



SCSI*toolbox*[™] 32



**Bus Analyzer Module
User Guide**

July, 2007

Copyright © 2003, 2004 SCSI Toolbox, LLC.
All rights reserved.

Introduction	4
Starting BAM	6
From the desktop icon	6
From within STB32	6
The BAM User Interface	7
The Main BAM Screen.....	8
Selecting Device(s) to monitor	9
The Device Selection menu.....	10
The Phase Selection Menu.....	15
Display column setup.....	19
Switch mode selection	20
Setting Capture Buffer Size and Data Size per I/O	21
Starting a trace capture	22
Stopping a trace capture.....	22
Explanation of captured data columns	23
The Device Column	23
The Phase Type Column.....	24
The CDB Description column	24
The Data Column	25
The Data Length column	26
The Delta Time column	27
The Date Column	28
The Driver Column	29
Sort by Time or Sort by Nexus	30
The Pause Display button	30
The Lower Screen.....	31
The Performance Monitors.....	32
Trace Performance Analysis.....	33
General Statistics	34
Performance statistics	34
Graphs.....	35
The I/O Statistics tab.....	35

Individual I/O Information Tab	37
An example of a CHECK CONDITION	38
The Raw Data Tab	39
Filters.....	40
Filtering by Driver Name	40
Filtering By CDB op code.....	41
Searching Trace Data	42
The File Menu	44

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.

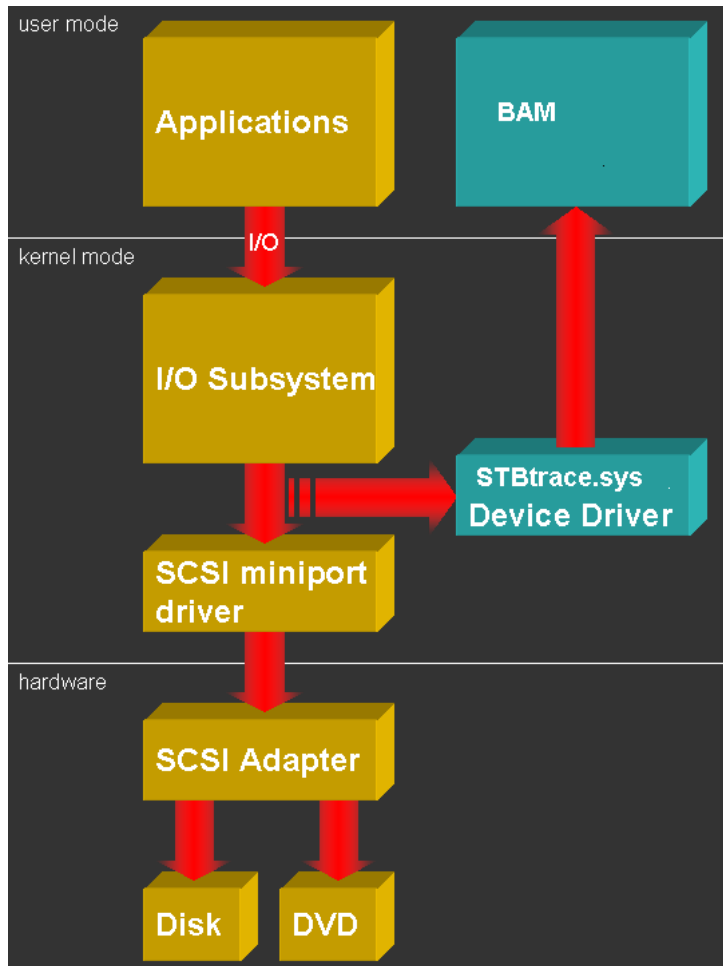
BAM is perfect for viewing commands and data sent between your host computer and your storage devices. It can help you quickly determine if the commands you think are being sent are indeed, as well as confirming that your storage device is responding as expected.

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

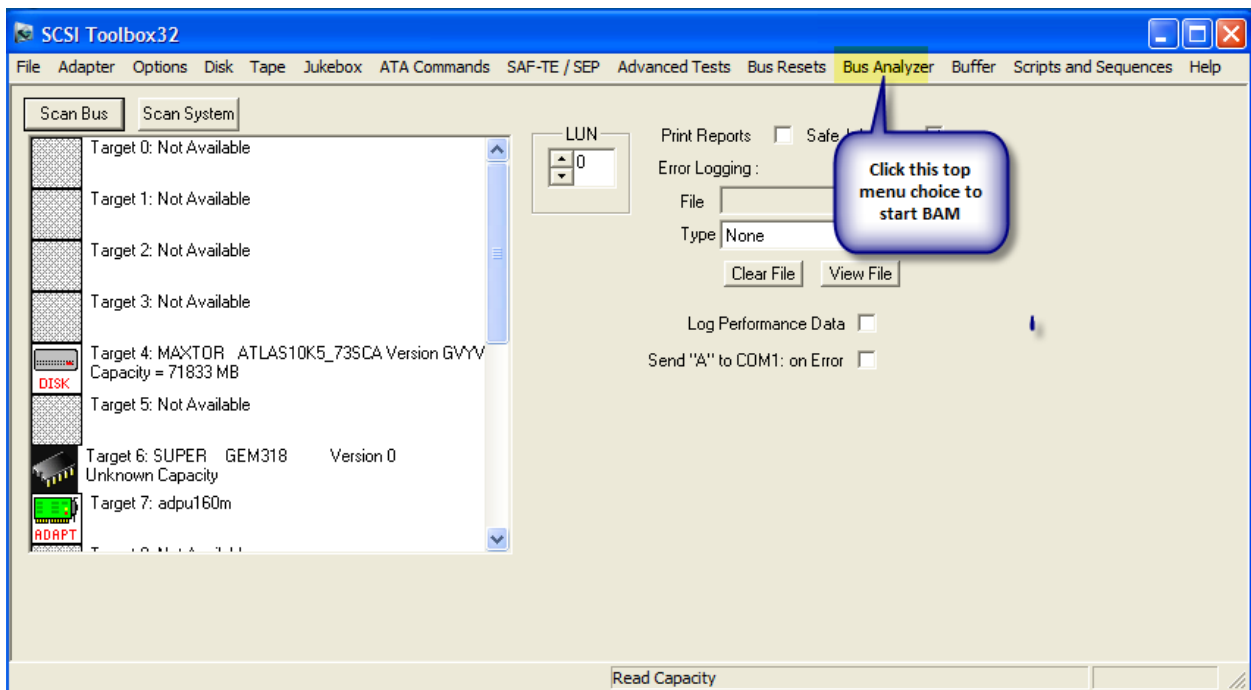
From the desktop icon

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

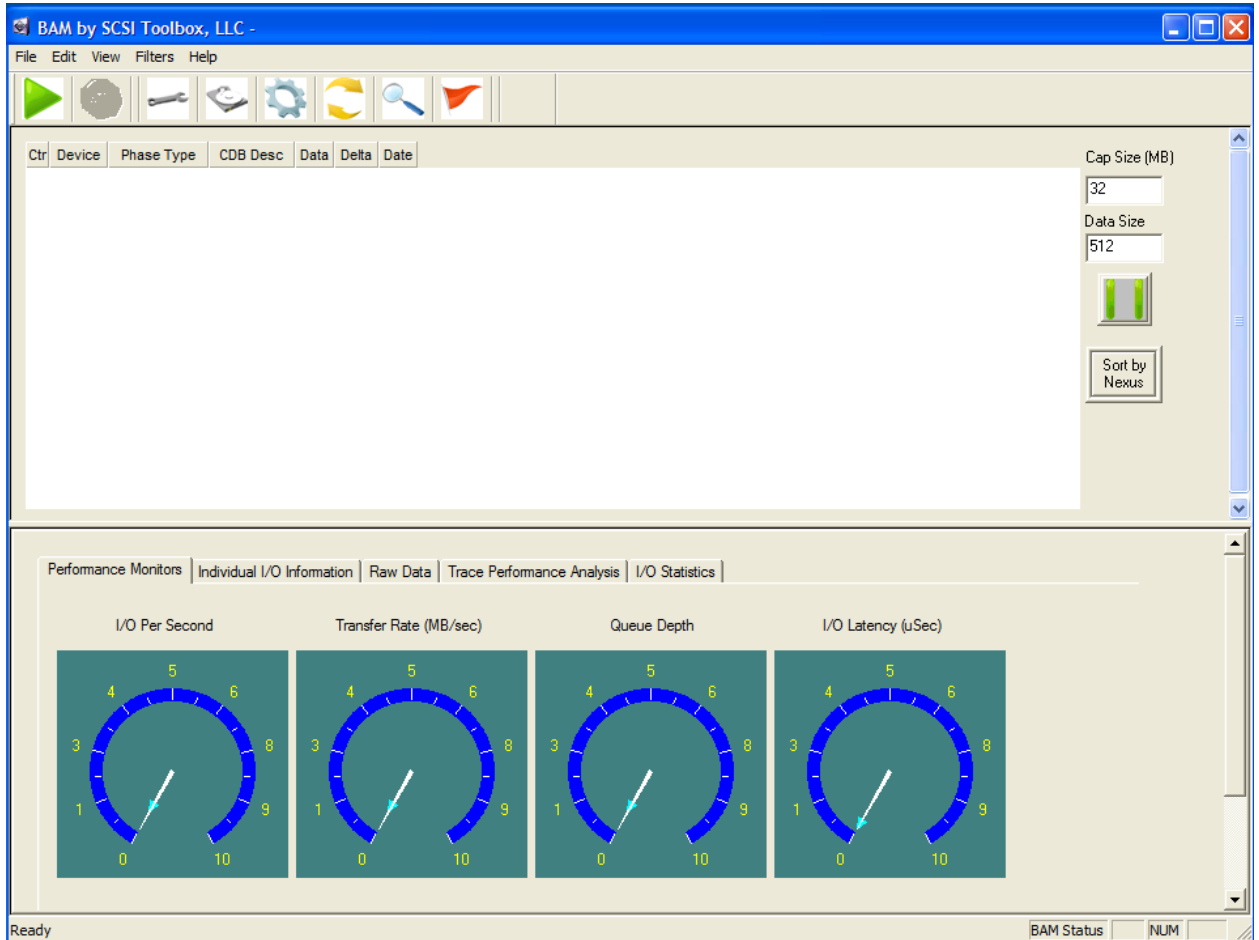
The main screen of BAM is shown below – in this section we will discuss how to :

- 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

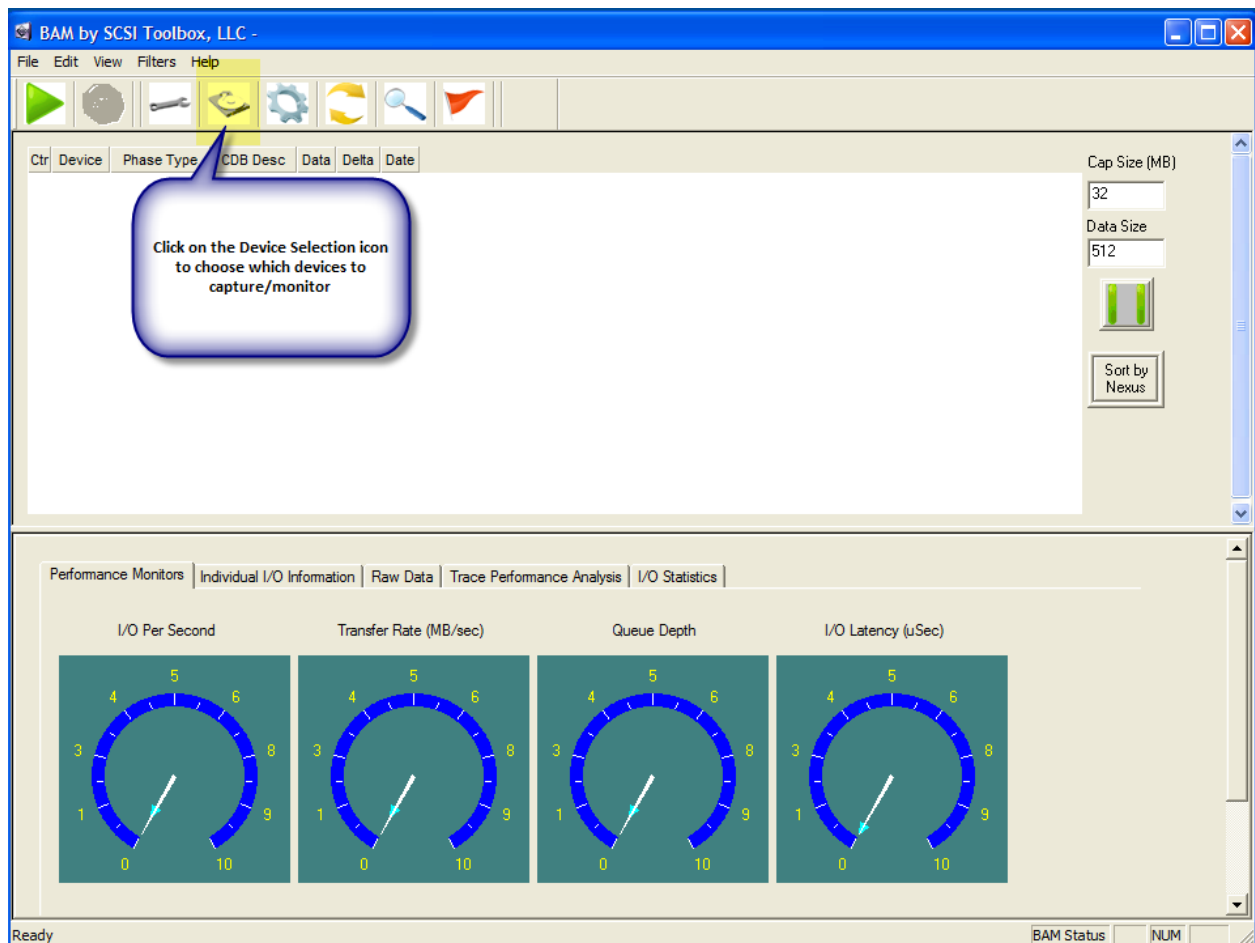
Once you launch BAM you will see the screen below. You will first need to select a device to capture trace data from.



Selecting Device(s) to monitor

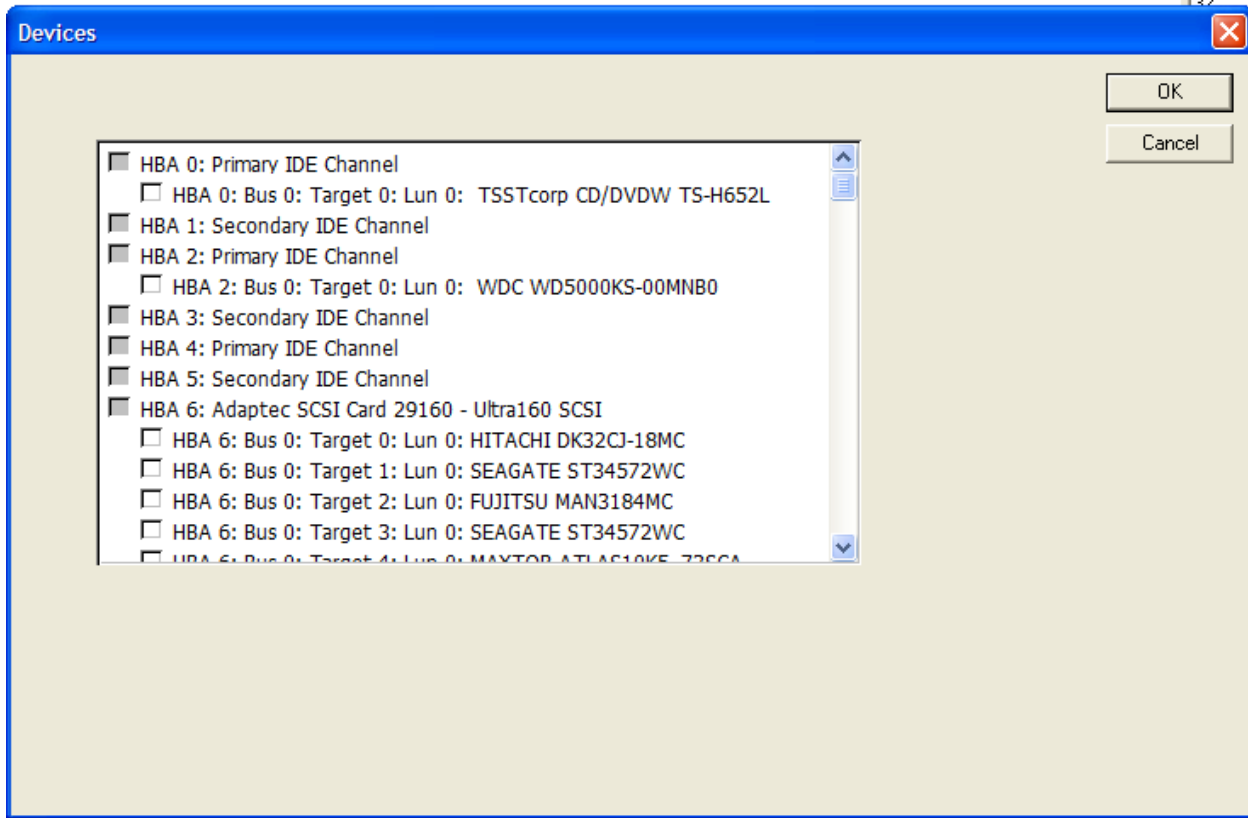
Use the Device icon to select what devices you wish to monitor. Note – in Performance Mode you are only allowed to select one device. Also, if you are planning to record the I/O session for later playback with the SCSI toolbox 32 CDB Sequencer you will also want to select only one device.

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

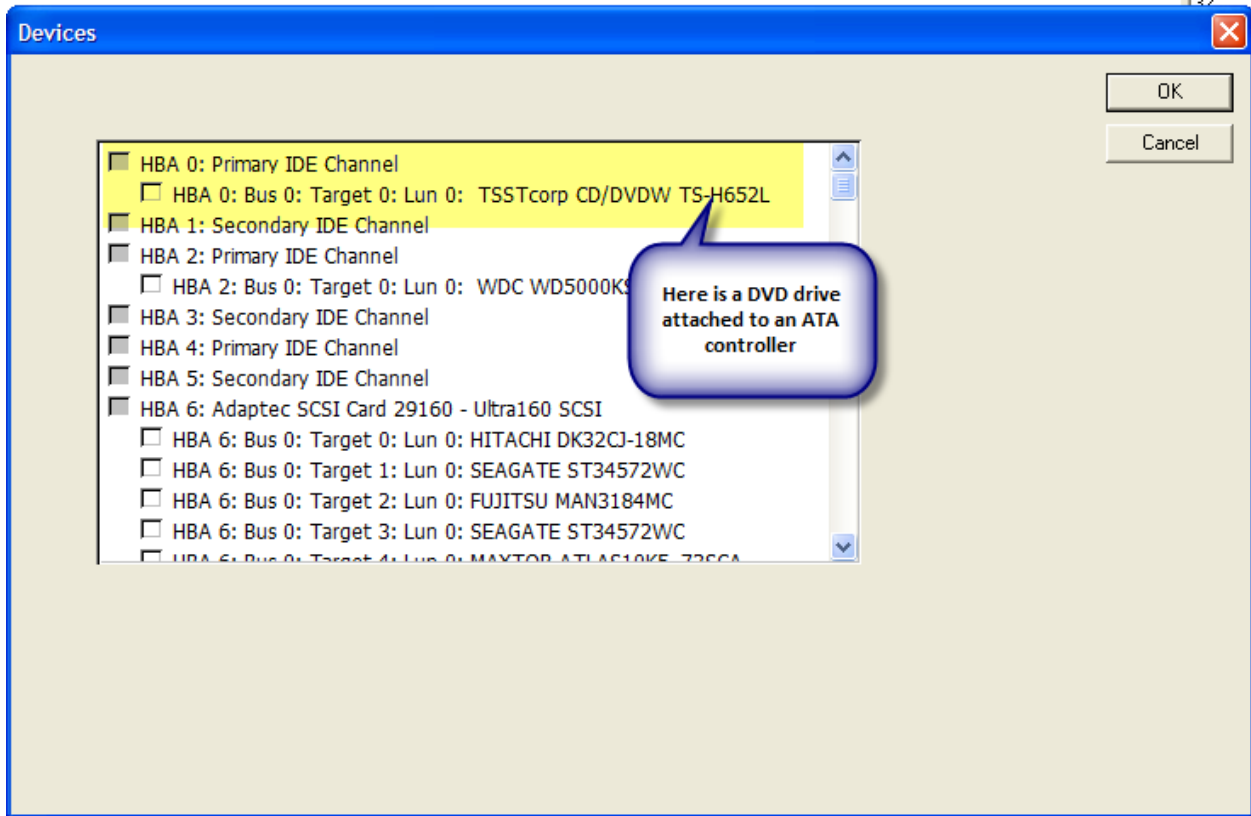


The Device Selection menu

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

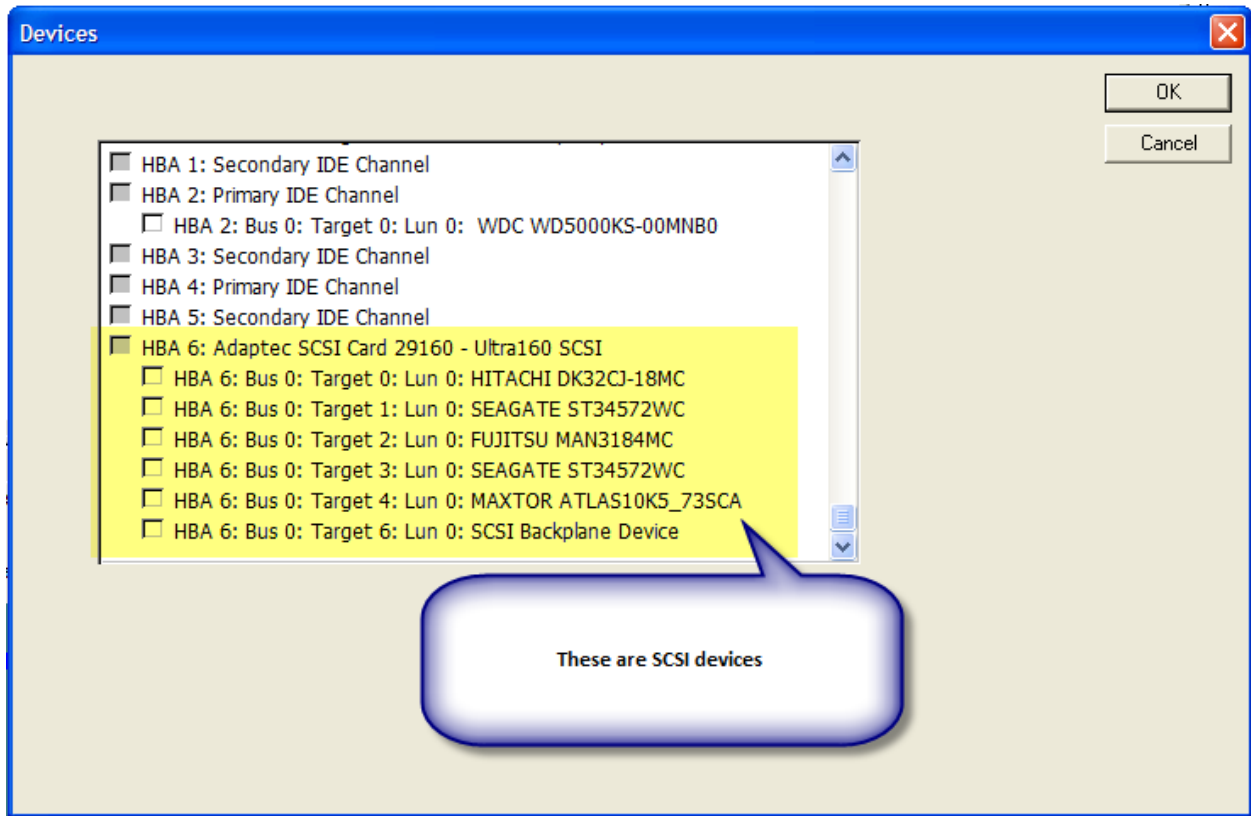


OK

Cancel

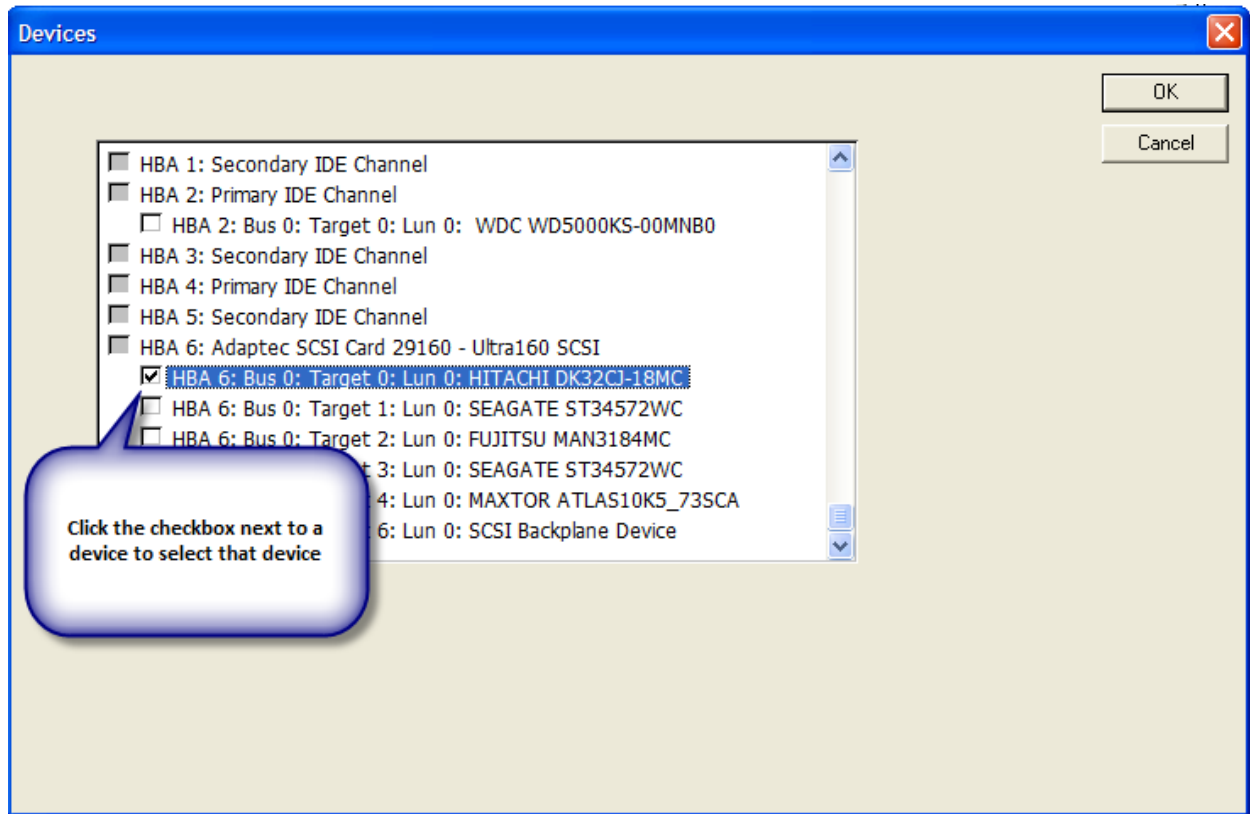
- HBA 0: Primary IDE Channel
 - HBA 0: Bus 0: Target 0: Lun 0: TSSTcorp CD/DVDW TS-H652L
- HBA 1: Secondary IDE Channel
- HBA 2: Primary IDE Channel
 - HBA 2: Bus 0: Target 0: Lun 0: WDC WD5000KS-00MN80
- HBA 3: Secondary IDE Channel
- HBA 4: Primary IDE Channel
- HBA 5: Secondary IDE Channel
- HBA 6: Adaptec SCSI Card 29160 - Ultra160 SCSI
 - 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
 - HBA 6: Bus 0: Target 4: Lun 0: MAXTOR ATLAS10K5 736CA

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.

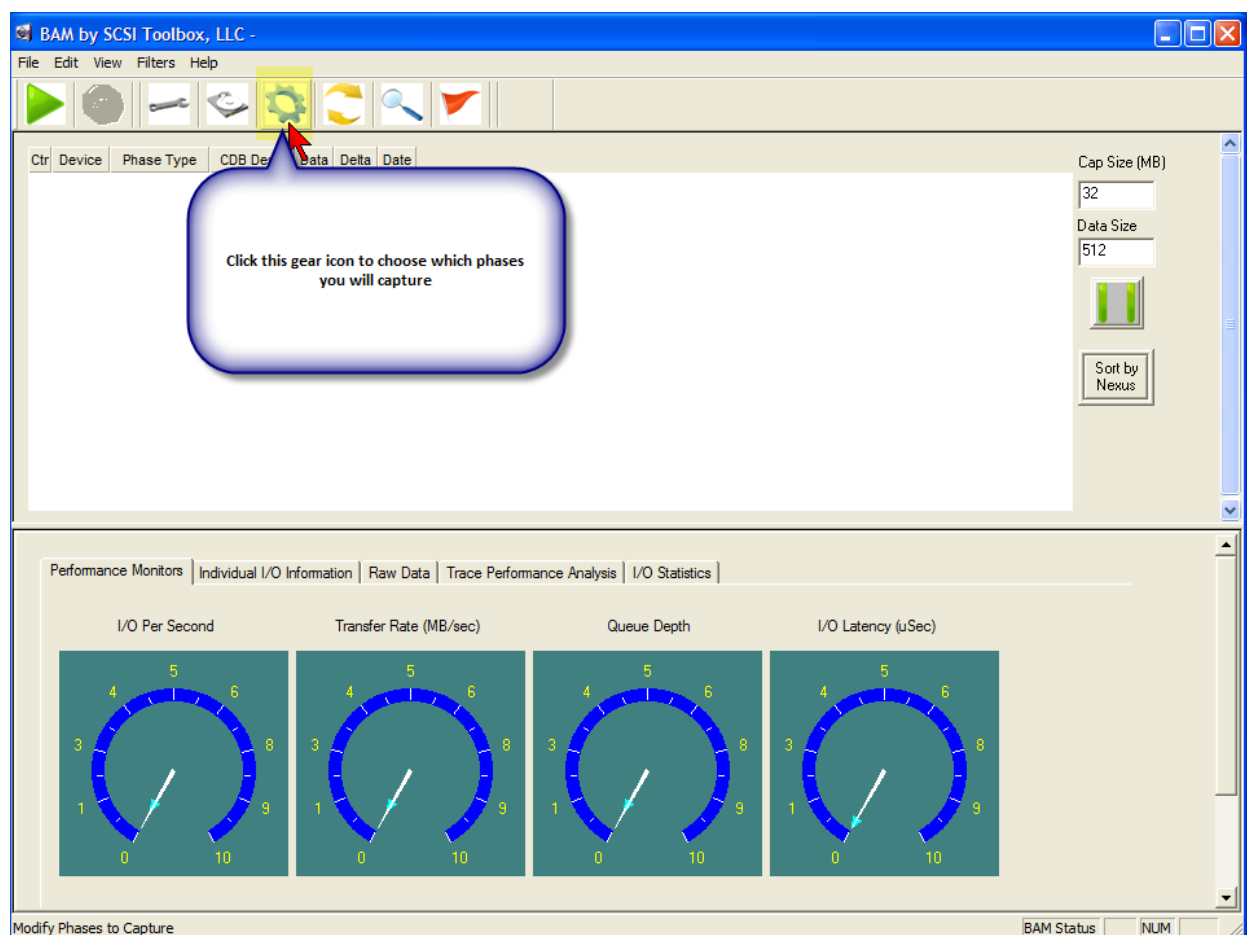


The Phase Selection Menu

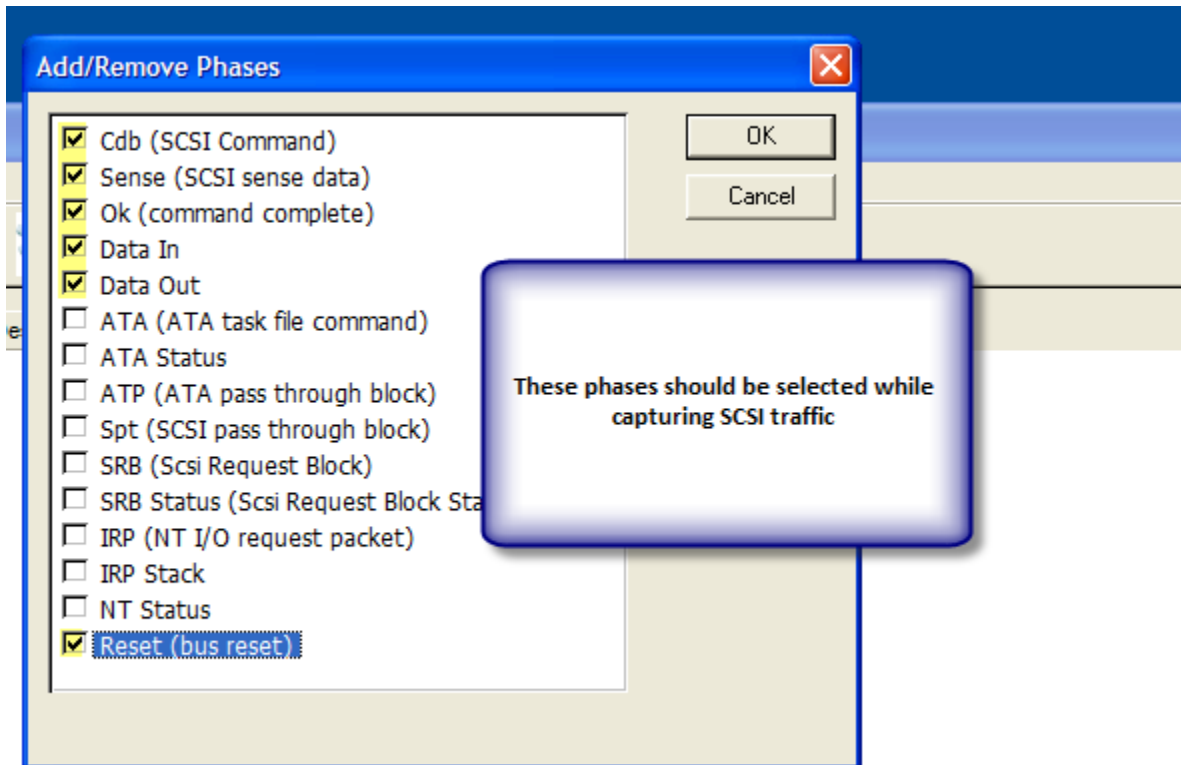
There are several types of phases that can be captured with BAM, from high-level phases such as CDB and DATA-IN DATA-OUT, down to low-level driver SRB phases. A complete command nexus will consist of at least a CDB phase, possibly a DATA IN or OUT phase, and possibly an OK phase if there is not data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

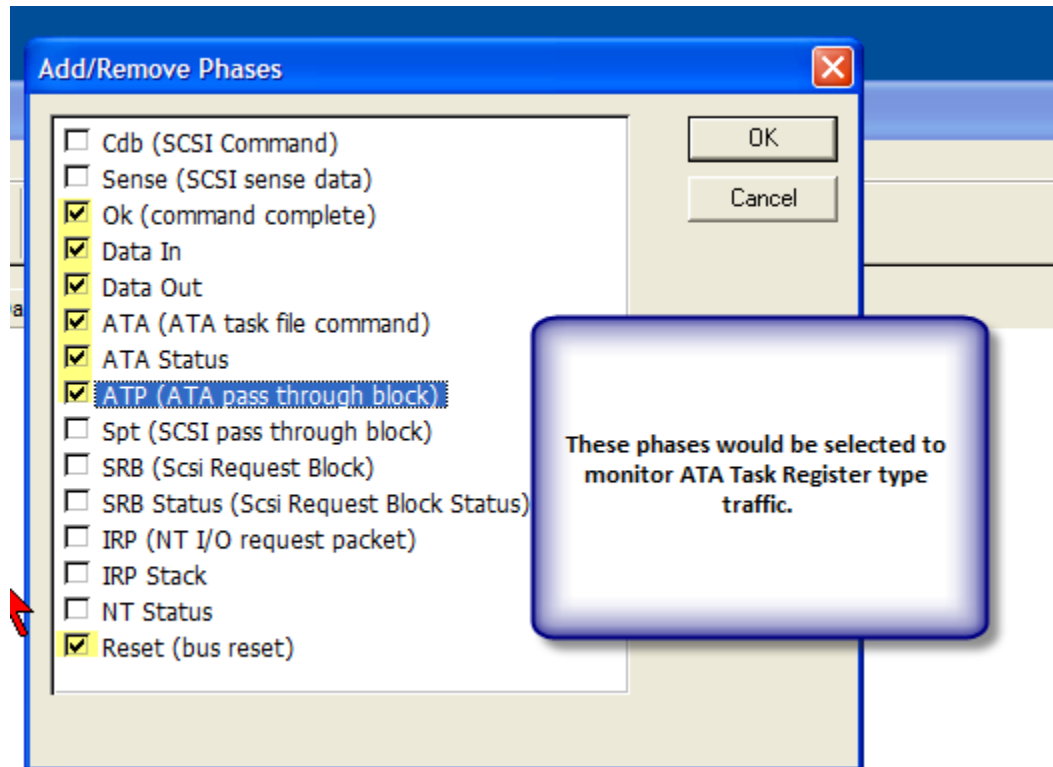
Unless you are doing device driver level testing we do not recommend that you select the Spt, SRB, IRP or NT Status phases.



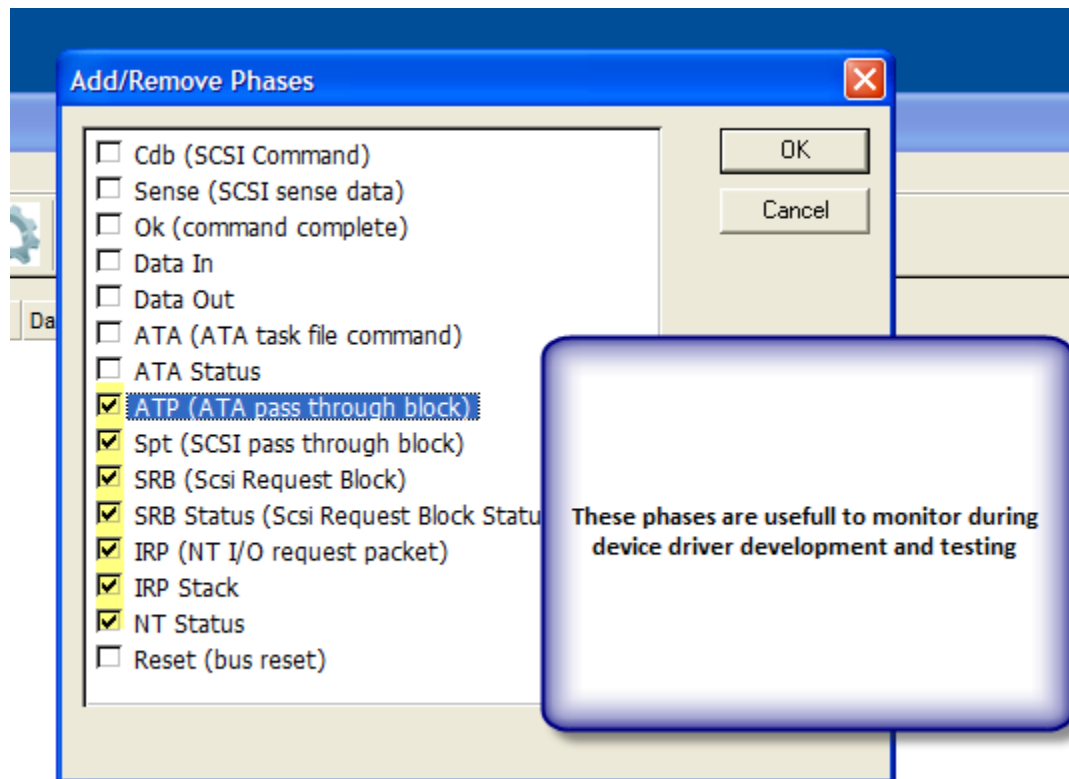
Typical Phase Setup for SCSI capture



Typical Phase Setup for ATA capture

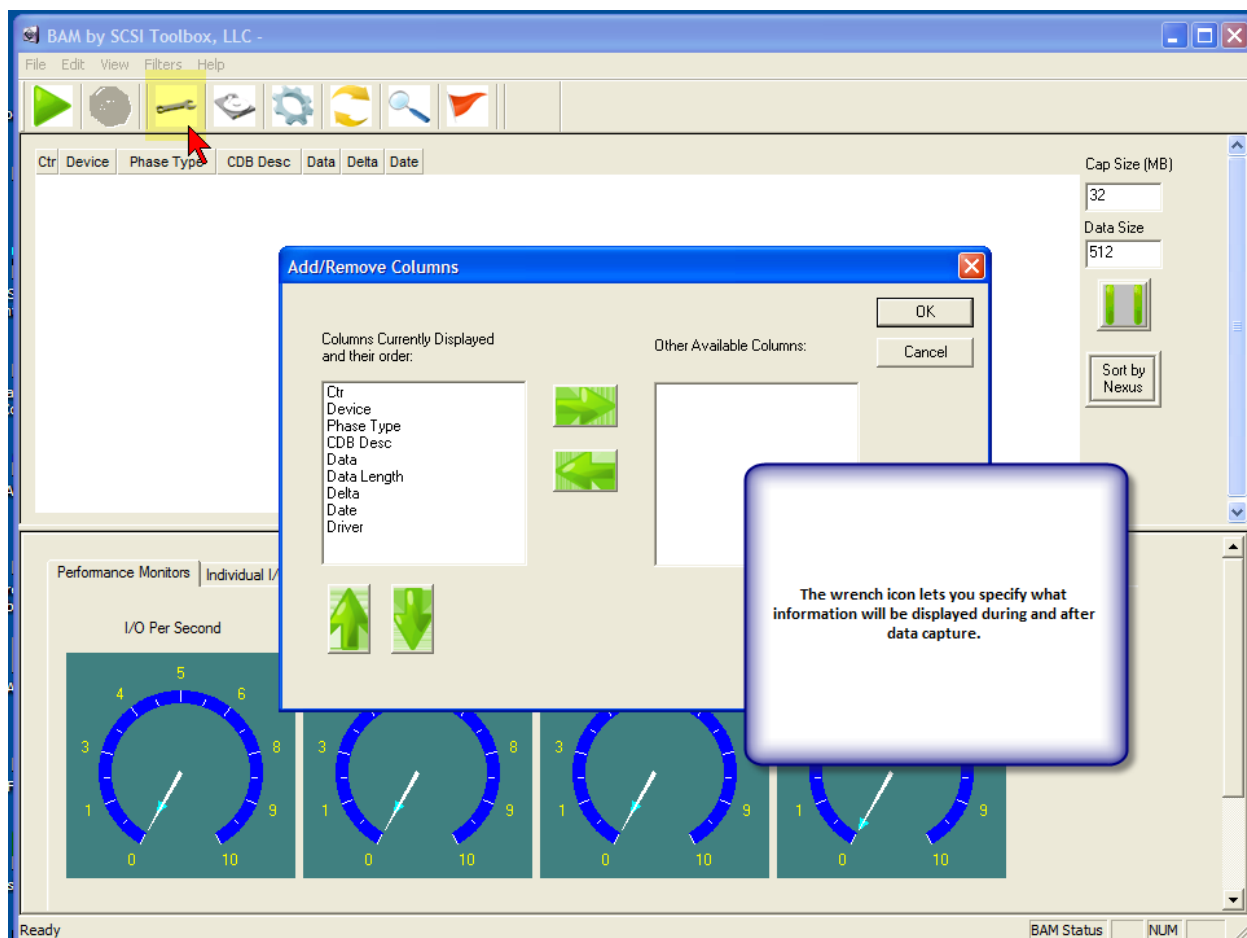


Typical Phase Setup for Driver test capture



Display column setup

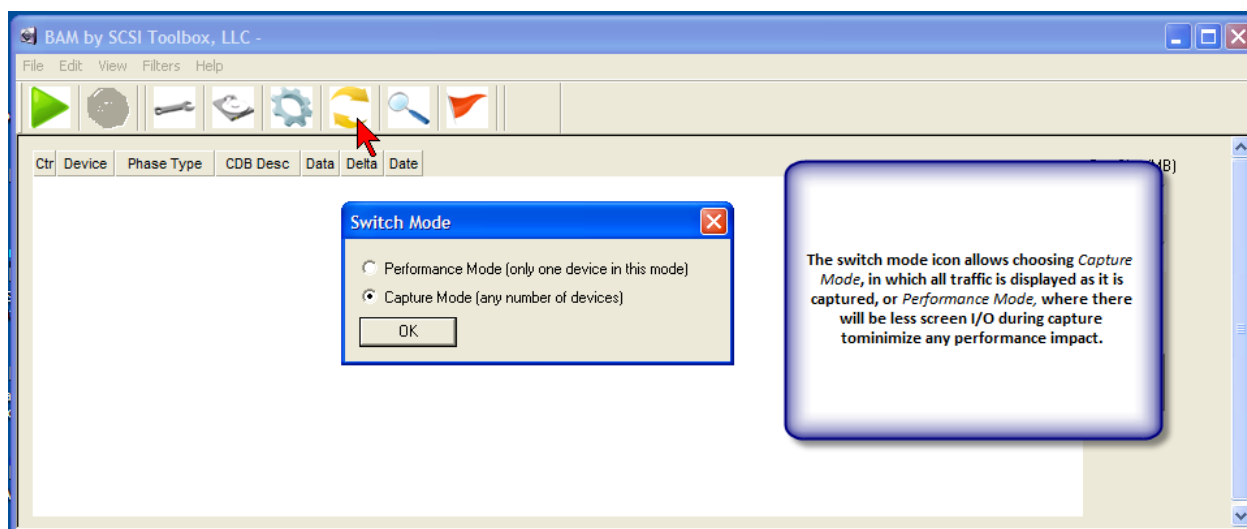
You can decide what columns you want to be displayed in the main screen, and what order they will be displayed.



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.

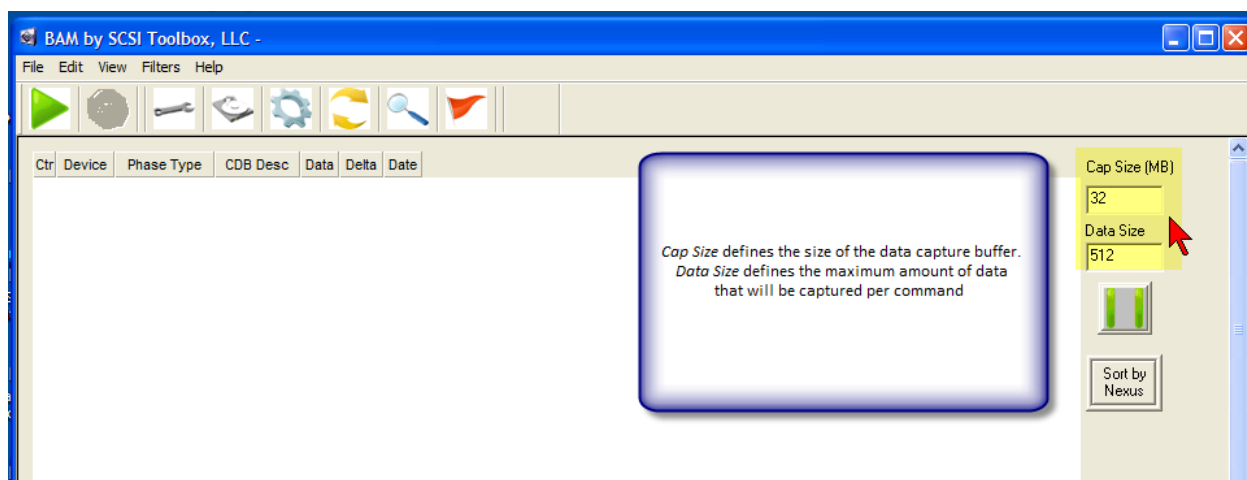


Setting Capture Buffer Size and Data Size per I/O

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

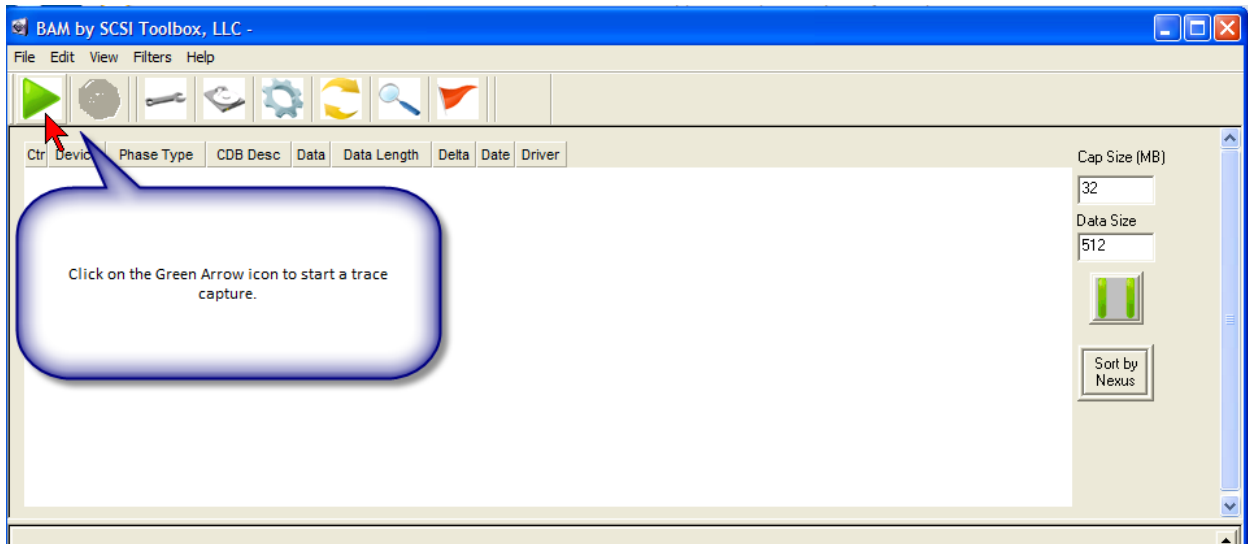
Set the Data Size to be as large as the largest data transfer you will encounter. For working with normal captures a setting of 32 bytes should be sufficient. If you want to capture read and write data to disk you should set this to at least the block size of the disk – the default size is 512 bytes.

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

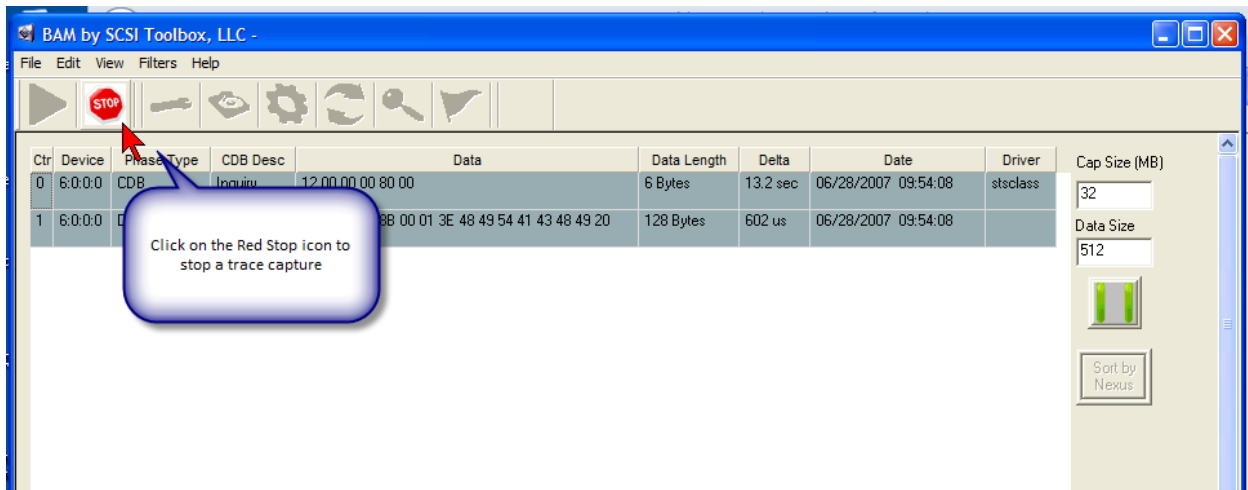


Starting a trace capture

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.



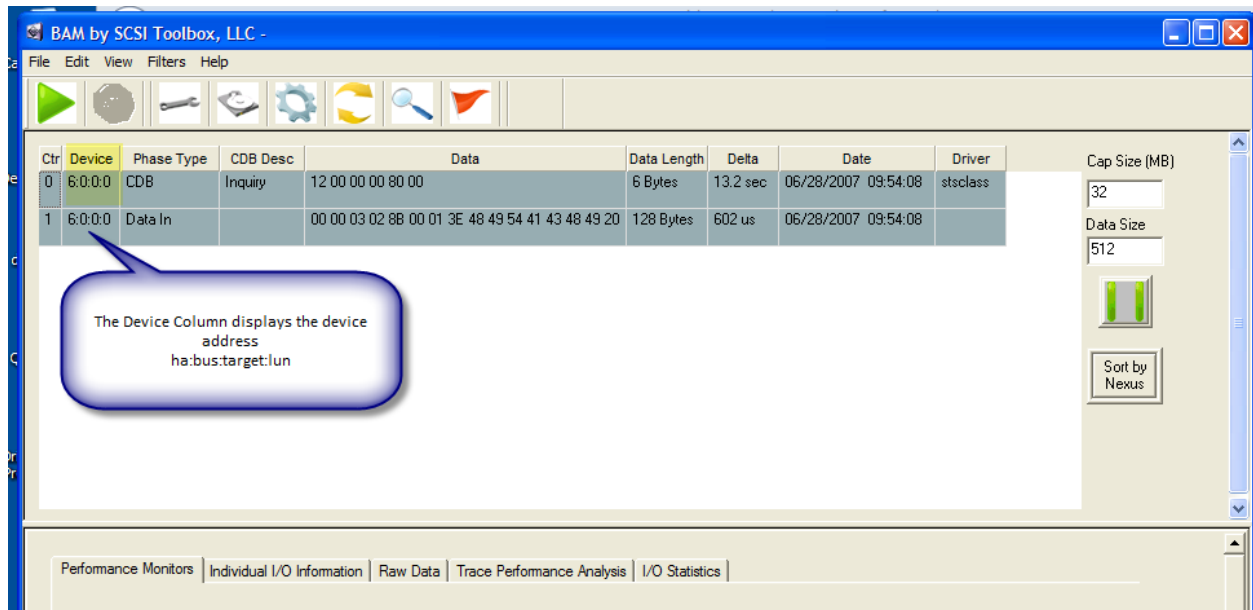
Stopping a trace capture



Explanation of captured data columns

The Device Column

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



The screenshot shows the 'BAM by SCSI Toolbox, LLC' application window. The main area contains a table with the following columns: Ctr, Device, Phase Type, CDB Desc, Data, Data Length, Delta, Date, Driver, and Cap Size (MB). The table has two rows of data. A callout box points to the 'Device' column in the first row, containing the text: 'The Device Column displays the device address ha:bus:target:lun'.

Ctr	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver	Cap Size (MB)
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass	32
1	6:0:0:0	Data In		00 00 03 02 8B 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08		512

Cap Size (MB): 32
Data Size: 512
Sort by Nexus

Performance Monitors | Individual I/O Information | Raw Data | Trace Performance Analysis | I/O Statistics

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 screenshot shows the BAM by SCSI Toolbox, LLC application window. The main data area contains a table with the following columns: Ctr, Device, Phase Type, CDB Desc, Data, Data Length, Delta, Date, Driver, and Cap Size (MB). Two rows are visible:

Ctr	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver	Cap Size (MB)
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass	32
1	6:0:0:0	Data In		00 00 03 02 8B 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08		512

A callout box points to the 'Phase Type' column and contains the text: "The Phase Type column describes what phase has been captured in this row. In this example the first row is a CDB phase, the second row is a Data In phase which is associated with the preceding CDB".

The CDB Description column

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

This screenshot is identical to the one above, showing the same table of captured phases. A callout box points to the 'CDB Desc' column and contains the text: "The CDB Description column interprets the op code of the CDB - in this case op code 0x12 is an INQUIRY command".

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.

Ctr	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver	Cap Size (MB)
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass	32
1	6:0:0:0	Data In		00 00 03 02 8B 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08		512

The Data Column displays the data that was captured in each phase. In this case the first row data is the data that makes up the CDB. In the second row the data is the actual data in associated with the preceding CDB

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

Ctr	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass
1	6:0:0:0	Data In		00 00 03 02 88 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08	

The Data Length column displays the actual amount of data that was transferred for each phase

The Delta Time column

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

Ctrl	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver	Cap Size (MB)
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass	32
1	6:0:0:0	Data In		00 00 03 02 88 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08		Data Size 512

The Delta column displays the amount of time that has passed since the preceding phase

Sort by Nexus

Performance Monitors | Individual I/O Information | Raw Data | Trace Performance Analysis | I/O Statistics

The Date Column

A time/date stamp is displayed here

Ctr	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass
1	6:0:0:0	Data In		00 00 03 02 88 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08	

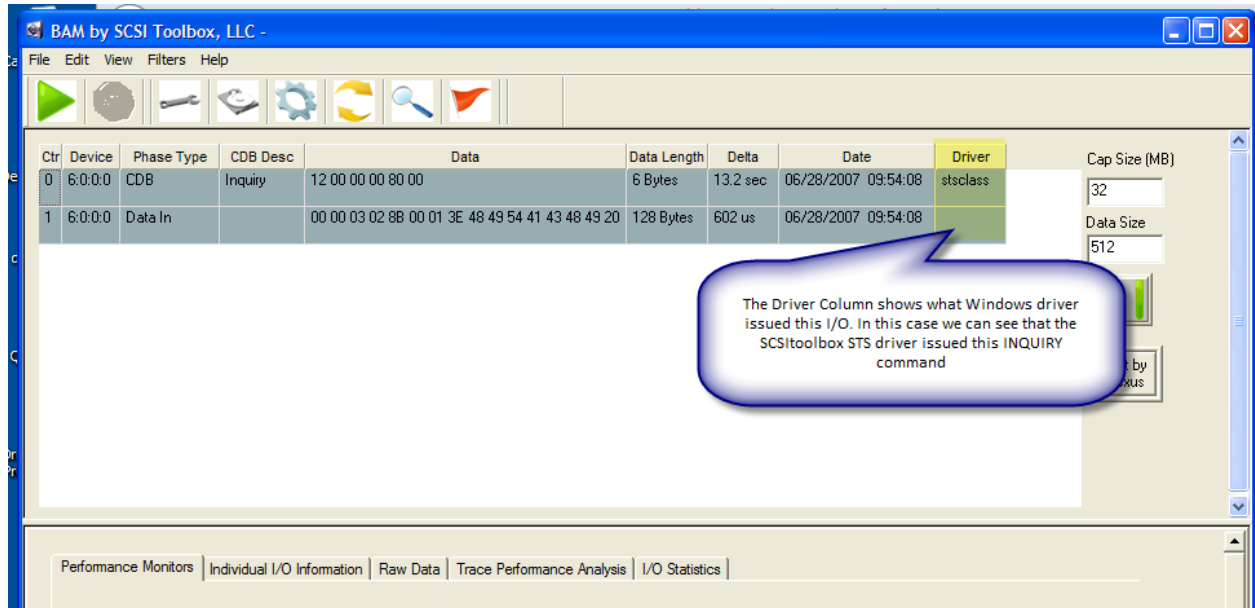
The Date Column displays a time/date stamp showing when this phase occurred

Cap Size (MB): 32
Data Size: 512
Sort by Nexus

Performance Monitors | Individual I/O Information | Raw Data | Trace Performance Analysis | I/O Statistics

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.



The screenshot shows the BAM by SCSI Toolbox, LLC application window. The main area contains a table with the following data:

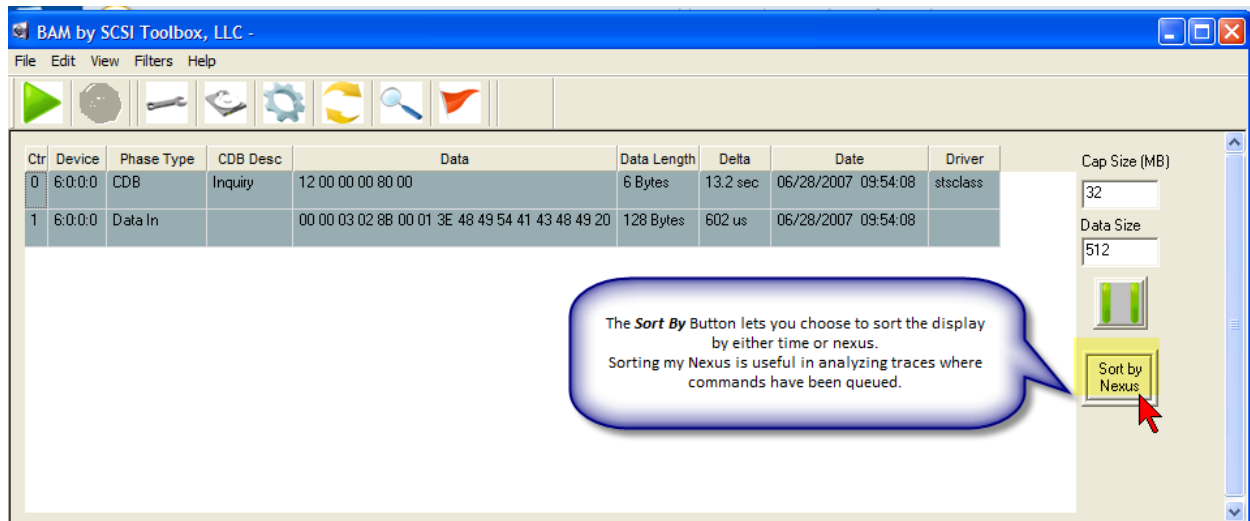
Ctrl	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Driver	Cap Size (MB)
0	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	13.2 sec	06/28/2007 09:54:08	stsclass	32
1	6:0:0:0	Data In		00 00 03 02 8B 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	602 us	06/28/2007 09:54:08		512

A callout bubble points to the 'Driver' column, containing the text: "The Driver Column shows what Windows driver issued this I/O. In this case we can see that the SCSI toolbox STS driver issued this INQUIRY command".

At the bottom of the window, there are tabs for: Performance Monitors | Individual I/O Information | Raw Data | Trace Performance Analysis | I/O Statistics.

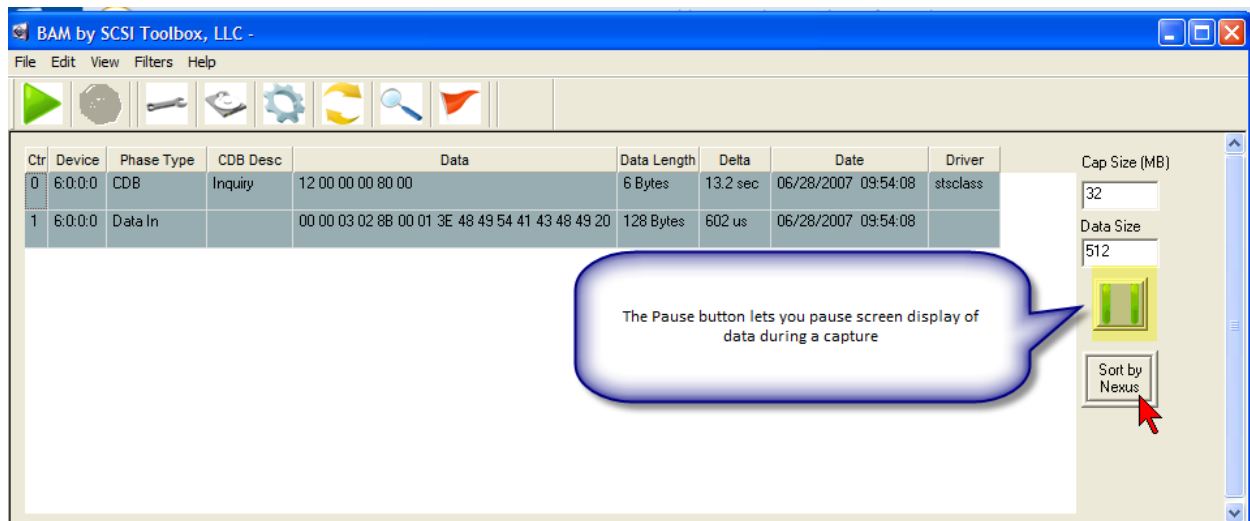
Sort by Time or Sort by Nexus

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.



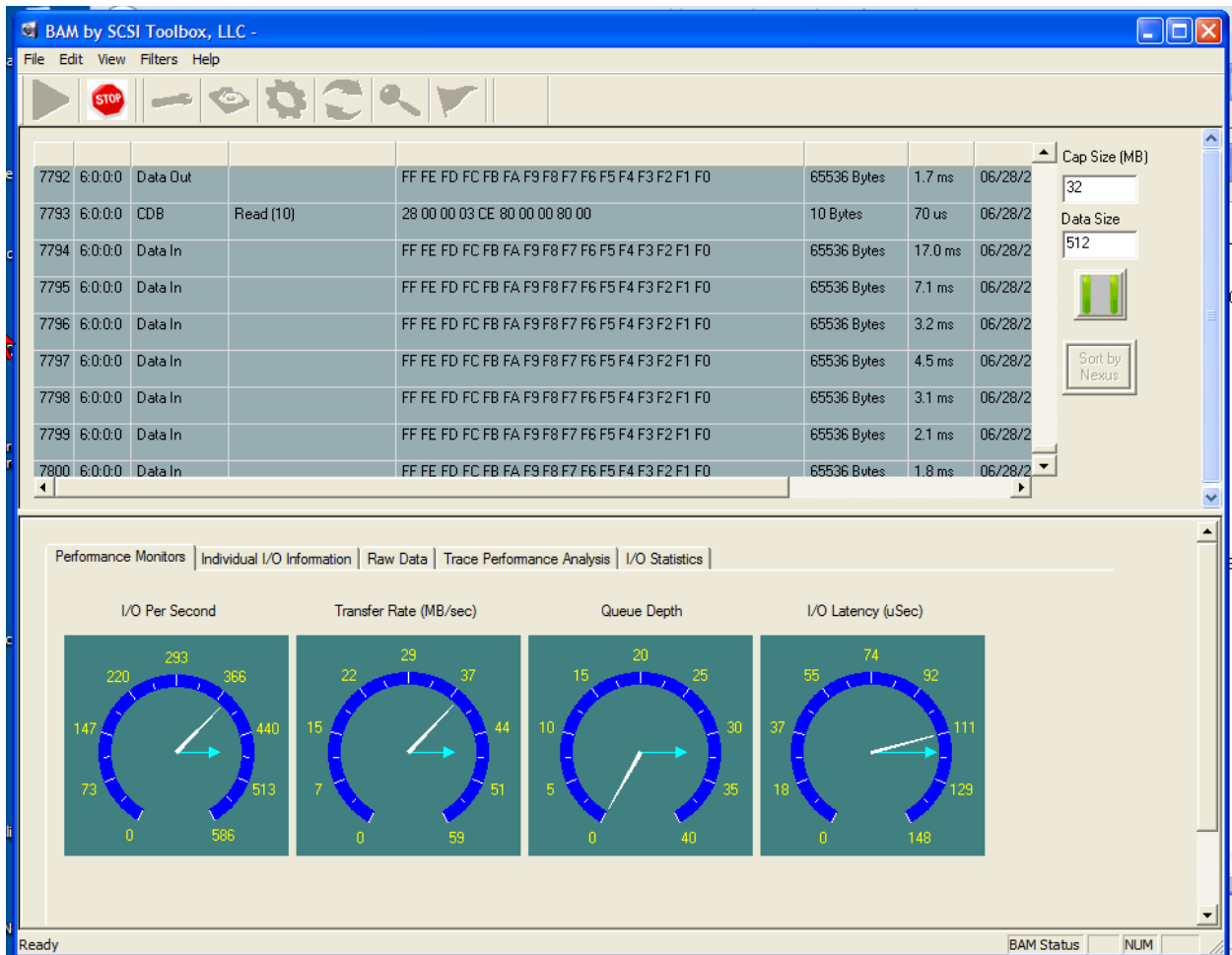
The Pause Display button

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.

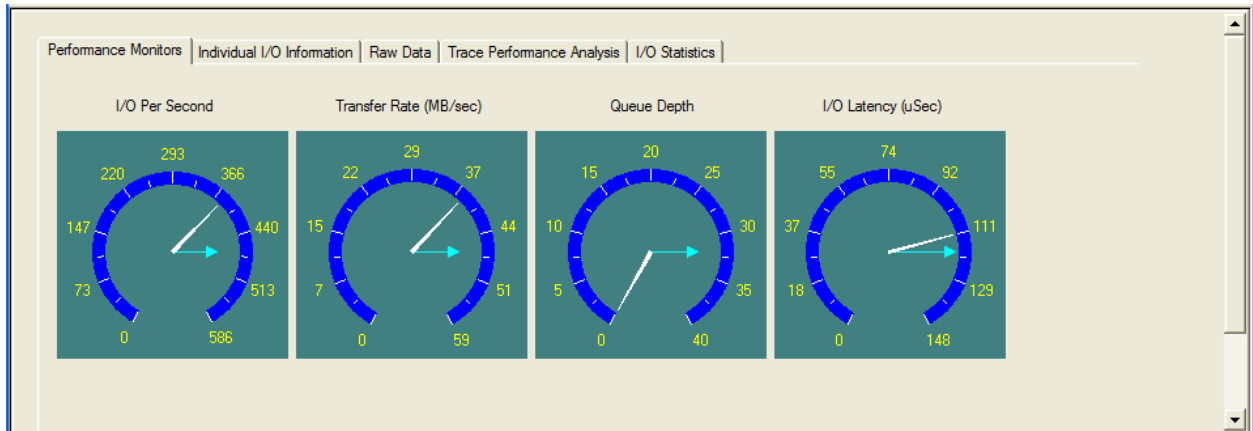


The Performance Monitors

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.

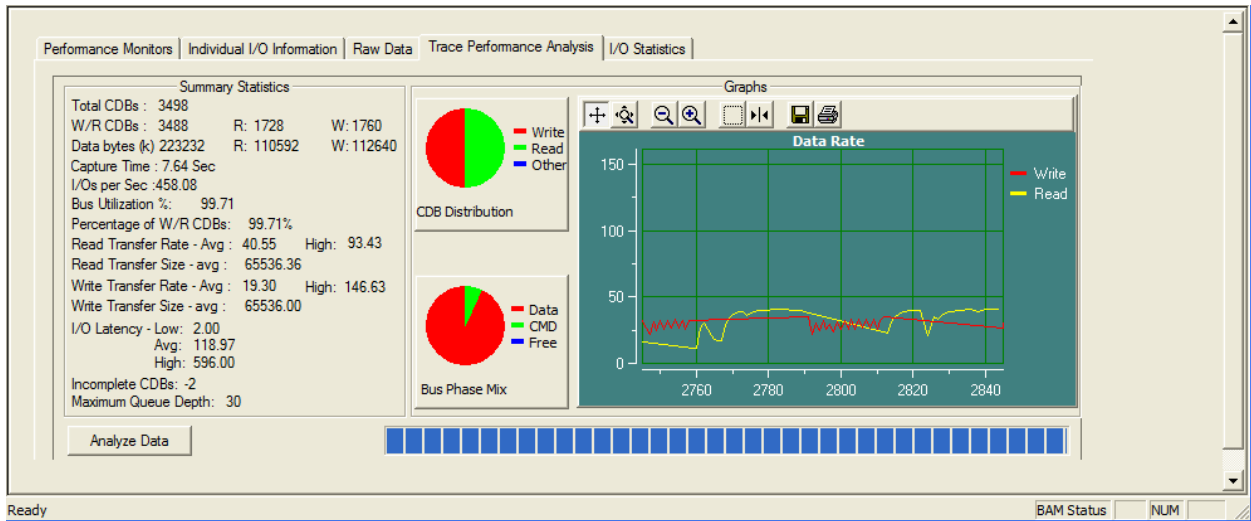
Some things to note in this example:

- 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



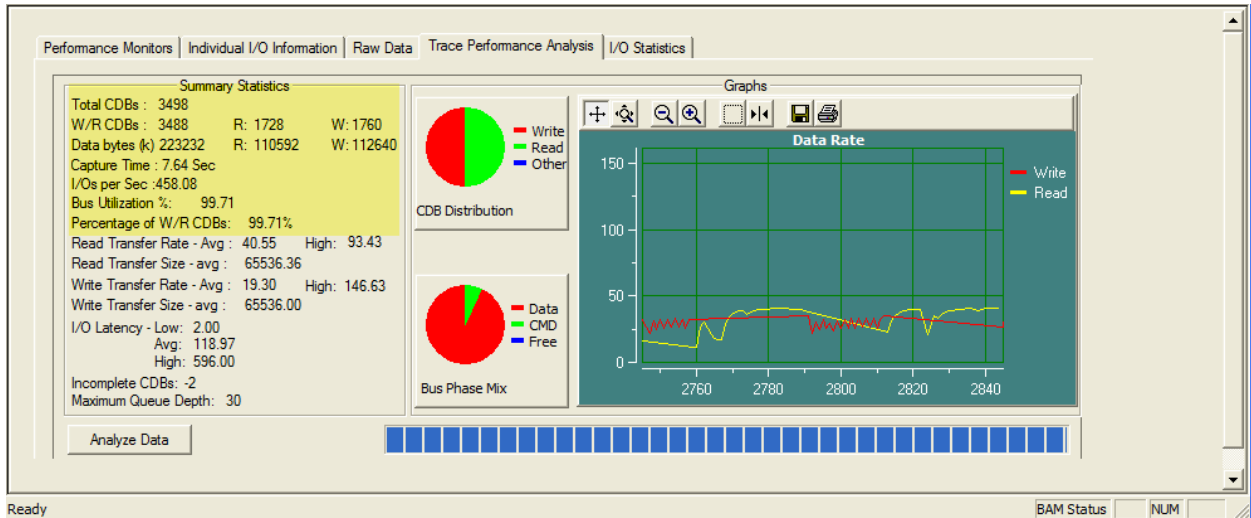
Trace Performance Analysis

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



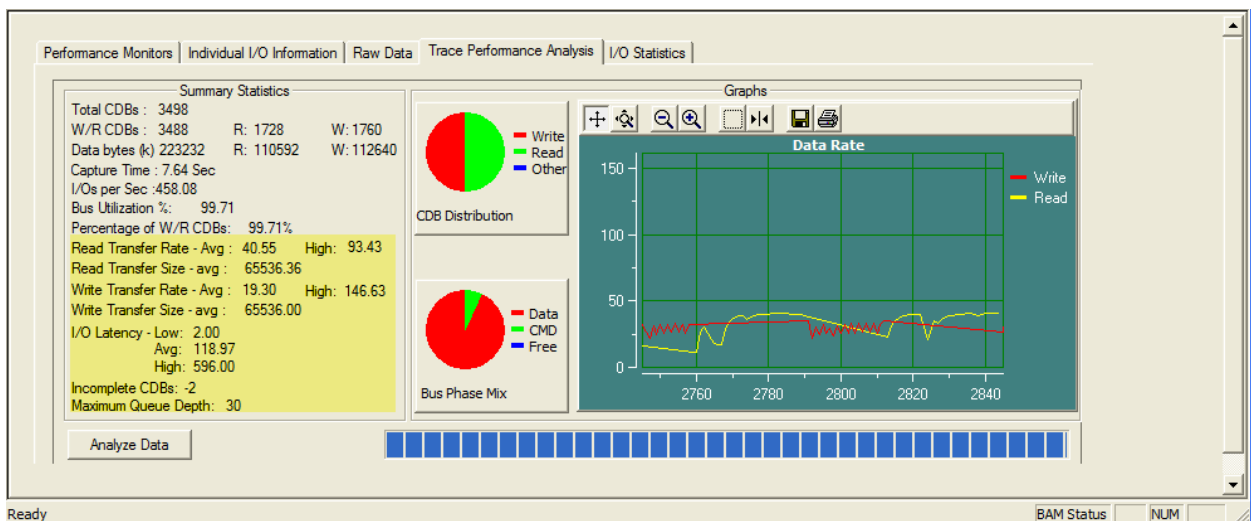
General Statistics

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



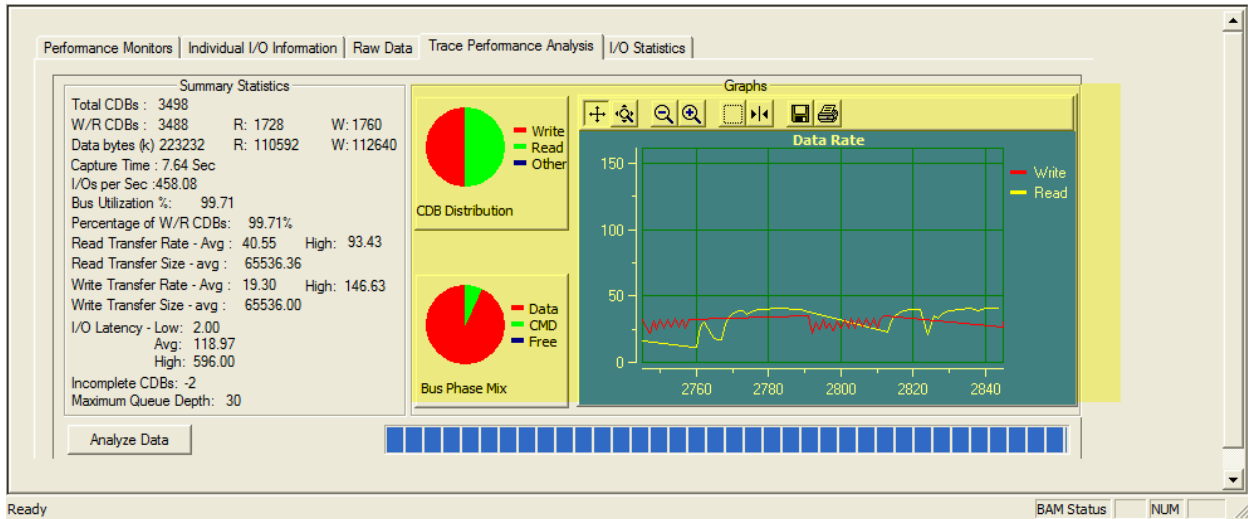
Performance statistics

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

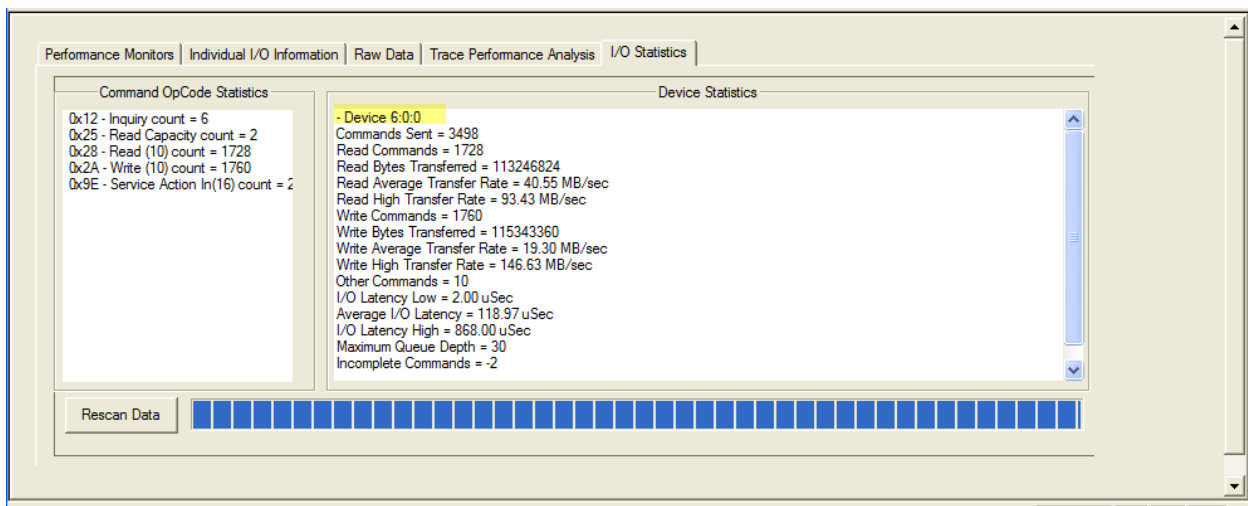
Command type mixture, phase mixture, and read and write transfer rates are graphed



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.

16	6:0:0:0	CDB	Read Capacity	25 00 00 00 00 00 00 00 00 00	10 Bytes	208 us	06/28/2
17	6:0:0:0	Data In		02 26 E2 3F 00 00 02 00	8 Bytes	375 us	06/28/2
18	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	4.8 ms	06/28/2
19	6:0:0:0	Data In		00 00 03 02 8B 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	572 us	06/28/2
20	6:0:0:0	CDB	Inquiry	12 01 80 00 FF 00	6 Bytes	38 us	06/28/2
21	6:0:0:0	Data In		00 80 00 08 31 4C 32 31 31 33 34 38	12 Bytes	440 us	06/28/2
22	6:0:0:0	CDB	Write (10)	2A 00 00 00 00 00 00 80 00	10 Bytes	46.4 ms	06/28/2
23	6:0:0:0	CDB	Write (10)	2A 00 00 00 00 80 00 80 00	10 Bytes	107 us	06/28/2
24	6:0:0:0	CDB	Write (10)	2A 00 00 00 01 00 00 00 80 00	10 Bytes	77 us	06/28/2

Performance Monitors | **Individual I/O Information** | Raw Data | Trace Performance Analysis | I/O Statistics

Originator: stsclass
Device: 6:0:0:0
Operation Code: 25 Read Capacity

CDB: 25 00 00 00 00 00 00 00 00 00
Bytes Transferred: 10

Error Information

SRB Status: 01	Sense Key: -
Target Status: 00	Sense ASC: -
Sense Data:	Sense ASCO: -

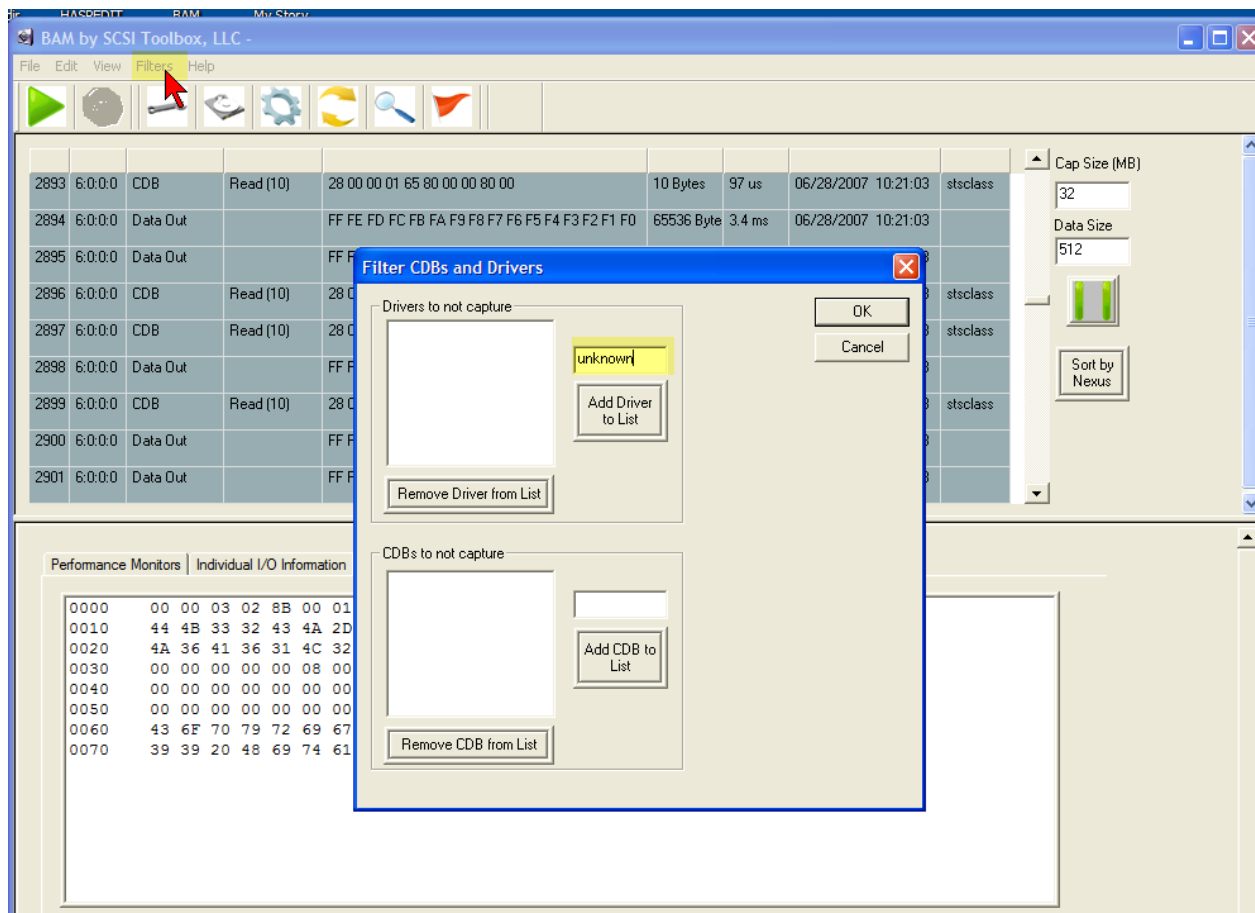
The *Individual I/O Information* tab displays detailed information about the phase that is pointed to in the top section of the trace. CDB, Driver, and error information is interpreted.

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

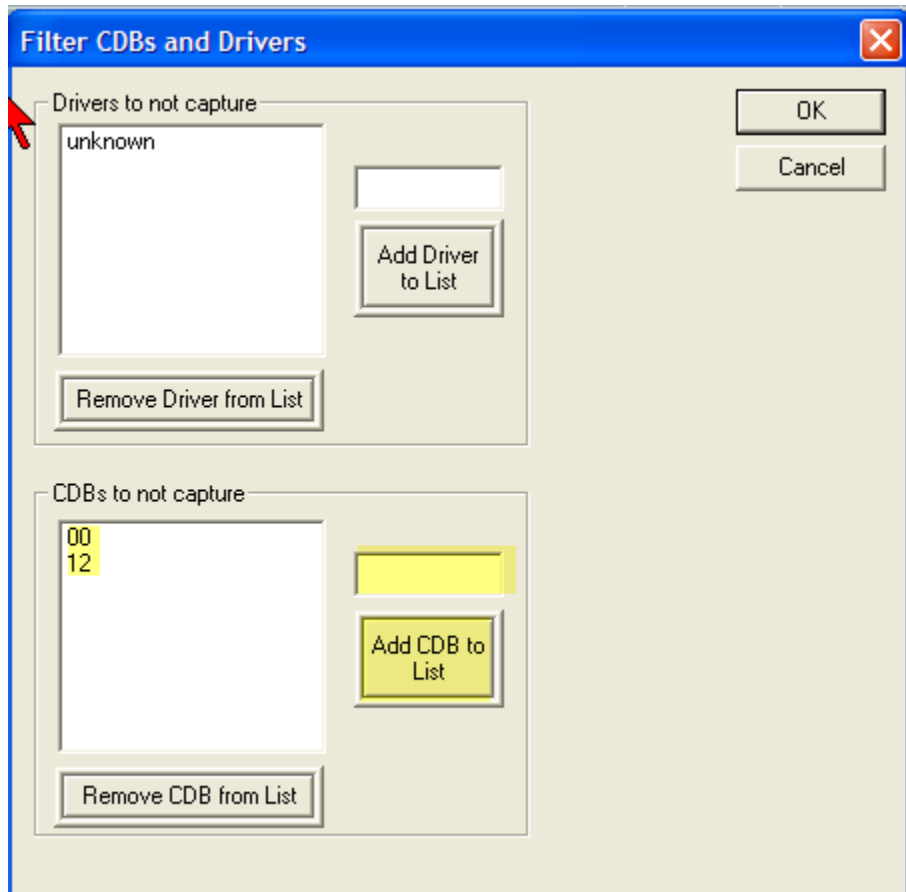
Filtering by Driver Name



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

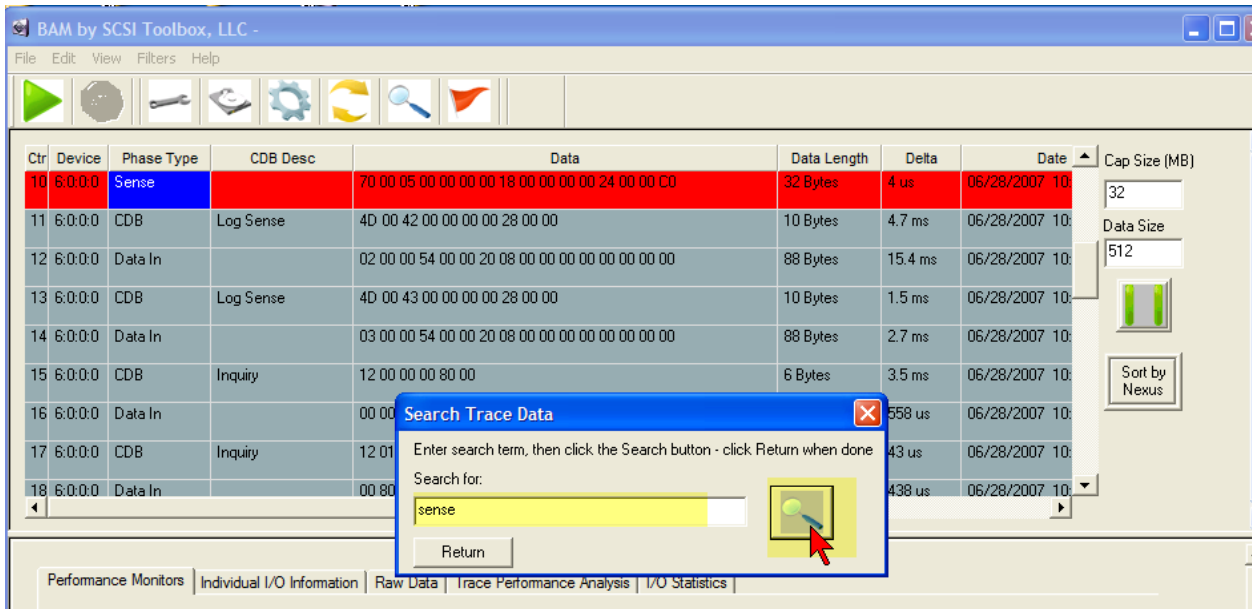
Click on the Magnifying Glass icon to search through trace data.

The screenshot displays the BAM by SCSI Toolbox application window. The main window features a menu bar (File, Edit, View, Filters, Help) and a toolbar with various icons. A red arrow points to the magnifying glass icon in the toolbar. Below the toolbar is a table of trace data with columns: Ctr, Device, Phase Type, CDB Desc, Data, Data Length, Delta, Date, and Cap Size (MB). A 'Search Trace Data' dialog box is open, prompting the user to enter a search term and click the Search button. Below the table, there are four performance monitors: I/O Per Second, Transfer Rate (MB/sec), Queue Depth, and I/O Latency (uSec), each represented by a circular gauge.

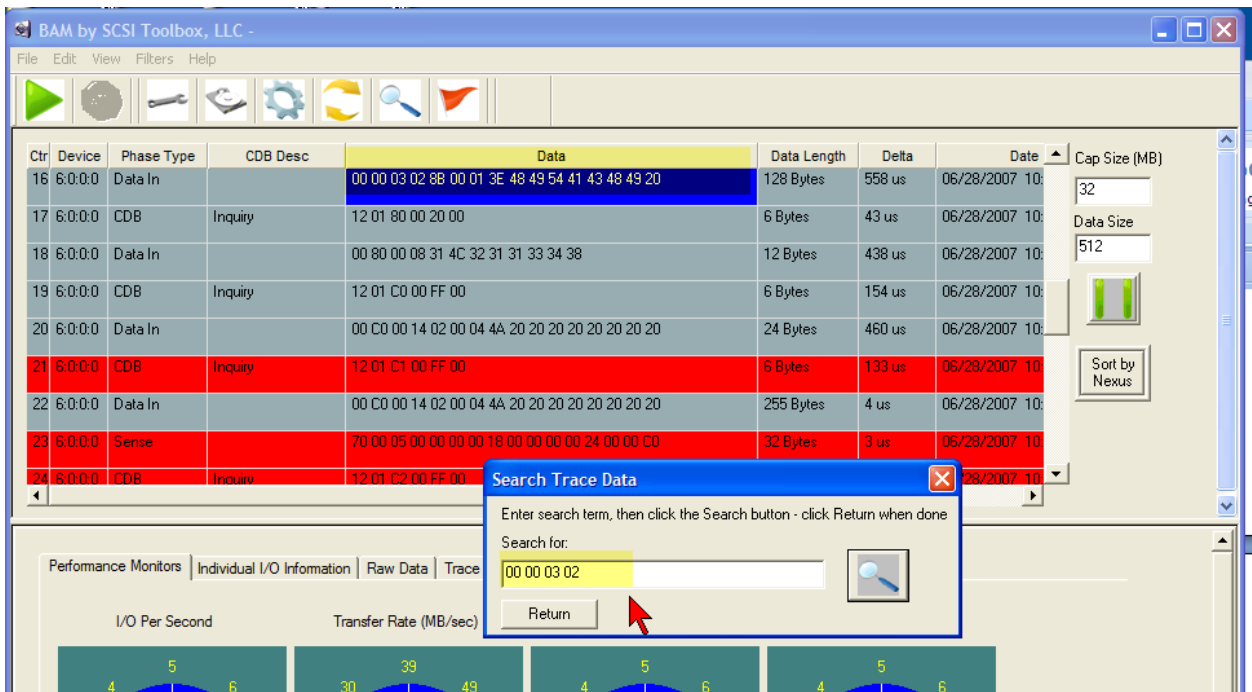
Ctr	Device	Phase Type	CDB Desc	Data	Data Length	Delta	Date	Cap Size (MB)
0	6:0:0:0	CDB	Read Defect (10)	37 00 15 00 00 00 00 04 00	10 Bytes	5.6 sec	06/28/2007 10:	32
1	6:0:0:0	Data In		00 15 1A E0	4 Bytes	151.5 ms	06/28/2007 10:	Data Size
2	6:0:0:0	CDB	Read Defect (10)	37 00 0D 00 00 00 00 04 00	10 Bytes	174 us	06/28/2007 10:	512
3	6:0:0:0	Data In		00 0D 00 00	4 Bytes	102.5 ms	06/28/2007 10:	
4	6:0:0:0	CDB	Inquiry	12 00 00 00 80 00	6 Bytes	5.9 ms	06/28/2007 10:	
5	6:0:0:0	Data In		00 00 03 02 8B 00 01 3E 48 49 54 41 43 48 49 20	128 Bytes	557 us	06/28/2007 10:	
6	6:0:0:0	Data In		18 02	68 us	06/28/2007 10:		
7	6:0:0:0	CDB	Inquiry	12 00	61 us	06/28/2007 10:		
8	6:0:0:0	Data In		00 00	532 us	06/28/2007 10:		

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

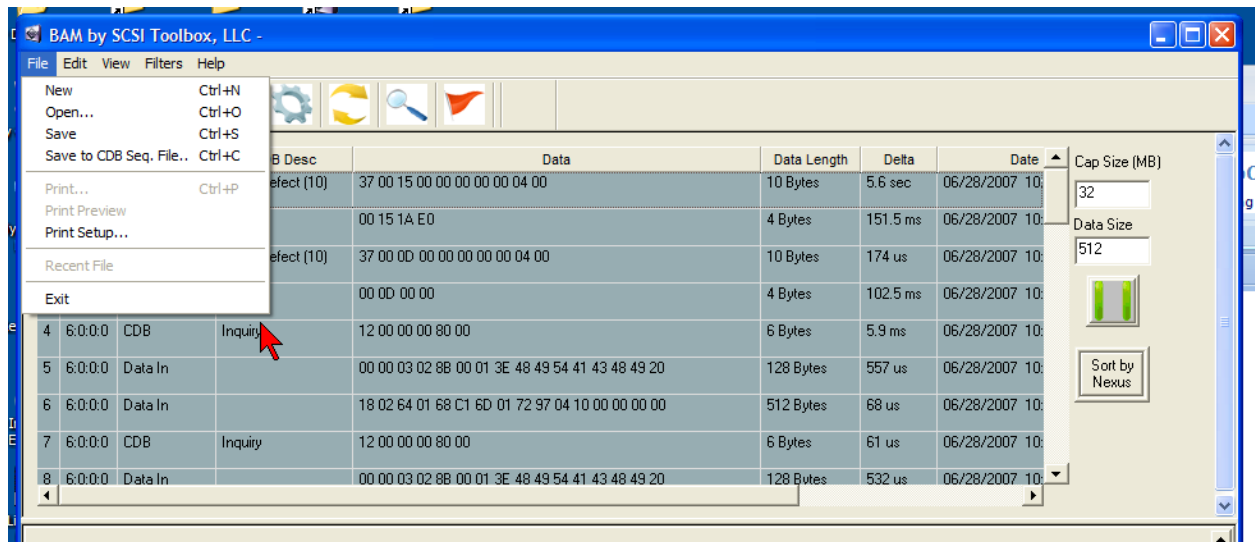
The trace data display will be positioned at the first occurrence of the search word. Click the Magnifying Glass icon to search for the next occurrence.



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 SCSI toolbox32 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"