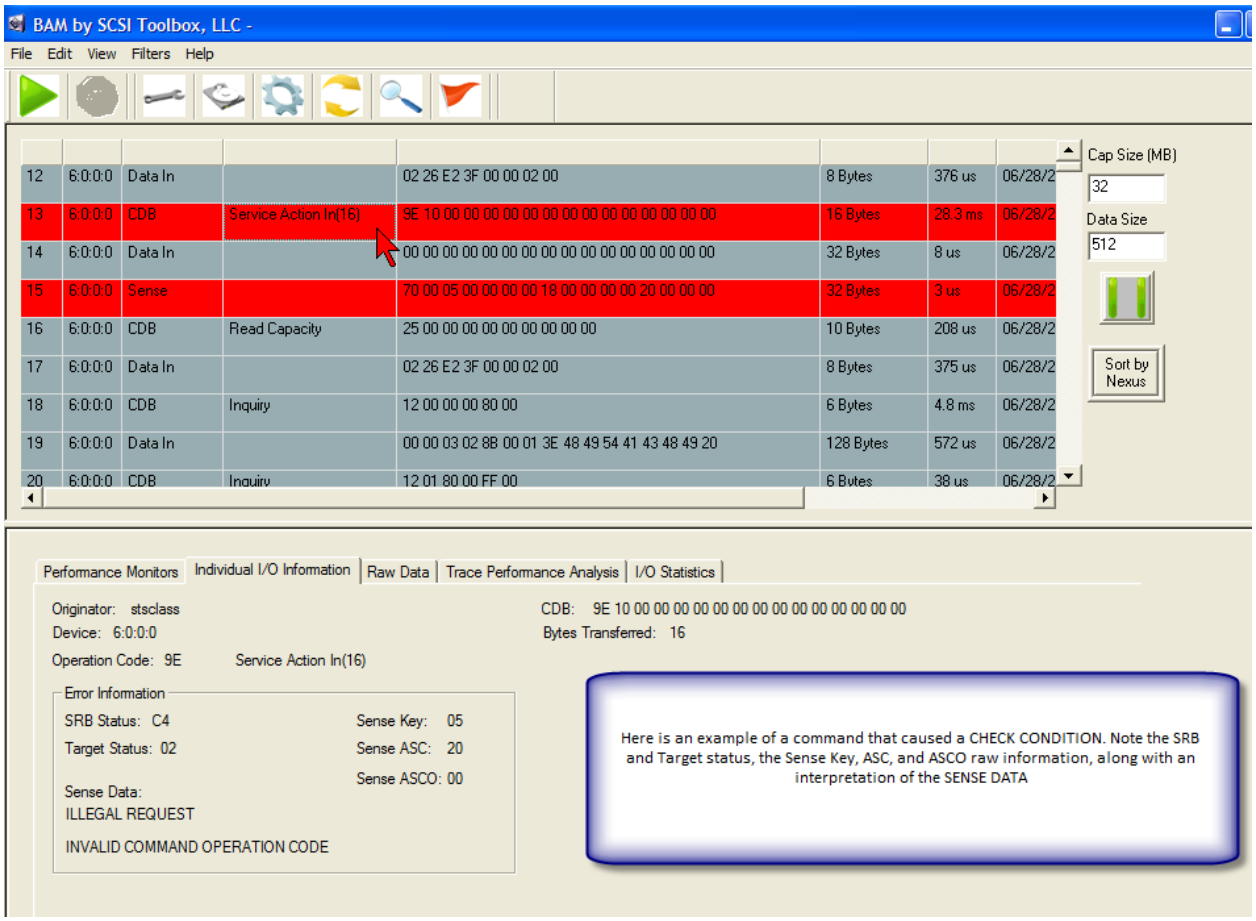
Individual I/O Information Tab

This tab lets you select a command from the trace data display and see a detailed description of the command.



An example of a CHECK CONDITION

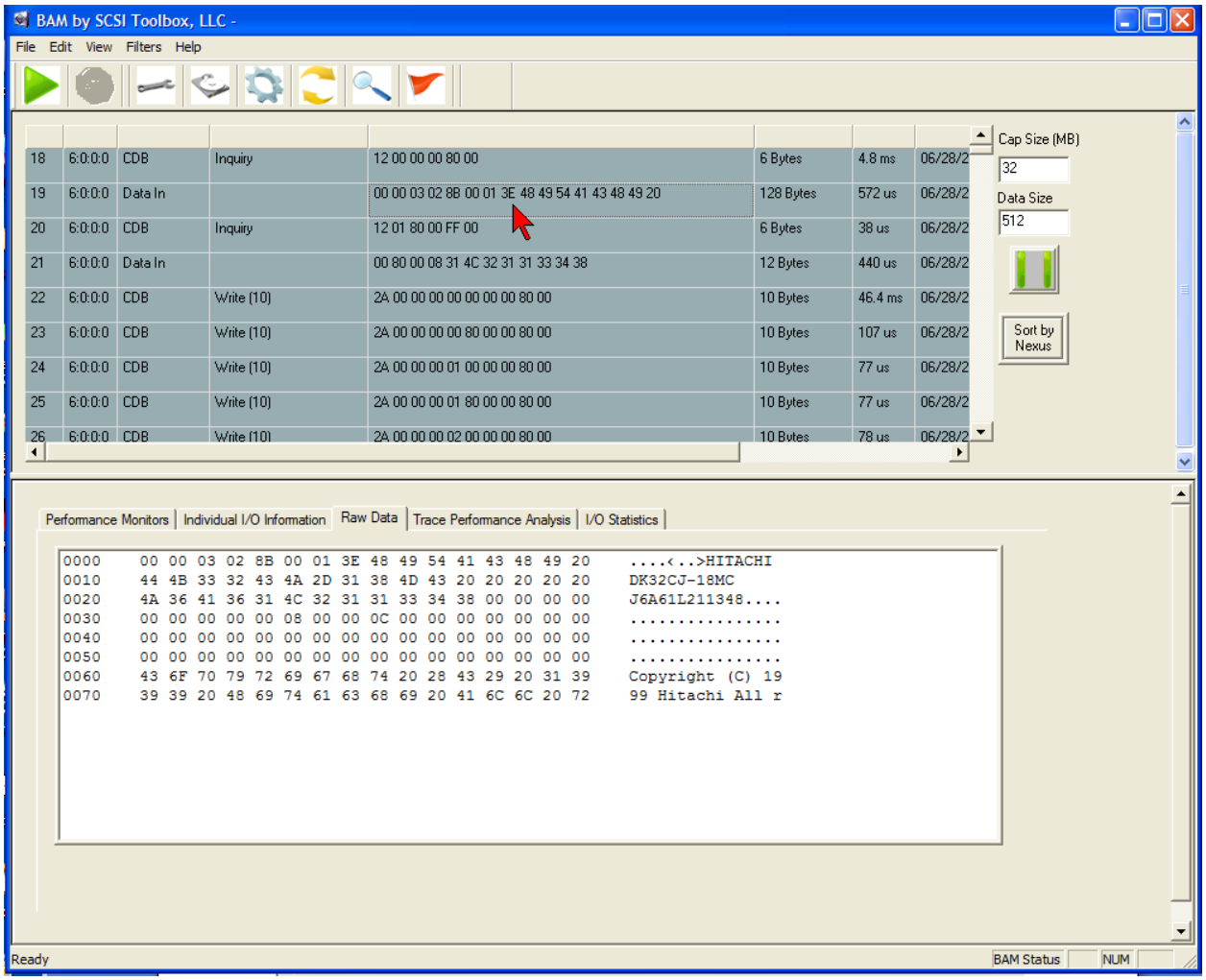
When a CHECK CONDITION occurs you will see the error data details in this tab.



Note that error conditions are easy to find because they are displayed in RED

The Raw Data Tab

Click on a phase in the trace data display and see the raw numerical data in this tab



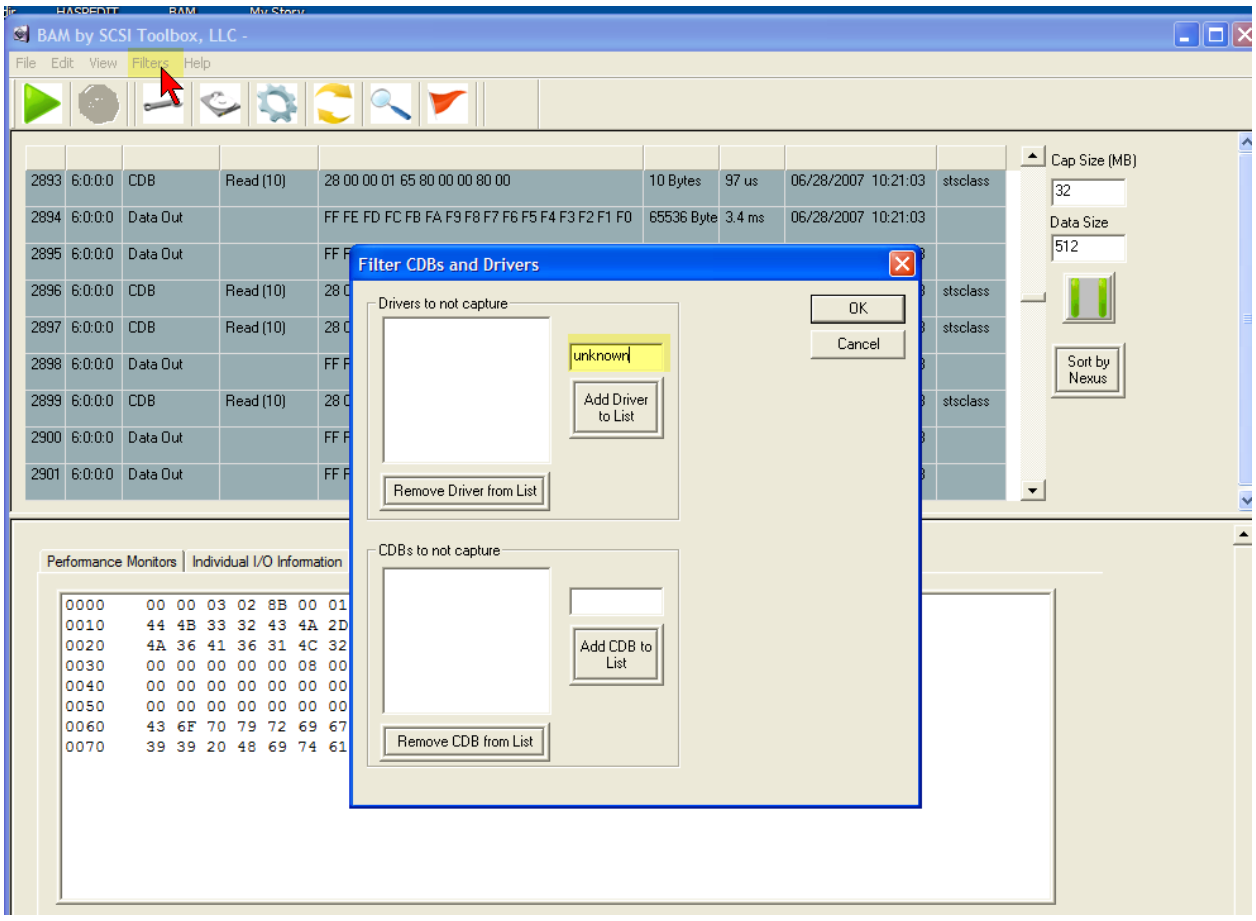
Note that the trace data displays truncates the amount of data seen – the Raw Data tab allows you to view all phase data, in this case 128 bytes of INQUIRY data

Filters

Capture data may be filtered by Driver Name or by CDB Op Code.

In this example we will specify that we want to ignore any I/O generated by any driver identified as “unknown”. Driver filtering is useful to filter out I/O from backup services, plug and play, etc

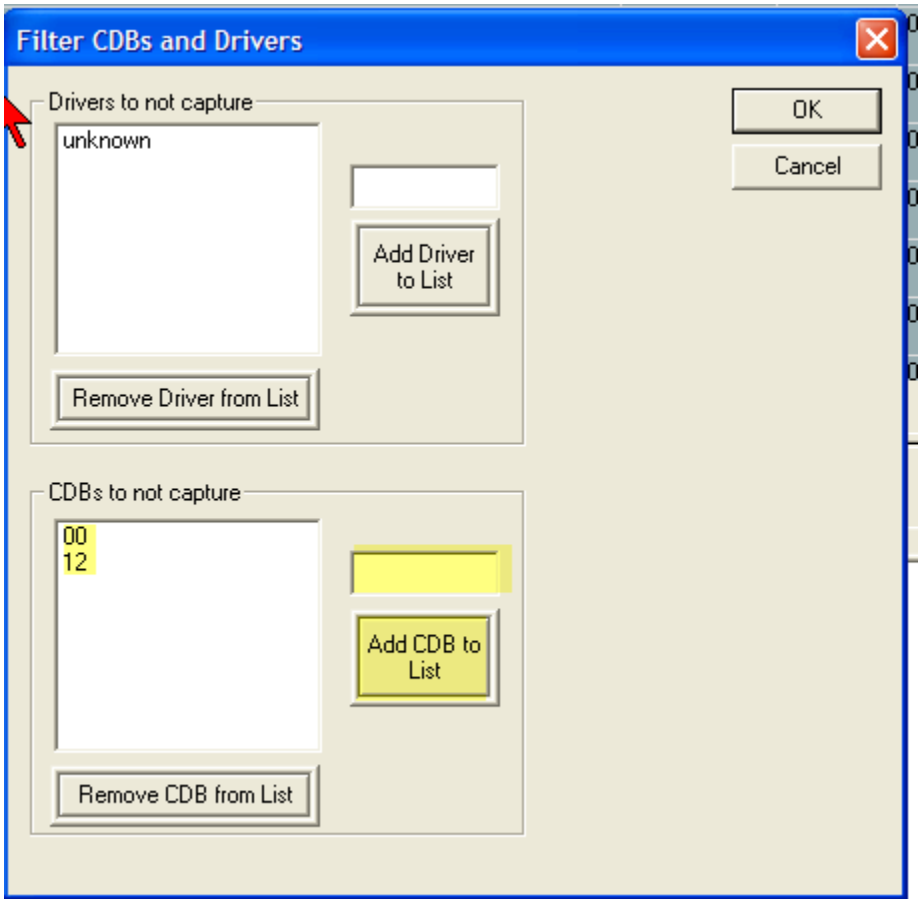
Filtering by Driver Name



Just enter the driver name and click Add Driver to List as highlighted above

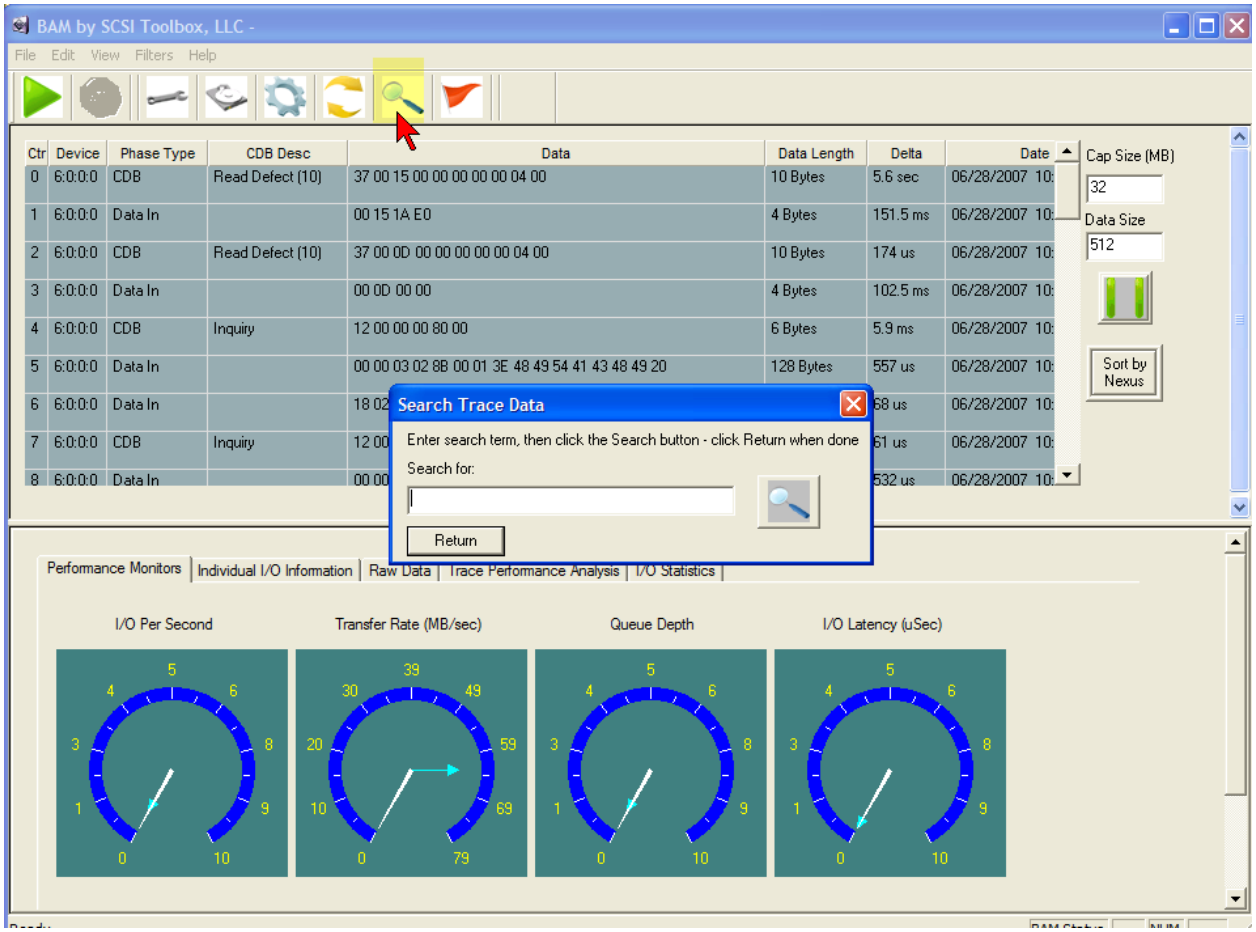
Filtering By CDB op code

Filtering CDB's is as easy as specifying the CDB op code that you wish to ignore – in the example below we have chosen to filter out TEST UNIT READY (op code 0x00) and INQUIRY (op code 0x12)



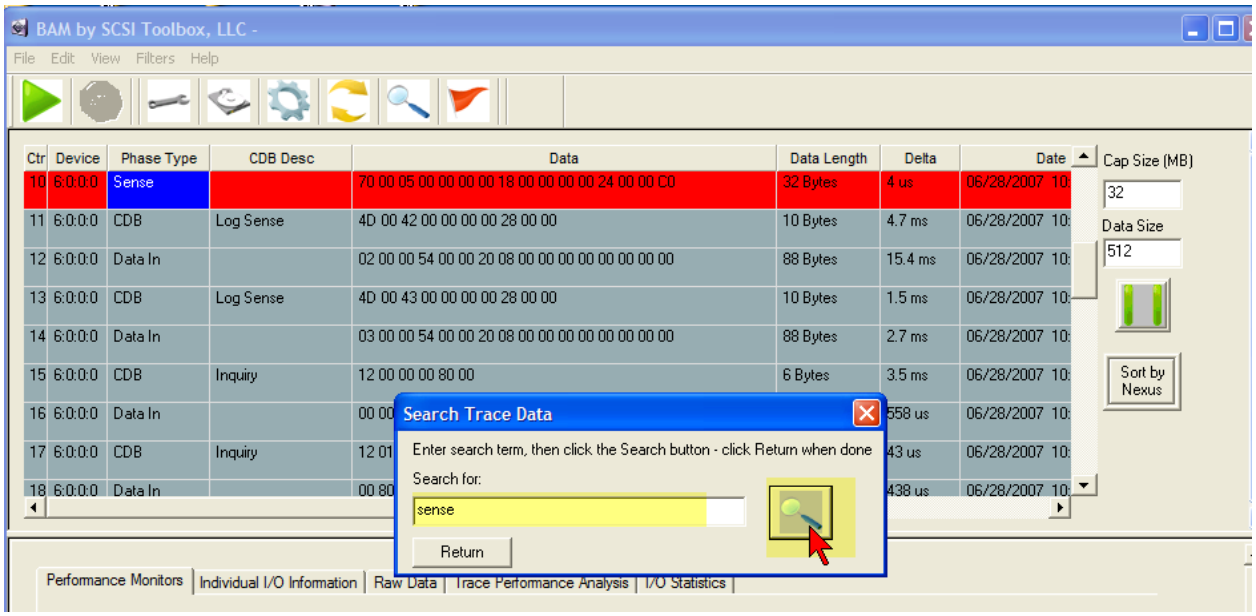
Searching Trace Data

Click on the Magnifying Glass icon to search through trace data.

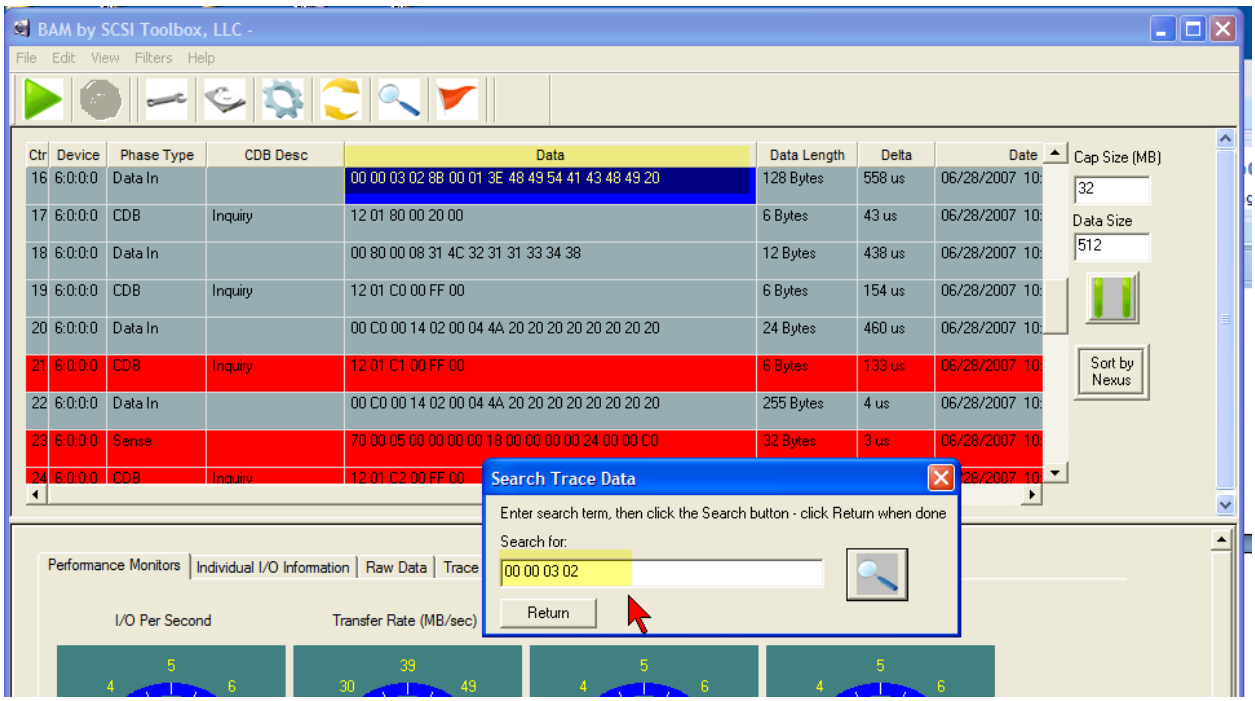


For example, to search for a SENSE data phase, enter sense in the search for: box, then click the Magnifying Glass icon to search.

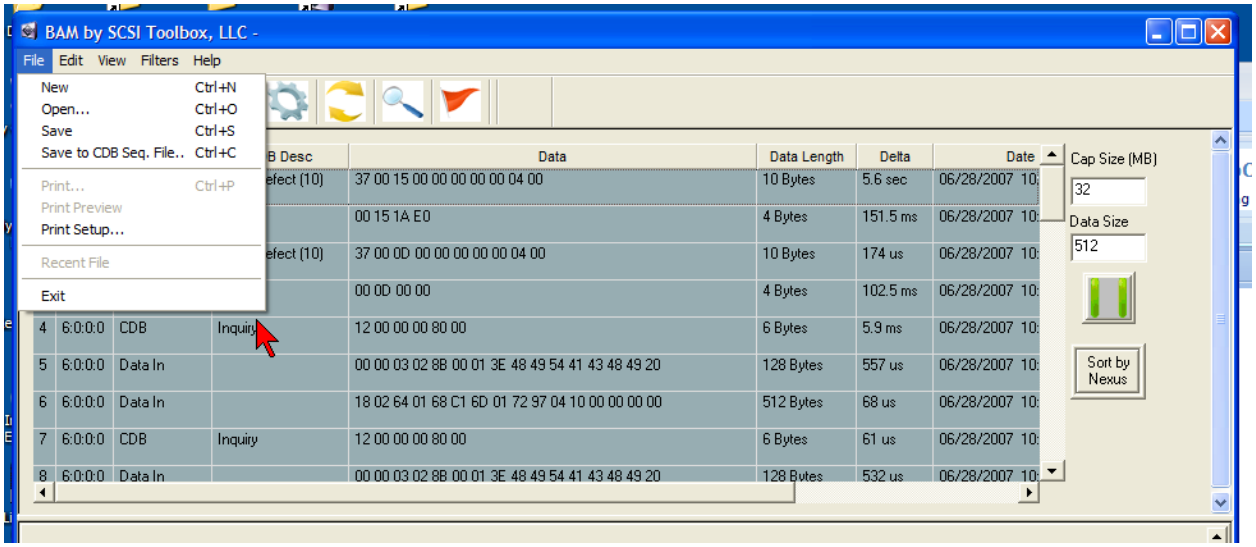
The trace data display will be positioned at the first occurrence of the search word. Click the Magnifying Glass icon to search for the next occurrence.



You can search for any data – in the example below we search for the sequence of bytes " 00 00 03 02"



The File Menu



Allows you to save a trace file, open a previously saved trace file, or save the capture session to be played back later using the SCSItoolbox32 CDB Sequencer.

Trace data will be saved with a default file extension of “.bam”, and CDB Sequencer files will be saved with a default file extension of “.his”