

# BusLogic MultiMaster and FlashPoint SCSI Driver for Linux

Version 2.0.15 for Linux 2.0

Version 2.1.15 for Linux 2.1

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## Introduction

BusLogic, Inc. designed and manufactured a variety of high performance SCSI host adapters which share a common programming interface across a diverse collection of bus architectures by virtue of their MultiMaster ASIC technology. BusLogic was acquired by Mylex Corporation in February 1996, but the products supported by this driver originated under the BusLogic name and so that name is retained in the source code and documentation.

This driver supports all present BusLogic MultiMaster Host Adapters, and should support any future MultiMaster designs with little or no modification. More recently, BusLogic introduced the FlashPoint Host Adapters, which are less costly and rely on the host CPU, rather than including an onboard processor. Despite not having an onboard CPU, the FlashPoint Host Adapters perform very well and have very low command latency. BusLogic has recently provided me with the FlashPoint Driver Developer's Kit, which comprises documentation and freely redistributable source code for the FlashPoint SCCB Manager. The SCCB Manager is the library of code that runs on the host CPU and performs functions analogous to the firmware on the MultiMaster Host Adapters. Thanks to their having provided the SCCB Manager, this driver now supports the FlashPoint Host Adapters as well.

My primary goals in writing this completely new BusLogic driver for Linux are to achieve the full performance that BusLogic SCSI Host Adapters and modern SCSI peripherals are capable of, and to provide a highly robust driver that can be depended upon for high performance mission critical applications. All of the major performance features can be configured from the Linux kernel command line or at module initialization time, allowing individual installations to tune driver performance and error recovery to their particular needs.

The latest information on Linux support for BusLogic SCSI Host Adapters, as well as the most recent release of this driver and the latest firmware for the BT-948/958/958D, will always be available from my Linux Home Page at URL ["http://sourceforge.net/projects/dandelion/"](http://sourceforge.net/projects/dandelion/).

Bug reports should be sent via electronic mail to "[lnz@dandelion.com](mailto:lnz@dandelion.com)". Please include with the bug report the complete configuration messages reported by the driver and SCSI subsystem at startup, along with any subsequent system messages relevant to SCSI operations, and a detailed description of your system's hardware configuration.

Mylex has been an excellent company to work with and I highly recommend their products to the Linux community. In November 1995, I was offered the opportunity to become a beta test site for their latest MultiMaster product, the BT-948 PCI Ultra SCSI Host Adapter, and then again for the BT-958 PCI Wide Ultra SCSI Host Adapter in January 1996. This was mutually beneficial since Mylex received a degree and kind of testing that their own testing group cannot readily achieve, and the Linux community has available high performance host adapters that have been well tested with Linux even before being brought to market. This relationship has also given me the opportunity to interact directly with their technical staff, to understand more about the internal workings of their products, and in turn to educate them about the needs and potential of the Linux community.

More recently, Mylex has reaffirmed the company's interest in supporting the Linux community, and I am now working on a Linux driver for the DAC960 PCI RAID Controllers. Mylex's interest and support is greatly appreciated.

Unlike some other vendors, if you contact Mylex Technical Support with a problem and are running Linux, they will not tell you that your use of their products is unsupported. Their latest product marketing literature even states "Mylex SCSI host adapters are compatible with all major operating systems including ... Linux ...".

Mylex Corporation is located at 34551 Ardenwood Blvd., Fremont, California 94555, USA and can be reached at 510/796-6100 or on the World Wide Web at <http://www.mylex.com>. Mylex HBA Technical Support can be reached by electronic mail at [techsup@mylex.com](mailto:techsup@mylex.com), by Voice at 510/608-2400, or by FAX at 510/745-7715. Contact information for offices in Europe and Japan is available on the Web site.

## Driver Features

## Configuration Reporting and Testing

During system initialization, the driver reports extensively on the host adapter hardware configuration, including the synchronous transfer parameters requested and negotiated with each target device. AutoSCSI settings for Synchronous Negotiation, Wide Negotiation, and Disconnect/Reconnect are reported for each target device, as well as the status of Tagged Queuing. If the same setting is in effect for all target devices, then a single word or phrase is used; otherwise, a letter is provided for each target device to indicate the individual status. The following examples should clarify this reporting format:

### Synchronous Negotiation: Ultra

Synchronous negotiation is enabled for all target devices and the host adapter will attempt to negotiate for 20.0 mega-transfers/second.

### Synchronous Negotiation: Fast

Synchronous negotiation is enabled for all target devices and the host adapter will attempt to negotiate for 10.0 mega-transfers/second.

### Synchronous Negotiation: Slow

Synchronous negotiation is enabled for all target devices and the host adapter will attempt to negotiate for 5.0 mega-transfers/second.

### Synchronous Negotiation: Disabled

Synchronous negotiation is disabled and all target devices are limited to asynchronous operation.

### Synchronous Negotiation: UFSNUUU#UUUUUUUU

Synchronous negotiation to Ultra speed is enabled for target devices 0 and 4 through 15, to Fast speed for target device 1, to Slow speed for target device 2, and is not permitted to target device 3. The host adapter's SCSI ID is represented by the "#".

The status of Wide Negotiation, Disconnect/Reconnect, and Tagged Queuing are reported as "Enabled", "Disabled", or a sequence of "Y" and "N" letters.

## Performance Features

BusLogic SCSI Host Adapters directly implement SCSI-2 Tagged Queuing, and so support has been included in the driver to utilize tagged queuing with any target devices that report having the tagged queuing capability. Tagged queuing allows for multiple outstanding commands to be issued to each target device or logical unit, and can improve I/O performance substantially. In addition, BusLogic's Strict Round Robin Mode is used to optimize host adapter performance, and scatter/gather I/O can support as many segments as can be effectively utilized by the Linux I/O subsystem. Control over the use of tagged queuing for each target device as well as individual selection of the tagged queue depth is available through driver options provided on the kernel command line or at module initialization time. By default, the queue depth is determined automatically based on the host adapter's total queue depth and the number, type, speed, and capabilities of the target devices found. In addition, tagged queuing is automatically disabled whenever the host adapter firmware version is known not to implement it correctly, or whenever a tagged queue depth of 1 is selected. Tagged queuing is also disabled for individual target devices if disconnect/reconnect is disabled for that device.

## Robustness Features

The driver implements extensive error recovery procedures. When the higher level parts of the SCSI subsystem request that a timed out command be reset, a selection is made between a full host adapter hard reset and SCSI bus reset versus sending a bus device reset message to the individual target device based on the recommendation of the SCSI subsystem. Error recovery strategies are selectable through driver options individually for each target device, and also include sending a bus device reset to the specific target device associated with the command being reset, as well as suppressing error recovery entirely to avoid perturbing an improperly functioning device. If the bus device reset error recovery strategy is selected and sending a bus device reset does not restore correct operation, the next command that is reset will force a full host adapter hard reset and SCSI bus reset. SCSI bus resets caused by other devices and detected by the host adapter are also handled by issuing a soft reset to the host adapter and re-initialization. Finally, if tagged queuing is active and more than one command reset occurs in a 10 minute interval, or if a command reset occurs within the first 10 minutes of operation, then tagged queuing will be disabled for that target device. These error recovery options improve overall system robustness by preventing individual errant devices from causing the system as a whole to lock up or crash, and thereby allowing a clean shutdown and restart after the offending component is removed.

## PCI Configuration Support

On PCI systems running kernels compiled with PCI BIOS support enabled, this driver will interrogate the PCI configuration space and use the I/O port addresses assigned by the system BIOS, rather than the ISA compatible I/O port addresses. The ISA compatible I/O port address is then disabled by the driver. On PCI systems it is also recommended that the AutoSCSI utility be used to disable the ISA compatible I/O port entirely as it is not necessary. The ISA compatible I/O port is disabled by default on the BT-948/958/958D.

## /proc File System Support

Copies of the host adapter configuration information together with updated data transfer and error recovery statistics are available through the /proc/scsi/BusLogic/<N> interface.

## Shared Interrupts Support

On systems that support shared interrupts, any number of BusLogic Host Adapters may share the same interrupt request channel.

## Supported Host Adapters

The following list comprises the supported BusLogic SCSI Host Adapters as of the date of this document. It is recommended that anyone purchasing a BusLogic Host Adapter not in the following table contact the author beforehand to verify that it is or will be supported.

FlashPoint Series PCI Host Adapters:

FlashPoint LT (BT-930)	Ultra SCSI-3
FlashPoint LT (BT-930R)	Ultra SCSI-3 with RAIDPlus
FlashPoint LT (BT-920)	Ultra SCSI-3 (BT-930 without BIOS)
FlashPoint DL (BT-932)	Dual Channel Ultra SCSI-3
FlashPoint DL (BT-932R)	Dual Channel Ultra SCSI-3 with RAIDPlus
FlashPoint LW (BT-950)	Wide Ultra SCSI-3
FlashPoint LW (BT-950R)	Wide Ultra SCSI-3 with RAIDPlus
FlashPoint DW (BT-952)	Dual Channel Wide Ultra SCSI-3
FlashPoint DW (BT-952R)	Dual Channel Wide Ultra SCSI-3 with RAIDPlus

MultiMaster "W" Series Host Adapters:

BT-948	PCI	Ultra SCSI-3
BT-958	PCI	Wide Ultra SCSI-3
BT-958D	PCI	Wide Differential Ultra SCSI-3

MultiMaster "C" Series Host Adapters:

BT-946C	PCI	Fast SCSI-2
BT-956C	PCI	Wide Fast SCSI-2
BT-956CD	PCI	Wide Differential Fast SCSI-2
BT-445C	VLB	Fast SCSI-2
BT-747C	EISA	Fast SCSI-2
BT-757C	EISA	Wide Fast SCSI-2
BT-757CD	EISA	Wide Differential Fast SCSI-2

MultiMaster "S" Series Host Adapters:

BT-445S	VLB	Fast SCSI-2
BT-747S	EISA	Fast SCSI-2
BT-747D	EISA	Differential Fast SCSI-2
BT-757S	EISA	Wide Fast SCSI-2
BT-757D	EISA	Wide Differential Fast SCSI-2
BT-742A	EISA	SCSI-2 (742A revision H)

MultiMaster "A" Series Host Adapters:

BT-742A	EISA	SCSI-2 (742A revisions A - G)
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AMI FastDisk Host Adapters that are true BusLogic MultiMaster clones are also supported by this driver.

BusLogic SCSI Host Adapters are available packaged both as bare boards and as retail kits. The BT- model numbers above refer to the bare board packaging. The retail kit model numbers are found by replacing BT- with KT- in the above list. The retail kit includes the bare board and manual as well as cabling and driver media and documentation that are not provided with bare boards.

# FlashPoint Installation Notes

## RAIDPlus Support

FlashPoint Host Adapters now include RAIDPlus, Mylex's bootable software RAID. RAIDPlus is not supported on Linux, and there are no plans to support it. The MD driver in Linux 2.0 provides for concatenation (LINEAR) and striping (RAID-0), and support for mirroring (RAID-1), fixed parity (RAID-4), and distributed parity (RAID-5) is available separately. The built-in Linux RAID support is generally more flexible and is expected to perform better than RAIDPlus, so there is little impetus to include RAIDPlus support in the BusLogic driver.

## Enabling UltraSCSI Transfers

FlashPoint Host Adapters ship with their configuration set to "Factory Default" settings that are conservative and do not allow for UltraSCSI speed to be negotiated. This results in fewer problems when these host adapters are installed in systems with cabling or termination that is not sufficient for UltraSCSI operation, or where existing SCSI devices do not properly respond to synchronous transfer negotiation for UltraSCSI speed. AutoSCSI may be used to load "Optimum Performance" settings which allow UltraSCSI speed to be negotiated with all devices, or UltraSCSI speed can be enabled on an individual basis. It is recommended that SCAM be manually disabled after the "Optimum Performance" settings are loaded.

## BT-948/958/958D Installation Notes

The BT-948/958/958D PCI Ultra SCSI Host Adapters have some features which may require attention in some circumstances when installing Linux.

### PCI I/O Port Assignments

When configured to factory default settings, the BT-948/958/958D will only recognize the PCI I/O port assignments made by the motherboard's PCI BIOS. The BT-948/958/958D will not respond to any of the ISA compatible I/O ports that previous BusLogic SCSI Host Adapters respond to. This driver supports the PCI I/O port assignments, so this is the preferred configuration. However, if the obsolete BusLogic driver must be used for any reason, such as a Linux distribution that does not yet use this driver in its boot kernel, BusLogic has provided an AutoSCSI configuration option to enable a legacy ISA compatible I/O port.

To enable this backward compatibility option, invoke the AutoSCSI utility via Ctrl-B at system startup and select "Adapter Configuration", "View/Modify Configuration", and then change the "ISA Compatible Port" setting from "Disable" to "Primary" or "Alternate". Once this driver has been installed, the "ISA Compatible Port" option should be set back to "Disable" to avoid possible future I/O port conflicts. The older BT-946C/956C/956CD also have this configuration option, but the factory default setting is "Primary".

### PCI Slot Scanning Order

In systems with multiple BusLogic PCI Host Adapters, the order in which the PCI slots are scanned may appear reversed with the BT-948/958/958D as compared to the BT-946C/956C/956CD. For booting from a SCSI disk to work correctly, it is necessary that the host adapter's BIOS and the kernel agree on which disk is the boot device, which requires that they recognize the PCI host adapters in the same order. The motherboard's PCI BIOS provides a standard way of enumerating the PCI host adapters, which is used by the Linux kernel. Some PCI BIOS implementations enumerate the PCI slots in order of increasing bus number and device number, while others do so in the opposite direction.

Unfortunately, Microsoft decided that Windows 95 would always enumerate the PCI slots in order of increasing bus number and device number regardless of the PCI BIOS enumeration, and requires that their scheme be supported by the host adapter's BIOS to receive Windows 95 certification. Therefore, the factory default settings of the BT-948/958/958D enumerate the host adapters by increasing bus number and device number. To disable this feature, invoke the AutoSCSI utility via Ctrl-B at system startup and select "Adapter Configuration", "View/Modify Configuration", press Ctrl-F10, and then change the "Use Bus And Device # For PCI Scanning Seq." option to OFF.

This driver will interrogate the setting of the PCI Scanning Sequence option so as to recognize the host adapters in the same order as they are enumerated by the host adapter's BIOS.

## Enabling UltraSCSI Transfers

The BT-948/958/958D ship with their configuration set to "Factory Default" settings that are conservative and do not allow for UltraSCSI speed to be negotiated. This results in fewer problems when these host adapters are installed in systems with cabling or termination that is not sufficient for UltraSCSI operation, or where existing SCSI devices do not properly respond to synchronous transfer negotiation for UltraSCSI speed. AutoSCSI may be used to load "Optimum Performance" settings which allow UltraSCSI speed to be negotiated with all devices, or UltraSCSI speed can be enabled

on an individual basis. It is recommended that SCAM be manually disabled after the "Optimum Performance" settings are loaded.

## Driver Options

BusLogic Driver Options may be specified either via the Linux Kernel Command Line or via the Loadable Kernel Module Installation Facility. Driver Options for multiple host adapters may be specified either by separating the option strings by a semicolon, or by specifying multiple "BusLogic=" strings on the command line. Individual option specifications for a single host adapter are separated by commas. The Probing and Debugging Options apply to all host adapters whereas the remaining options apply individually only to the selected host adapter.

The BusLogic Driver Probing Options comprise the following:

### NoProbe

The "NoProbe" option disables all probing and therefore no BusLogic Host Adapters will be detected.

### NoProbePCI

The "NoProbePCI" options disables the interrogation of PCI Configuration Space and therefore only ISA Multimaster Host Adapters will be detected, as well as PCI Multimaster Host Adapters that have their ISA Compatible I/O Port set to "Primary" or "Alternate".

### NoSortPCI

The "NoSortPCI" option forces PCI MultiMaster Host Adapters to be enumerated in the order provided by the PCI BIOS, ignoring any setting of the AutoSCSI "Use Bus And Device # For PCI Scanning Seq." option.

### MultiMasterFirst

The "MultiMasterFirst" option forces MultiMaster Host Adapters to be probed before FlashPoint Host Adapters. By default, if both FlashPoint and PCI MultiMaster Host Adapters are present, this driver will probe for FlashPoint Host Adapters first unless the BIOS primary disk is controlled by the first PCI MultiMaster Host Adapter, in which case MultiMaster Host Adapters will be probed first.

### FlashPointFirst

The "FlashPointFirst" option forces FlashPoint Host Adapters to be probed before MultiMaster Host Adapters.

The BusLogic Driver Tagged Queuing Options allow for explicitly specifying the Queue Depth and whether Tagged Queuing is permitted for each Target Device (assuming that the Target Device supports Tagged Queuing). The Queue Depth is the number of SCSI Commands that are allowed to be concurrently presented for execution (either to the Host Adapter or Target Device). Note that explicitly enabling Tagged Queuing may lead to problems; the option to enable or disable Tagged Queuing is provided primarily to allow disabling Tagged Queuing on Target Devices that do not implement it correctly. The following options are available:

### QueueDepth:<integer>

The "QueueDepth:" or "QD:" option specifies the Queue Depth to use for all Target Devices that support Tagged Queuing, as well as the maximum Queue Depth for devices that do not support Tagged Queuing. If no Queue Depth option is provided, the Queue Depth will be determined automatically based on the Host Adapter's Total Queue Depth and the number, type, speed, and capabilities of the detected Target Devices. Target Devices that do not support Tagged Queuing always have their Queue Depth set to BusLogic\_UntaggedQueueDepth or BusLogic\_UntaggedQueueDepthBB, unless a lower Queue Depth option is provided. A Queue Depth of 1 automatically disables Tagged Queuing.

### QueueDepth:[<integer>,<integer>...]

The "QueueDepth:[...]" or "QD:[...]" option specifies the Queue Depth individually for each Target Device. If an <integer> is omitted, the associated Target Device will have its Queue Depth selected automatically.

### TaggedQueuing:Default

The "TaggedQueuing:Default" or "TQ:Default" option permits Tagged Queuing based on the firmware version of the BusLogic Host Adapter and based on whether the Queue Depth allows queuing multiple commands.

### TaggedQueuing:Enable

The "TaggedQueuing:Enable" or "TQ:Enable" option enables Tagged Queuing for all Target Devices on this Host Adapter, overriding any limitation that would otherwise be imposed based on the Host Adapter firmware version.

### TaggedQueuing:Disable

The "TaggedQueuing:Disable" or "TQ:Disable" option disables Tagged Queuing for all Target Devices on this Host Adapter.

#### TaggedQueuing:<Target-Spec>

The "TaggedQueuing:<Target-Spec>" or "TQ:<Target-Spec>" option controls Tagged Queuing individually for each Target Device. <Target-Spec> is a sequence of "Y", "N", and "X" characters. "Y" enables Tagged Queuing, "N" disables Tagged Queuing, and "X" accepts the default based on the firmware version. The first character refers to Target Device 0, the second to Target Device 1, and so on; if the sequence of "Y", "N", and "X" characters does not cover all the Target Devices, unspecified characters are assumed to be "X".

The BusLogic Driver Miscellaneous Options comprise the following:

#### BusSettleTime:<seconds>

The "BusSettleTime:" or "BST:" option specifies the Bus Settle Time in seconds. The Bus Settle Time is the amount of time to wait between a Host Adapter Hard Reset which initiates a SCSI Bus Reset and issuing any SCSI Commands. If unspecified, it defaults to BusLogic\_DefaultBusSettleTime.

#### InhibitTargetInquiry

The "InhibitTargetInquiry" option inhibits the execution of an Inquire Target Devices or Inquire Installed Devices command on MultiMaster Host Adapters. This may be necessary with some older Target Devices that do not respond correctly when Logical Units above 0 are addressed.

The BusLogic Driver Debugging Options comprise the following:

#### TraceProbe

The "TraceProbe" option enables tracing of Host Adapter Probing.

#### TraceHardwareReset

The "TraceHardwareReset" option enables tracing of Host Adapter Hardware Reset.

#### TraceConfiguration

The "TraceConfiguration" option enables tracing of Host Adapter Configuration.

#### TraceErrors

The "TraceErrors" option enables tracing of SCSI Commands that return an error from the Target Device. The CDB and Sense Data will be printed for each SCSI Command that fails.

#### Debug

The "Debug" option enables all debugging options.

The following examples demonstrate setting the Queue Depth for Target Devices 1 and 2 on the first host adapter to 7 and 15, the Queue Depth for all Target Devices on the second host adapter to 31, and the Bus Settle Time on the second host adapter to 30 seconds.

Linux Kernel Command Line:

```
linux BusLogic=QueueDepth:[,7,15];QueueDepth:31,BusSettleTime:30
```

LILO Linux Boot Loader (in /etc/lilo.conf):

```
append = "BusLogic=QueueDepth:[,7,15];QueueDepth:31,BusSettleTime:30"
```

INSMOD Loadable Kernel Module Installation Facility:

```
insmod BusLogic.o \  
    'BusLogic="QueueDepth:[,7,15];QueueDepth:31,BusSettleTime:30"'
```

#### **Note**

Module Utilities 2.1.71 or later is required for correct parsing of driver options containing commas.

## **Driver Installation**

This distribution was prepared for Linux kernel version 2.0.35, but should be compatible with 2.0.4 or any later 2.0 series kernel.

To install the new BusLogic SCSI driver, you may use the following commands, replacing "/usr/src" with wherever you keep your Linux kernel source tree:

```
cd /usr/src
tar -xvzf BusLogic-2.0.15.tar.gz
mv README.* LICENSE.* BusLogic.[ch] FlashPoint.c linux/drivers/scsi
patch -p0 < BusLogic.patch (only for 2.0.33 and below)
cd linux
make config
make zImage
```

Then install "arch/x86/boot/zImage" as your standard kernel, run lilo if appropriate, and reboot.

## BusLogic Announcements Mailing List

The BusLogic Announcements Mailing List provides a forum for informing Linux users of new driver releases and other announcements regarding Linux support for BusLogic SCSI Host Adapters. To join the mailing list, send a message to "[buslogic-announce-request@dandelion.com](mailto:buslogic-announce-request@dandelion.com)" with the line "subscribe" in the message body.