



endace  
a c c e l e r a t e d

## DAG 3.7D Card User Guide

EDM01-16



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When present on equipment this manual pertains to, the statement "This device complies with part 15 of the FCC rules" specifies the equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the Federal Communications Commission [FCC] Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

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# Contents

<b>Introduction</b>	<b>1</b>
Overview .....	1
Card Features .....	1
Purpose of this User Guide .....	1
System Requirements .....	2
General .....	2
Operating System .....	2
Other Systems .....	2
Card Description .....	3
Battery removal – don't do it! .....	3
Card Architecture .....	4
Line Types .....	5
Supported Types .....	5
<b>Installation</b>	<b>7</b>
Introduction .....	7
DAG Software package .....	7
Inserting the DAG Card .....	7
Port Connectors .....	8
Coaxial Transceivers .....	9
Connecting to the Network .....	9
Router .....	9
DSX-3 Tap .....	9
<b>Configuring the DAG card</b>	<b>11</b>
Introduction .....	11
Before configuring the DAG card .....	11
Firmware images .....	11
Full Line Rate Configuration .....	12
E3 Fractional Configuration .....	12
Kentrox Substrate Configuration .....	12
Setting up the FPGA .....	13
Programming the FPGA .....	13
dagrom .....	14
Loading new firmware images onto a DAG Card .....	15
Preparing the DAG card for use .....	15
Configuring the DAG card .....	16
Display Current Configuration .....	16
dagconfig tokens explained .....	21
dagconfig options .....	28
dagthree options .....	29
Viewing the DAG card status .....	30
Interface Status .....	30
Extended status .....	30
<b>Using your DAG card to capture data</b>	<b>31</b>
Introduction .....	31
Basic data capture .....	31
Starting a capture session .....	31
dagsnap .....	32
Capturing data at high speed .....	33
Viewing captured data .....	34
dagbits .....	34
Converting captured data .....	36
Dagconvert .....	37

Using third party applications .....	38
<b>Synchronizing Clock Time</b> .....	<b>39</b>
Overview .....	39
DUCK Configuration.....	39
Common Synchronization .....	39
Network Time Protocol.....	40
Timestamps.....	41
Example .....	41
Dagclock.....	42
Dagclock Statistics reset.....	43
Dagclock output explained .....	44
Card with Reference .....	46
Overview .....	46
Pulse Signal from External Source .....	46
Connecting the Time Distribution Server .....	46
Testing the Signal .....	46
Single Card No Reference .....	47
Two Cards No Reference .....	48
Overview .....	48
Synchronizing with Each Other .....	48
Synchronizing with Host.....	49
Connector Pin-outs .....	50
Overview .....	50
Pin Assignments.....	50
<b>Data Formats</b> .....	<b>51</b>
Overview .....	51
Generic ERF Header .....	52
ERF 1. TYPE_POS_HDLC.....	54
ERF 3. TYPE_ATM.....	55
Extension Headers (EH).....	56
Introduction .....	56
<b>Troubleshooting</b> .....	<b>57</b>
Reporting Problems .....	57
<b>Version History</b> .....	<b>59</b>

## Overview

The Endace DAG 3.7D card provides the means to transfer data at the full speed of the network into the memory of the host PC, with zero packet loss in even worst-case conditions. Further, unlike a Network Interface Card (NIC), Endace products actively manage the movement of network data into memory while only consuming a minimal amount of the host computer's resources. The full attention of the CPU remains focused on the analysis of incoming data without a constant stream of interruptions as new packets arrive from the network. For a busy network link, this feature has a turbo-charging effect similar to that of adding a second CPU to the system.

The DAG 3.7D is a two port. PCI card that allows capture and transmission of data. It supports packet and cell capture for DS3/E3, ATM and HDLC networks. It has two interfaces which may be used simultaneously to allow a single card to monitor either one or both directions of a full duplex link.

## Card Features

The following features are available on this DAG card. **Note:** Different firmware images may be required. Not all features are available on each firmware image. For further information on which feature is available in what firmware image, see [Firmware images](#) (page 11).

- DS3, E3, ATM and HDLC
- Frame Relay
- Kentrox Subrate
- Cisco Fractional

## Purpose of this User Guide

The purpose of this User Guide is to provide you with an understanding of the DAG 3.7D card architecture, functionality and to guide you through the following:

- Installing the card and associated software and firmware
- Configuring the card for your specific network requirements
- Running a data capture session
- Synchronizing clock time
- Data formats

You can also find additional information relating to functions and features of the DAG 3.7D card in the following documents which are available from the Support section of the Endace website at <http://www.endace.com>:

- *EDM04-01 DAG Software Installation Guide*
- *EDM04-03 dagflood User Manual*
- *EDM04-04 dagfwdemo User Guide*
- *EDM04-06 Daggen User Guide*
- *EDM04-08 Configuration and Status API Programming Guide*
- *EDM04-19 DAG Programming Guide*
- *EDM05-01 Time Distribution Server User Guide*
- *EDM11-01 ERF types*

This User Guide and the *EDM04-01 DAG Software Installation Guide* are also available in PDF format on the installation CD shipped with your DAG 3.7D card.

## System Requirements

### General

The minimum system requirements for the DAG 3.7D card are:

- A computer, with at least a Intel Xeon 1.8GHz or faster and a minimum of 1GB RAM.
- At least one free PCI slot supporting 33 MHz operation.
- Software distribution requires 60MB free space.
- For details of the supported operating systems, see one of the following documents:
  - *EDM04-01 DAG Software Installation Guide*
  - Current release notes - See the Documentation CD or the Endace support website at <https://www.endace.com/support>.

### Operating System

This document assumes you are installing the DAG 3.7D card in a computer which already has an operating system installed. To install refer to *EDM04-01 DAG Software Installation Guide*. All related documentation is included on the CD shipped with the DAG 3.7D card.

### Other Systems

For advice on using an operating system that is substantially different from any of those specified above, please contact Endace Customer Support at [support@endace.com](mailto:support@endace.com).

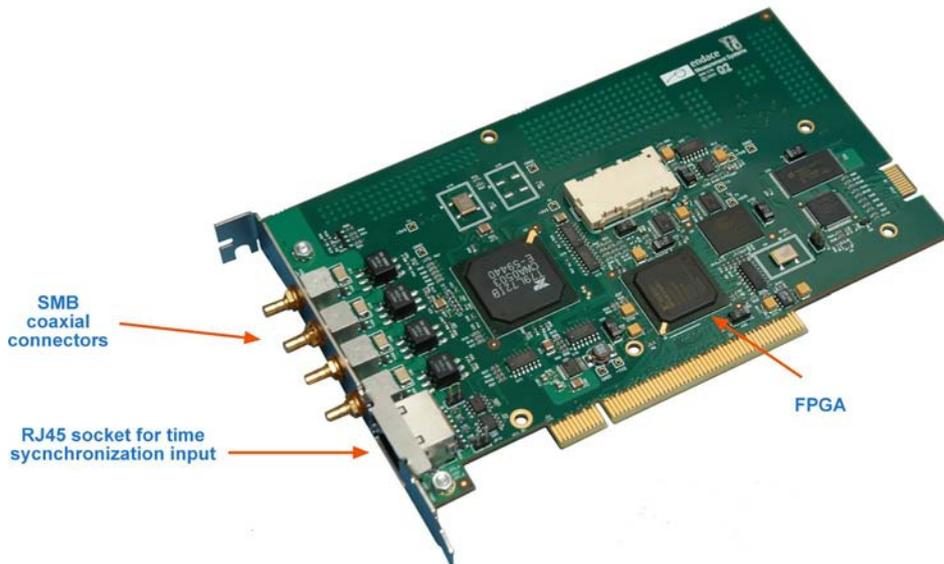
## Card Description

The DAG 3.7D card has two DS3/E3 co-axial interfaces each of which are able to receive and transmit. It is capable of capturing 100% of traffic at full line rate over ATM, HDLC, frame relay and channelized networks.

**Note:** Transmit is not currently supported on the DAG 3.7D card.

The DAG 3.7D supports Kentrox format subrate DS3 but requires a specific image to do so. Please contact Endace Technical Support at [support@endace.com](mailto:support@endace.com) for more information.

The DAG 3.7D card is shown below:



The key features of the card are:

- Four SMB format DS3/E3 network interfaces (2 x receive, 2 x transmit).
- 100% capture into host memory of IP packets between 40 and 1500 bytes.
- Supports DSX-3 monitor mode.
- Full, header only, or variable length packet capture.
- Conditioned clock with 1-PPS input and local synchronization capability.
- 32-bit 33MHz PCI 2.9 compliant bus interface with 3.3V signalling.

### **Battery removal – don't do it!**

**Removing the battery from a DAG card voids your warranty.**

Removing the battery from a DAG card will cause the loss of encryption key used to decode the DAG card's firmware. Once the encryption key is lost the DAG card must be returned to Endace for reprogramming.

The battery in this product is expected to last a minimum of 10 years.

### **Caution**

Risk of explosion if the battery is replaced by an incorrect type.  
Dispose of used batteries carefully.

## Card Architecture

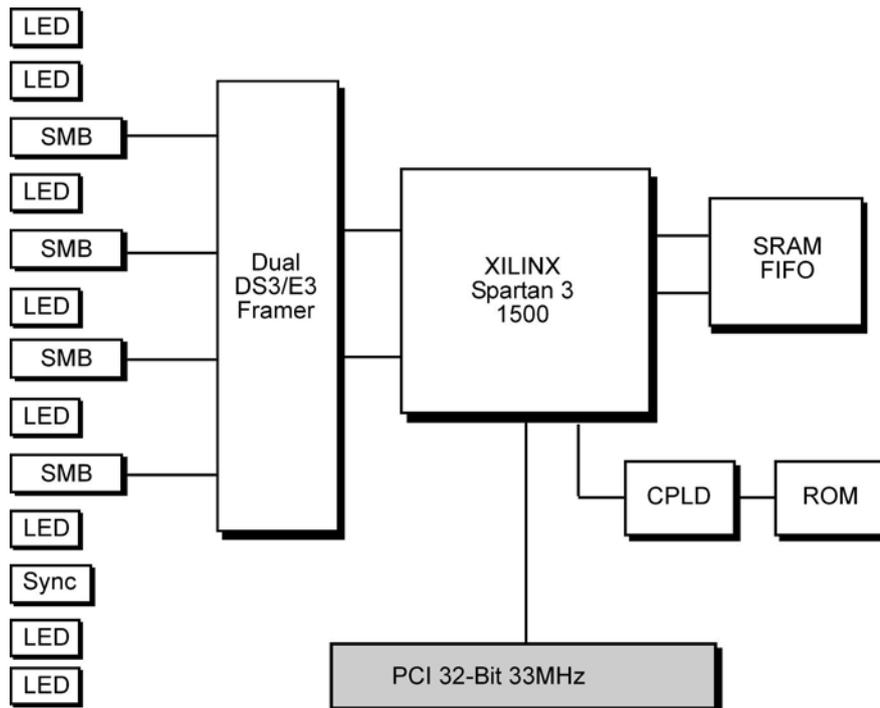
Serial PDH data received by the two coaxial interfaces feeds into the dual DS3/E3 framer. The network data is then directed to the Field Programmable Gate Array (FPGA). The FPGA also contains the DAG Universal Clock Kit (DUCK) timestamp engine which provides high resolution per-packet timestamps which can be accurately synchronized.

The close association of these two components means that packets or cells can be time-stamped very accurately. The time stamped packet records are stored in the FIFO which interfaces to the PCI bus via the FPGA.

**Note:** For further information on the DUCK and time synchronizing, see [Synchronizing Clock Time](#) (page 39).

All packet records are written to host PC memory during capture operations.

The diagram below shows the DAG 3.7D card's major components and flow of data:



## Line Types

It is important that you understand the physical characteristics of the network to which you want to connect. If your configuration settings do not match your network, the DAG 3.7D card will not function as expected.

There are various Ethernet line speeds and corresponding protocols which are identified using the IEEE naming convention. Each line speed has a set of requirements associated with it relating to the type of cable, maximum allowable distance, etc.

**Note:** If you are unsure about which of the options listed below to apply to your network, please contact your Network Administrator for further information.

### Supported Types

The line characteristics supported by the DAG 3.7D card are described below.

Line Types	Description
DS3	Digital Signal 3 - North American digital standard 44.736Mbps (also referred to as T3).
E3	European digital standard 34.38Mbps
Line Rate	Description
Full	The full speed of the network, either DS3 or E3 as described above.
Fractional	A fraction of the full speed of the network. There are several proprietary fractional rates available. Please contact your network provider for further details. The DAG 3.7D supports fractional E3 only and the rate is represented as the number of timeslots used out of a possible 95.
Data Type	Description
ATM	Asynchronous Transfer Mode which carries data in small fixed sized cells.
HDLC	High-level Data Link Control which carries data in variable sized frames.
Encoding Type	Description
B3ZS	Bipolar with Three Zero Substitution (DS3 only)
HDB3	Hi-Density Bipolar Three Zeros (E3 only)



## Introduction

The DAG 3.7D card can be installed in any free 3.3V PCI slot.

Although the DAG driver supports up to sixteen DAG cards in one system, limitations on the number of available slots in most computers means that it is not usually possible to support more than 3-4 DAG cards in the same computer.

## DAG Software package

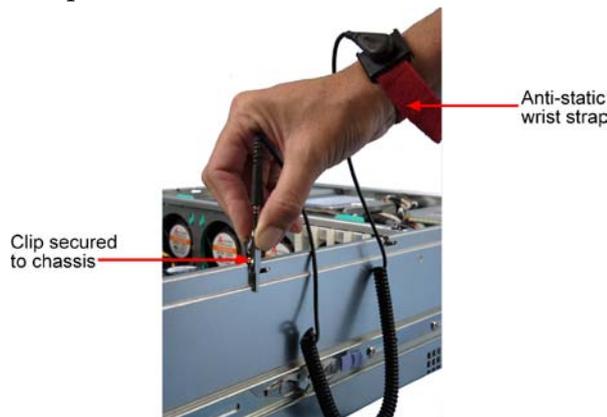
The latest DAG Software package must be installed before you install the DAG 3.7D card itself. See *EDM04-01 DAG Software Installation Guide*, which is included on the CD shipped with the DAG 3.7D card.

## Inserting the DAG Card

### Caution:

It is very important to protect both the computer and the DAG 3.7D card from damage by electro-static discharge (ESD). Failure to do so could cause damage to components and subsequently cause the card to partially or completely fail.

1. Turn power to the computer OFF.
2. Remove the PCI bus slot screw and cover.
3. Using an approved ESD protection device attach the end with the strap to your wrist and pull or clip firmly so there is firm contact with your wrist.
4. Securely attach the clip on the other end of the strap to a solid metal area on the computer chassis as shown below.

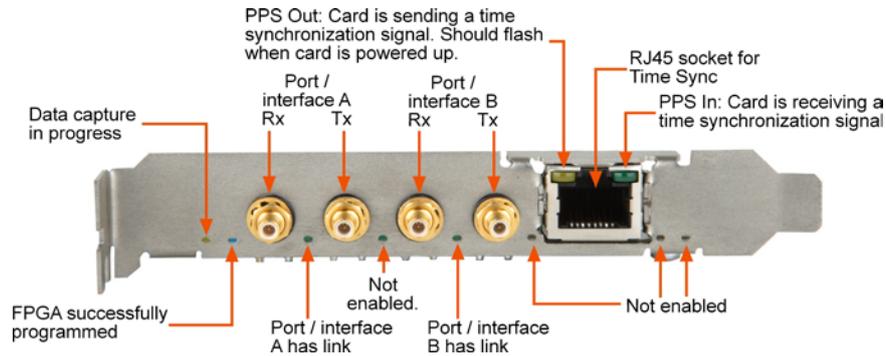


5. Insert the DAG 3.7D card into PCI bus slot ensuring it is firmly seated.
6. If this DAG card requires an external power supply, complete the following steps:
  - a. Connect the supplied (or equivalent) power cable to the external power connector on the DAG card.
  - b. Connect the cable to the appropriate power connector on your server's power supply unit.
7. Check the free end of the card fits securely into the card-end bracket that supports the weight of the card.
8. Secure the card with the bus slot cover screw.
9. Turn power to the computer ON.
10. Ensure the blue (FPGA successfully programmed) LED on the DAG card illuminates.

## Port Connectors

The DAG 3.7D has four coaxial SMB connectors consisting of two pairs. One connector in each pair is used for the receive signal and the other connector of each pair is used for the transmit signal as shown below:

**Note:** The DAG 3.7D firmware does not currently support transmission.



In addition there is an 8-pin RJ45 socket located below the port connectors which is available to connect to a time synchronization source.

**Caution:** Never connect anything other than a PPS input to the time synchronization sockets.

## Coaxial Transceivers

The input signal to the DAG card must be within the receiver's dynamic range. If it is slightly outside of this range it will cause an increased bit error rate. If it is significantly outside of this range the system will not be able to lock onto the signal.

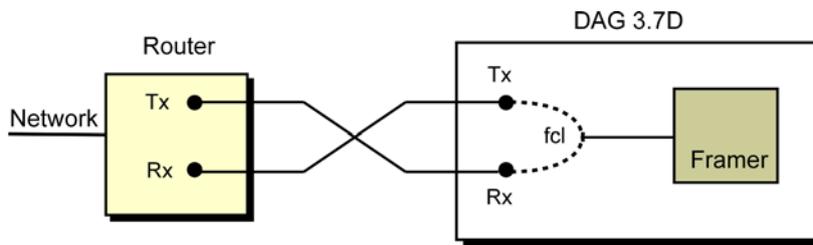
The DAG 3.7D card supports industry standard SMB coaxial connectors. Endace recommends that you use the 75Ω SMB to 75 Ω BNC 1m cables which are supplied with the card.

## Connecting to the Network

You can connect the DAG 3.7D to the network using either a router or a DSX-3 tap. Depending upon which method you are using you will need to configure your connection as shown below:

**Note:** If you are unsure of the method used to connect to the network please consult your system administrator for more information.

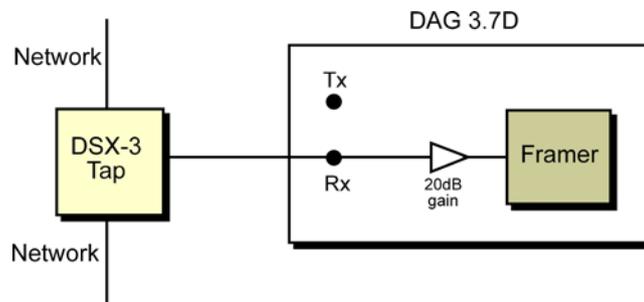
### Router



If you are connecting to the network via a router you must provide a complete circuit by enabling facility loopback (`fcl`) on the card. In this configuration you should set `monitor` mode to **OFF**.

For more information on configuring `fcl` and `monitor` mode please see [Configuring the DAG card](#) (page 16) later in this user guide.

### DSX-3 Tap



If you are not connecting to the network via a router you can use a DSX-3 tap as shown above. In this configuration the supports DSX-3 monitor mode so you should set `monitor` mode to **ON**.

For more information on configuring `monitor` mode please see [Configuring the DAG card](#) (page 11) later in this user guide.



# Configuring the DAG card

## Introduction

Configuring the DAG 3.7D card ready for capturing data requires the following steps:

- [Setting up the FPGA](#) (page 13)
- [Preparing the DAG card for use](#) (page 15)
- [Configuring the DAG Card](#) (page 16)
- [Viewing the DAG card statistics](#) (page 30)

Once the DAG 3.7D is configured you can start capturing data, see [Using your DAG card to capture data](#) (page 31) for details on capturing data.

## Before configuring the DAG card

Before configuring the FPGA, you should ensure that:

- `dagmem` has been run and memory allocated to each installed DAG card.
- `dagload` has been run so that all DAG drivers have been installed.

Refer to the *Installing the drivers* section for the required Operating system in *EDM04-01 DAG Software Installation Guide* for the further details.

## Firmware images

The following lists the features available on each firmware image available on this DAG card.

FPGA image (Software version string)	DS3	E3	Framed Relay	Cisco Fractional	Kentrox Subrate	ATM	HDLC
dag37dpci_erf.bit (dag37dpci_erf_pci...)	✓	✓	✓			✓	✓
dag37dpci_fract3.bit (dag37dpci_fract3_pci...)		✓		✓			
dag37dpci_kentrox.bit (dag37dpci_kentrox_pci...)	✓				✓		

The software version strings are displayed in the `dagconfig` output and when using the `dagrom -x` command. They include a version number and creation date.

The FPGA image that you load on the card will depend upon the type of data you want to capture. The DAG 3.7D card supports the following types of capture:

- DS3 framed full line rate ATM
- DS3 framed, full line rate HDLC
- E3 framed full line rate ATM
- E3 framed full line rate HDLC
- E3 framed HDLC Cisco fractional
- DS3 Kentrox subrate

There are two FPGA images shipped as standard with the DAG 3.7D card. One is for use with full line rate capture and the other is for use with E3 fractional capture.

However the Kentrox subrate is a proprietary application. If you wish to use this you should contact Endace Technical Support at [support@endace.com](mailto:support@endace.com) for further information on obtaining the appropriate firmware image.

See [Full Line Rate Configuration](#) (page 12), [Fractional Configuration](#) (page 12) and [Kentrox Subrate Configuration](#) (page 12) for detailed information on configuring the card for specific applications.

### **Full Line Rate Configuration**

Configuring the DAG 3.7D card for full line rate capture will enable you to capture data at the full speed of the network.

### **E3 Fractional Configuration**

Configuring the DAG 3.7D card for fractional capture allows you to capture data from a fractional **E3 HDLC** network. Fractional rate is a fraction of the full speed of the network. The fractional rate supported by the DAG 3.7D is measured as the number of timeslots used to carry data out of a possible 95.

There are a several proprietary fractional rates available. Please consult your network provider if you are unsure of the fractional rate you are using.

### **Kentrox Subrate Configuration**

Kentrox Subrate is one of several proprietary fractional rates which use a fraction of the full speed of the network. Kentrox Subrate is available on **DS3 HDLC** networks only. Configuring the DAG 3.7D card for Kentrox Subrate capture allows you to capture data from a Network if you are using the proprietary Kentrox Subrate.

**Note:** The maximum line rate available for Kentrox Subrate is 35Mbps.

## Setting up the FPGA

All DAG cards have at least one Field-Programmable Gate Array (FPGA). The FPGA contains the firmware for the DAG card. The firmware defines how the DAG card operates when capturing data and contains the specific configuration.

**Note:** Some DAG cards have multiple FPGA's.

For each FPGA there are two firmware images:

- a factory image - contains fixed basic functionality for operating the DAG card.
- a user image - contains an upgradable version of the DAG card firmware. Additional functionality for the DAG card is available via the user image. Different user images may be available with different functionality, i.e. TERF, DSM etc.

Firmware images are loaded into DAG card flash ROM in the factory. The image is programmed into the FPGA each time the DAG card is powered up. The user image can then be programmed into the FPGA either manually or via a script.

### Programming the FPGA

Before configuring the DAG card for capture, you must load and program the DAG card with the appropriate FPGA image.

**Note:** For information about the `dagrom` options, see [dagrom](#) (page 14).

Load the appropriate FPGA image using `dagrom` as follows:

For full line rate capture load the card with the FPGA image:

```
dagrom -d0 -rvp dag37dpci-erf.bit
```

For fractional rate capture load the card with the FPGA image:

```
dagrom -d0 -rvp dag37dpci-frace3.bit
```

For Kentrox Substrate capture you must load the card with the FPGA image:

```
dagrom -d0 -rvp dag37dpci-kentrox.bit
```

(where "0" is the device number of the DAG card you wish to capture data from). The filename of the FPGA image may differ from the above depending on the version required.

## dagrom

dagrom is a software utility that enables you to configure the FPGA on Endace DAG cards. The following is a list of options available in dagrom.

Option	Description
-a,--alternate-half	Use alternate (stable) half. [Default is current half.] Factory / User.
-A,--entire-rom	Entire ROM. [Default is current half only.]
-b,--swid-rom-check	Check if there is a SWID on the ROM.
-c,--cpu-region <region>	Access CPU region: c=copro, b=boot, k=kernel, f=filesystem.
--continue	Continue on erase error.
-d,--device <device>	DAG device to use.
-e,--erase	Erase ROM. [Default is read.]
-F,--disable-cfi-fast	Disable fast program option for CFI mode.
-f,--file <filename>	File to be read when programming ROM. There are multiple FPGA images per DAG card, covering the different versions, ERF, TERF DSM etc.
--force	Force loading firmware. Dangerous.
-g,--rom-number <rom>	Access specified ROM controller. [Default is 0.]
-h,--help -?,--usage	This page.
-i,--halt-ixp	Halt the embedded IXP Processor (DAG 7.1S only).
--image-table-fpga <image table fpga>	Specify the Power On image selection table FPGA number
--image-table-image <image table image>	Specify the Power On image selection table Image number
-j,--swid-rom-check-key <key>	Check the ROM SWID key with the one supplied.
-l,--hold-bus	Hold PBI bus from XScale (DAG 3.7T only).
-m,--swid-key <key>	Hexadecimal key for writing the Software ID (aka SWID).
-o,--swid-rom-read	Read SWID from ROM.
-p,--program-current	Program current User 1 Xilinx image into FPGA.
-q,--image-number <image number>	Specify the image number to write or to program the card.[0 - 3]. 0 factory image, 1 user image 1, 2 user image 2, 3 user image 3. (7.5G2/G4 only)
--swid-write <swid>	Write given SWID. The key must be supplied with the -m option, requires a valid running XScale ROM Image. (3.7T, 3.7D, 3.8S and 7.1S only)
-r,--reprogram	Reprogram ROM (may imply erase and write).
--reset-method <reprogram method>	Specify the method to reprogram the card.[1.Ringo 2.George 3.Dave]
-s,--swid-rom-write <swid>	Write given SWID to ROM. The key must be supplied with the -m option.
-t,--swid-read-bytes <bytes>	Read <bytes> of SWID, requires a valid running XScale ROM image (3.7T only)
-u,--swid-erase	Erase SWID from ROM.
--unknown	Force loading firmware. Dangerous.
-v,--verbose	Increase verbosity.
-V,--version	Display version information.
-w,--write	Write ROM (implies erase). [Default is read.]
--write-out <filename>	Write the contents of the ROM to a file.
-x,--list-revisions	Display Xilinx revision strings (the default if no arguments are given).
-y,--verify	Verify write to ROM.
-z,--zero	Zero ROM. [Default is read.]

All commands apply to the current image portion of the ROM, unless one of the options -a, -A, -c is specified.

**Note:** Not all commands are supported by all DAG cards.

## Loading new firmware images onto a DAG Card

New DAG card FPGA images are released regularly by Endace as part of software packages. They can be downloaded from the Endace website at <https://www.endace.com/support>.

Endace recommends you use the `dagrom -r` command when loading images from the computer to the ROM on the DAG card.

The `-r` option invokes a comparison of images on the computer and in the DAG card. Newer versions are automatically loaded onto the DAG card and programmed into the FPGA. See [dagrom](#) (page 14). This eliminates unnecessary reprogramming of the ROM and extends its life.

## Preparing the DAG card for use

Before configuring the DAG 3.7D card you must run the following `dagconfig` command to set the default parameters in the DAG card. This ensures the DAG 3.7D card functions correctly once you begin capturing data.

**Note:** Ensure you run this command each time the FPGA is reprogrammed.

```
dagconfig -d0 default
```

The current DAG 3.7D configuration displays and the firmware is verified as correctly loaded. See [dagconfig](#) (page 28) for more information.

## Configuring the DAG card

### Display Current Configuration

Once you have loaded the FPGA image you should run the `dagconfig` tool without arguments to display the current card configuration and verify the firmware has been loaded correctly.

To display the current DAG card configuration, type the following:

```
dagconfig -d0 default
```

where "0" is the device number of the DAG card you wish to capture data from. A description of available tokens follows.

**Note:** If you are connected to the network via a Cisco Systems router, the relevant Cisco commands are included in *blue* for your reference.

Not all tokens displayed in the following diagram.

`dagthree` has been depreciated from DAG Software release 3.2 onwards. It has been replaced with `dagconfig`. Both are still valid. Endace recommends that new customer use `dagconfig`.

### DS3 Framed Full Line Rate ATM

You can display the default configuration using:

```
dagconfig -d0 default_ds3_atm
```

```
Firmware: dag37dpci_erf_pci_v2_9 3s1500fg456 2007/10/05 18:07:12 (user)
Serial : 7000003
```

```
Port A: noeql fcl ds3_cbit atm norx_monitor crc32 descramble nodiscard
Port B: noeql fcl ds3_cbit atm norx_monitor crc32 descramble nodiscard
```

```
GPP0:
varlen slen=48 align64
```

```
Port A: drop_count = 1371
Port B: drop_count = 1452
```

```
PCI Burst Manager:
33MHz
buffer_size=128 rx_streams=1 tx_streams=0 nodrop
```

```
Memory Streams:
mem=128
```

Cisco: framing {m23plcp | cbitplcp | m23adm | cbitadm}

**Note:** Enabling the pre-amplifier using `rx_monitor` adds approx 20dB of linear amplification for monitor applications where the signal has been reduced 20dB with resistive tap circuits.

### DS3 Framed Full Line Rate HDLC

You can display the default configuration using:

```

dagconfig -d0 default_ds3_hdlc

Firmware: dag37dpci_erf_pci_v2_9 3s1500fg456 2007/10/05 18:07:12 (user)
Serial : 7000003
Sets (eq) or unsets (noeq) equipment loopback.
Sets the card to receive HDLC cells.
Sets the expected size of the crc for the receive packet processor
Enables (discard) or disables (nodiscard) discarding of CRC bytes.
Port A: noeq1 fcl ds3_cbit hdlc norx_monitor crc32 nodescramble nodiscard
noff00del
Port B: noeq1 fcl ds3_cbit hdlc norx_monitor crc32 nodescramble nodiscard
noff00del
Enables (ffoodel) or disables (noffoodel) deletion of extra bits inserted by some routers when receiving E3 HDLC.
Default DS3 framing mode.
Enables (rx_monitor) or disables (norx_monitor) LIU monitor mode pre-amplifier
Enables (descramble) or disables (nodescramble) receive cell descrambling.
GPP0:
varlen slen=48 align64 ← First 48 bytes of packet will be captured.
Captured records will be 64-bit aligned
Port A: drop_count = 156
Port B: drop_count = 153 ← Number of packets dropped on each port during current capture session.
PCI Burst Manager:
33MHz
buffer_size=128 rx_streams=1 tx_streams=0 nodrop
Memory Streams:
mem=128 ← Total memory in MiB available to the card for capture.
Memory in MB allocated to the rx (128MB)

```

Cisco: no framing or framing {cbit | m13} Framing bypass not supported

**Note:** Enabling the pre-amplifier using `rx_monitor` adds approx 20dB of linear amplification for monitor applications where the signal has been reduced 20dB with resistive tap attenuator circuits.

### E3 Framed Full Line Rate ATM

You can display the default configuration using:

```

dagconfig -d0 default_e3_atm

Firmware: dag37dpci_erf_pci_v2_9 3s1500fg456 2007/10/05 18:07:12 (user)
Serial : 7000003
Sets (eq) or unsets (noeq) equipment loopback.
Sets the card to receive ATM cells.
Enables (descramble) or disables (nodescramble) receive cell descrambling.
Port A: noeq1 fcl e3_g751 atm norx_monitor crc32 descramble nodiscard
Port B: noeq1 fcl e3_g751 atm norx_monitor crc32 descramble nodiscard
Sets (fcl) or unsets (nofcl) equipment loopback.
Default E3 framing mode.
Enables (rx_monitor) or disables (norx_monitor) LIU monitor mode pre-amplifier
Enables (discard) or disables (nodiscard) discarding of CRC bytes.
GPP0:
varlen slen=48 align64 ← Captured records will be 64-bit aligned
Port A: drop_count = 7589
Port B: drop_count = 7095 ← Number of packets dropped on each port during current capture session.
PCI Burst Manager:
33MHz
buffer_size=128 rx_streams=1 tx_streams=0 nodrop
Memory Streams:
mem=128 ← Total memory in MiB available to the card for capture.
Memory in MB allocated to the rx (128MB)

```

Cisco: framing { g751adm | g751plcp }

**Note:** Enabling the pre-amplifier using `rx_monitor` adds approx 20dB of linear amplification for monitor applications where the signal has been reduced 20dB with resistive attenuator tap circuits.

### E3 Framed Full Line Rate HDLC

You can display the default configuration using:

```

dagconfig -d0 default_e3_hdlc

Firmware: dag37dpci_erf_pci_v2_9 3s1500fg456 2007/10/05 18:07:12 (user)
Serial : 7000003

Port A: noeql fcl e3_g751_if hdlc norx_monitor crc16 nodescramble nodiscard ff00del
Port B: noeql fcl e3_g751_if hdlc norx_monitor crc16 nodescramble nodiscard ff00del

GPP0:
varlen slen=48 align64

Port A: drop_count = 138
Port B: drop_count = 145

PCI Burst Manager:
33MHz
buffer_size=128 rx_streams=1 tx_streams=0 nodrop

Memory Streams:
mem=128
    
```

**Sets (eql) or unsets (noeql) equipment loopback.** (points to noeql)

**Sets the card to receive HDLC cells.** (points to fcl)

**Sets the expected size of the crc for the receive packet processor** (points to crc16)

**Enables (descramble) or disables (nodescramble) receive cell descrambling.** (points to nodescramble)

**Enables (discard) or disables (nodiscard) discarding of CRC bytes.** (points to nodiscard)

**Sets (fcl) or unsets (nofcl) equipment loopback.** (points to fcl)

**E3 framing mode. Should always be e3\_g751\_cbit for full line rate capture.** (points to e3\_g751\_if)

**Enables (rx\_monitor) or disables (norx\_monitor) LIU monitor mode pre-amplifier. See note below.** (points to norx\_monitor)

**Enables (ffoodel) or disables (noffoodel) deletion of extra bits insterted by some routers when receiving E3 HDLC.** (points to ff00del)

**First 48 bytes of packet will be captured.** (points to 48)

**Captured records will be 64-bit aligned** (points to align64)

**Number of packets dropped on each port during current capture session.** (points to drop\_count)

**Total memory in MiB available to the card for capture.** (points to 128)

**Memory in MB allocated to the rx (128MB)** (points to mem=128)

**Cisco:** framing no or framing g751 options dsu bandwidth 34010 or bandwidth no

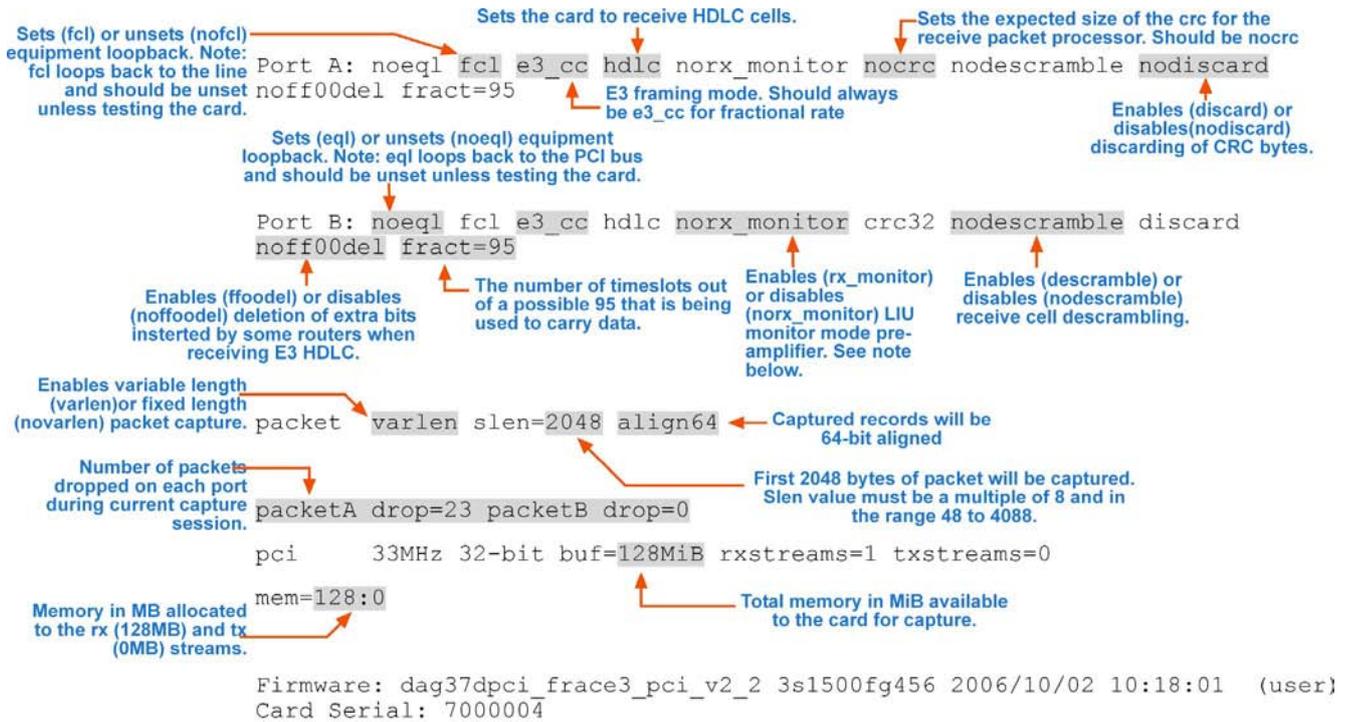
**Note:** Enabling the pre-amplifier using rx\_monitor adds approx 20dB of linear amplification for monitor applications where the signal has been reduced 20dB with resistive tap circuits.

### E3 Framed HDLC Fractional

**Note:** This option uses **dagthree**. For more details see [dagthree tokens](#). (page 29)

You can display the default configuration using:

```
dagthree -d0 default_e3_hdlc_fract
```



Cisco: framing no or framing g751 options

**Note:** Enabling the pre-amplifier using `rx_monitor` adds approx 20dB of linear amplification for monitor applications where the signal has been reduced 20dB with resistive attenuator circuits.

### Kentrox

You can display the default configuration using:

```

dagconfig -d0 default_kentrox
Firmware: dag37dpci_erf_pci_v2_9 3s1500fg456 2007/10/05 18:07:12 (user)
Serial : 7000003
Port A: noeql fcl ds3_cbit hdlc norx_monitor crc16 nodescramble discard noff00del
Port B: noeql fcl ds3_cbit hdlc norx_monitor crc16 nodescramble discard noff00del
GPP0:
varlen slen=48 align64
Port A: drop_count = 374
Port B: drop_count = 299
PCI Burst Manager:
33MHz
buffer_size=128 rx_streams=1 tx_streams=0 nodrop
Memory Streams:
mem=128

```

### Cisco: framing no or framing g751 options

**Note:** Enabling the pre-amplifier using `rx_monitor` adds approx 20dB of linear amplification for monitor applications where the signal has been reduced 20dB with resistive tap circuits.

## dagconfig tokens explained

The DAG 3.7D card now uses `dagconfig` instead of `dagthree`. The tokens listed below can be used with `dagconfig`.

`dagthree` is depreciated and is only used by a few tokens, see [dagthree tokens](#) (page 29).

### align64

Sets whether the generated packets are 64-bit aligned (`align64`) or 32-bit aligned (`noalign64`) before being received by the host.

Example

```
dagconfig align64
dagconfig noalign64
```

### atm

Sets framer into ATM cell receive mode.

Example

```
dagconfig atm
```

### buffer\_size

The `buffer_size=nMB` indicates that a total of  $n$  MB of memory have been allocated to the DAG card in total. Memory allocation occurs when the `dagmem` driver is loaded at boot time. See *EDM04-01 DAG Software Installation Guide* for details on how to allocate memory.

### crc16/crc32/nocrc

Sets the Packet over SONET (PoS) checking to None, 16 or 32 bits. SONET only.

Example

```
dagconfig nocrc
dagconfig crc16
dagconfig crc32
```

### default

The `default` command initializes the DAG card configuration and sets all settings to default values. The command also resets the DAG card configuration back to its default state.

**Note:** When you run `dagconfig -d0 default` the `dagclock` inputs and outputs are also reset to defaults.

Example

```
dagconfig -d0 default
```

### default\_ds3\_atm

Configure the card for DS3 ATM.

Example

```
dagconfig default_ds3_atm
```

### default\_ds3\_hdlc

Configure the card for DS3 HDLC.

Example

```
dagconfig default_ds3_hdlc
```

### default\_e3\_atm

Configure the card for E3 ATM.

Example

```
dagconfig default_e3_atm
```

**default\_e3\_hdlc**

Configure the card for E3 HDLC.

Example

```
dagconfig default_e3_hdlc
```

**default\_kentrox**

Configure the card for Kentrox substrate. For use with Kentrox firmware.

Example

```
dagconfig default_kentrox
```

**descramble/nodescramble**

Enable/disable receive cell descrambling.

Example

```
dagconfig descramble
dagconfig nodescramble
```

**discard/nodiscard**

When enabled the CRC bytes are discarded. When set to nodiscard the CRC bytes are passed on. This option is ignored when nocrc is set.

Example

```
dagconfig discard
dagconfig nodiscard
```

**drop**

Details the number of packets dropped during current capture session. Resets to 0 when the session restarted. Indication only can not be changed.

Example

The following shows that 15 packets have been dropped in the current session:

```
drop=15
```

**ds3\_cbit**

CBIT framing mode.

Example

```
dagconfig ds3_cbit
```

**ds3\_cbit\_if**

CBIT IF framing mode.

Example

```
dagconfig ds3_cbit_if
```

**ds3\_cbit\_ef**

CBIT EF framing mode.

Example

```
dagconfig ds3_cbit_ef
```

**ds3\_cbit\_ff**

CBIT FF framing mode.

Example

```
dagconfig ds3_cbit_ff
```

**ds3\_cbit\_plcp**

CBIT PLCP framing mode.

Example

```
dagconfig ds3_cbit_plcp
```

**ds3\_m23**

M23 framing mode.

Example

```
dagconfig ds3_m23
```

**ds3\_m23\_if**

M23 IF framing mode.

Example

```
dagconfig ds3_m23_if
```

**ds3\_m23\_ef**

M23 EF framing mode.

Example

```
dagconfig ds3_m23_ef
```

**ds3\_m23\_ff**

M23 FF framing mode.

Example

```
dagconfig ds3_m23_ff
```

**ds3\_m23\_plcp**

M23 PLCP framing mode.

Example

```
dagconfig ds3_m23_plcp
```

**e3**

E3 framing mode.

Example

```
dagconfig e3
```

**e3\_cc**

E3 Clear Channel mode. This bypasses the DS3/E3 part of the framer on the card and sends the data directly to the ATM/HDLC processing block.

Example

```
dagconfig e3_cc
```

**e3\_g751**

E3 framing mode (same as above e3).

Example

```
dagconfig e3_g751
```

**e3\_g751\_if**

E3 IF framing mode.

Example

```
dagconfig e3_g751_if
```

**e3\_g751\_plcp**

E3 PLCP framing mode.

Example

```
dagconfig e3_g751_plcp
```

**enable/disable**

Sets whether this DAG card captures data on the defined port (a or b).

**Note:** DAG ports are enabled by default. You do not need to use `dagconfig` to enable the card in order to begin capture unless you have previously disabled it.

Example

```
dagconfig -d0 enablea
dagconfig -d0 disablea
dagconfig -d0 enableb
dagconfig -d0 disableb
```

where "0" is the device number of the DAG card you wish to capture data from

**Note:** On some firmware images changes to this option may not take effect.

**eq1/noeq1**

Sets or unsets equipment loopback. For testing set to `eq1` mode and normal operation set to `noeq1` mode.

**Note:** `eq1` mode loops transmit data from the host back to the PCI bus.

Example

```
dagconfig eq1
dagconfig noeq1
```

**Error**

Turns on or off the error reporting for this DAG card.

Example

```
dagconfig error
dagconfig noerror
```

**fcl/nofcl**

**Note:** Sets or unsets Facility loop back. For testing set to `fcl` mode and normal operation set to `nofcl` mode.

FCL retransmits the data received and also send it to the host.

Example

```
dagconfig fcl
dagconfig nofcl
```

**ff00del/noff00del**

Enable deletion of extra bits inserted by some routers (e.g. Cisco) when receiving E3 HDLC.

Example

```
dagconfig ff00del
dagconfig noff00del
```

**fract=<number>**

A number out of 95 specifying the number of timeslots used by whatever is sending the data. This is used with the fractional e3 hdlc firmware.

Example

```
dagconfig fract=95
```

**HDLC**

Tells the card to process HDLC packets.

**Example**

```
dagconfig hdlc
```

**mem**

You can split the DAG card's allocated memory between the receive and transmit stream buffers to suit your own requirements. The split is displayed as a ratio as shown below:

```
mem=X:Y
```

where:

x is the memory allocated in MB to the rx stream

y is the memory allocated in MB to the tx stream.

If there are multiple rx or tx streams memory can be allocated to each stream:

```
mem=X:Y:X:Y:X:Y
```

[Buffer size](#) (page 21) and [rx and tx Streams](#) (page 26) are related to mem.

**Example**

You can split 128MB of memory evenly between the tx and rx streams using:

```
dagconfig -d0 mem=64:64
```

**Note:** You can not change the stream memory allocations while packet capture or transmission is in progress.

**overlap/nooverlap**

Configures the rx and tx memory hole to be overlapped. This enables in-line forwarding without copying the data across the memory holes.

**Example**

```
dagconfig overlap
dagconfig nooverlap
```

**Note:** This option is only applicable on firmware images containing TX.

**PCI**

Describes the following information about the DAG card:

- The type of PCI used by the DAG card (PCI, PCIx or PCIe)
- Bus speed
- Bus width

**Example**

```
pcix 133MHz 64-bit
pci 33MHz 32-bit
pcie 8 Gbs 4Lane
```

**reset**

Resets the ethernet framers, set auto mode.

**Example**

```
dagconfig -d0 reset
```

**rx\_monitor/norx\_monitor**

Used to enable the receive LIU monitor mode pre-amplifier. Enabling the pre-amplifier adds approx 20 dB of linear amplification for use in monitor applications where the signal has been reduced 20 dB using resistive attenuator circuits.

## Example

```
dagconfig rx_monitor
dagconfig norx_monitor
```

**rx and tx Streams**

Indicates the number of `rx` and `tx` streams are available on the DAG card. Not configurable.

Stream information relates to the setting of [mem](#) (page 25).

**slen**

Before you begin to capture data you can set the size that you want the captured packets to be. You can do this using the `dagconfig` tool to define the packet snaplength (`slen`).

**Note:** The snaplength value must be a multiple of 8 and in the range 48 to 4088 per card inclusive.

By default, `slen` which is the portion of the packet that you want to capture is set to 48 per card. This means that only the first 48 bytes of each packet will be captured.

If for example you want to capture only the IP header of each packet you may want to set the length to a different value. Alternatively if you want to ensure you capture the whole packet you can set the length to a larger value.

## Example

Setting up a DAG 3.7D card with a snap length of 200 bytes:

```
dagconfig -d0 slen=200
```

**Note:** The ERF header is not included in the `slen` value. Therefore a `slen` of 48 will produce a 64-byte capture record made up of 48 bytes plus the number of bytes in the ERF header.

However because the Ethernet record headers occupy 18 bytes instead of the standard 16 bytes, any payload captured will always be 2 bytes less than the `slen` value i.e. a `slen` of 48 will produce a 64-byte record made up of 18 bytes of header and 46 bytes of payload.

For more information on Ethernet records, see [Data Formats](#) (page 51) later in this user guide.

**varlen/novarlen**

The DAG 3.7D card is able to capture packets in two ways. They are:

- Variable length capture (`varlen`)
- Fixed length capture (`novarlen`) - (not support on some firmware images)

In **variable length** (`varlen`) mode, the DAG card will capture the whole packet, providing its size is less than the `slen` value. Therefore to use this capture mode effectively you should set the `slen` value to the largest number of bytes that a captured packet is likely to contain. For more information on `snaplength`, see [slen](#) (page 26).

Any packet that is larger than the `slen` value will be truncated to that size. Any packet that is smaller than the `slen` value will be captured at its actual size therefore producing a shorter record which saves bandwidth and storage space.

**Example**

The example below shows a configuration for variable length full packet capture:

```
dagconfig -d0 varlen
```

In **fixed length** (`novarlen`) mode the card will capture all packets at the same length. Any packet that is longer than the `slen` value will be truncated to that size, in the same way as for `varlen` capture. However any packet that is shorter than the `slen` value will be captured at its full size and then padded out to the size of the `slen` value.

This means that in `novarlen` mode you should avoid large `slen` values because short packets arriving will produce records with a large amount of padding which wastes bandwidth and storage space.

**Note:** Using the `novarlen` option on DAG cards with an on-board Co-Processor (accelerated cards) is not recommended. It may cause excessive loss of packets.

**Example**

The example below shows a configuration for fixed length packet capture that will produce a 64-byte record:

```
dagconfig -d0 align64 novarlen slen=40
```

**Note:** For Ethernet records a 64 byte record is made up of 46 bytes of payload and 18 bytes of ERF header. For more information on Ethernet records, see [Data Formats](#) (page 51) later in this user guide.

**Version information**

Details the following information about the connected DAG card:

- Firmware image programmed in the FPGA
- The DAG card serial number
- The MAC address(s) of the DAG card's ports (ethernet cards only).

**Example**

```
Firmware: dag37dpci_erf_pci_v2_8 3s1500fg456 2006/09/28 10:18:01 (user)
Card Serial: 7000004
MAC Address A: 00:0e:a7:00:57:fa
MAC Address B: 00:0e:a7:00:57:fb
```

## dagconfig options

dagconfig is a software utility used to configure and display statistics.

By default all commands, unless otherwise defined, run on device 0 (-d0). Commands only apply to one DAG card.

The following is a list options available in dagconfig. Not all options listed are applicable to all cards.

Options:	Description
-1,--porta	Port A only (default all). Multi-port cards only.
-2,--portb	Port B only (default all). Multi-port cards only.
-3,--portc	Port C only (default all). Four-port cards only.
-4,--portd	Port D only (default all). Four-port cards only.
--porte to --portp	As above, for extra ports on the 3.7T DAG card.
-c,--concfg <conncfg>	Connection configuration. Used by the DAG 7.1S only.
-C,--counters	Outputs the counters. Verbosity levels from 0=(basic / default) to 3=(full).
-d,--device <device>	DAG device to use. Default is d0.
-e,--extended	Displays the current extended statistics (non boolean and image dependant). Verbosity levels from 0=(basic / default) to 3=(full). Note: Some images may not contain extended statistics.
-G,--getattribute <getattribute>	Gets individual attributes by attribute name. Use in conjunction with the --porta or --portb options to get individual only multi-port cards.
-h,--help	Displays the MAN pages. The information displayed is dynamically based on the DAG card and does not work correctly when there is no DAG card in the system. <b>Note:</b> There are a few commands that display even though they are not applicable.
-i,--interval <seconds>	Interval to repeat in seconds.
-m,--hmon	Outputs the hardware monitor information.
-n,--voltages	Outputs the DAG card voltage monitor information.
-S,--setattribute <setattribute>	Sets individual attributes by attribute name. Use in conjunction with the --porta or --portb options to get individual only multi-port cards.
-s,--statistics	Outputs the statistics for the DAG card. Verbosity levels from 0=(basic / default) to 3=(full).
-T,--tree	Outputs the supported Configuration and Status attributes and components with the description and name. Using the -v2 verbosity level also outputs all components and attribute codes. Verbosity levels from 0=(basic / default) to 3=(full).
-t,--txstats	Outputs the transmit statistics for the DAG card. Where applicable.
-u, --ucounters	Outputs the universal counters for the DAG card. Where applicable.
-v,--verbose <level>	Sets the verbosity level, from 0 (basic) to 3 (full).
-V,--version	Display the DAG card version information.

**Note:** For cards with more than 2 ports you can select the required port using: - (portnumber) or --(portletter).

## dagthree options

`dagthree` has been depreciated from DAG Software release 3.2 onwards. It has been replaced with `dagconfig`. Both are still valid. Endace recommends that new customer use `dagconfig`.

`dagthree` is a software utility used to configure and display statistics.

By default all commands, unless otherwise defined, run on device 0 (-d0). Commands only apply to one DAG card.

The following is a list options available in `dagthree`.

Option	Description
-l,--1544	Crystal is 1.544MHz not 2.048MHz
-a,--porta	Port A only (default both).
-b,--portb	Port B only (default both).
-c,--counters <c1,c2>	Display counter statistics c1 and c2.
-d,--device <device>	DAG device to use.
-f,--framer	Display E1/T1 Framer statistics.
-h,--help, -?	Displays the help pages.
-i,--interval <seconds>	Interval to repeat -s or -c in seconds.
-p,--ptest	Production test output
-s,--stats	Display SONET/SDH/PHY statistics
-S,--sticky-counters <seconds>	Accumulate counter statistics for a number of seconds.
-t,--detect	Detect card configuration
-u,--sonicid	Display SONIC user device ID.
-v,--verbose	Increase verbosity.
-V,--version	Display version information.

## dagthree tokens

Only the following tokens have not been updated to `dagconfig` and therefore still use `dagthree`.

### default\_e3\_hdlc\_fract

Configure the card for fractional E3 HDLC. For use with E3 HDLC firmware.

Example

```
dagconfig default_e3_hdlc_fract
```

## Viewing the DAG card status

### Interface Status

When you have configured the card according to your specific requirements you can view the interface statistics to check the status of each of the links using:

```
dagconfig -d0 -s
```

For more information see `dagconfig`.

Example outputs are shown below:

**Note:** “1” indicates the condition is present on the link “0” indicates the condition is not present on the link.

Port	RLOL	LOS	LOF	RDI	AIS	OOF
A	1	1	1	0	0	1
B	1	1	1	0	0	1

### Status Conditions

**Note:** Interface statistics are the DAG 3.7D are the same for all firmware versions.

A definition of each of the status conditions is described below:

Condition	Definition
RLOL	Receive Loss of Lock
LLOS	Loss of Signal
LOF	Loss of Frame:
RDI	Remote Defect Indicator. <b>Note:</b> When this condition exists the link will still carry data
AIS	Alarm Indication Signal. <b>Note:</b> When this condition exists the link will not carry data
OOF	Out Of Frame

### Extended status

Extended status are also available:

There are multiple printout levels. The statistics displayed below are printout level 0.

The following example shows the extended statistics.

```
dagconfig -e
Port      rx_bytes  tx_bytes
A         0         0
B         0         0
```

### Status conditions

A definition of each status condition up to printout level 2 is described below:

Condition	Definition
Port	Indicates the port the status conditions apply to.
rx_bytes	Number of RX bytes received.
tx_bytes	Number of TX bytes received.
rx_frames	Number of RX frames received.
tx_frames	Number of TX frames received.

# Using your DAG card to capture data

## Introduction

This chapter describes how to complete the following operations for a DAG card:

- [Capturing data](#) (page 31)
- [Viewing captured data](#) (page 34)
- [Converting captured data](#) (page 36)
- [Using third party applications](#) (page 38)

## Basic data capture

`dagsnap` is a software utility used to write to disk the raw data captured from a DAG card.

Data is collected in Extensible Record Format (ERF) which can then be viewed using `dagbits`, or converted to other formats using `dagconvert`.

When capturing high speed data Endace recommends you use `dagsnap`, see [Capturing data at high speed](#) (page 33).

For further information on the software utilities see:

- [dagsnap](#) (page 32)
- [dagbits](#) (page 34)
- [dagconvert](#) (page 37)

## Starting a capture session

To start the capture session type the following at the prompt:

```
dagsnap -d0 -v -o tracefile
```

(where "0" is the device number of the DAG card you wish to capture data from)

**Note:** You can use the `-v` option to provide user information during a capture session although you may want to omit it for automated trace runs.

By default, `dagsnap` runs indefinitely. To stop, use `CTRL+C`. You can also configure `dagsnap` to run for a fixed time period then exit.

## dagsnap

dagsnap is a data capture software utility.

The following is a list of the options available in dagsnap.

Option	Description
-d DEVICE --device DEVICE	Use the DAG device referred to by DEVICE. Supported syntax includes 0, dag1, and /dev/dag3 to refer to DAG cards, and 0:2, dag1:0, and /dev/dag2:0 to refer to specific streams on cards.
-h, -? --help, --usage	Display usage (help) information.
-j	Maximize disk writing performance by only writing data to disk in chunks. This option may not be available on all operating systems.
-m NUM	Write at most NUM megabytes of data per call to the DAG API (default is 4 MiB).
-o FILE --fname FILE	Write the captured packets to FILE, in ERF format (default is standard output).
-s NUM --runtime NUM	Run for NUM seconds, then exit.
-v --verbose	Increase output verbosity. When dagsnap is run with this command three columns of data are reported every second. These columns contain <ol style="list-style-type: none"> <li>1. The cumulative total of data written out from the DAG card.</li> <li>2. The buffer occupancy. Small values indicate no packet loss.</li> <li>3. The rate at which data is currently being written.</li> </ol>
-V, --version	Display version information.
-w, --wait SEC	Delay(wait) in seconds before capture and after.

## Capturing data at high speed

As the DAG 3.7D card captures packets from the network link, it writes a record for each packet into a large buffer in the host computer's main memory.

To avoid packet loss, the user application reading the record, such as `dagsnap`, must be able to read records out of the buffer as fast or faster than they arrive. If not the buffer will eventually fill and packet records will be lost.

If the user process is writing records to hard disk, it may be necessary to use a faster disk or disk array. If records are being processed in real-time, a faster host CPU may be required.

In Linux and Free BSD, when the computer buffer fills, the following message displays on the computer screen:

```
kernel: dagN: pbm safety net reached 0xNNNNNNNNN
```

The same message is also printed to log `/var/log/messages` file. In addition, when the computer buffer fills the "Data Capture" LED on the card will flash or flicker, or may go OFF completely.

In Windows no screen message displays to indicate when the buffer is full. Please contact Endace Customer Support at [support@endace.com](mailto:support@endace.com) for further information on detecting buffer overflow and packet loss in Windows.

### Detecting Packet Losses

Once the buffer fills, any new packets arriving will be discarded by the DAG 3.7D card until some data is read out of the buffer to create free space.

You can detect any such losses by observing the Loss Counter (`lctr` field) of the Extensible Record Format (ERF). See [Data Formats](#) (page 51) later in this User Guide for more information on the Endace ERF record format.

### Increasing Buffer Size

You can increase the size of the host computer buffer to enable it to cope with bursts of high traffic load on the network link.

For information on increasing the buffer size, see [buffer\\_size](#) (page 21).

## Viewing captured data

Data captured in ERF format can be viewed with `dagbits`. For further details on how to use `dagbits`, see [dagbits](#) (page 34).

**Note:** `dagbits` decodes and displays ERF header fields and packet contents are displayed as a Hex dump only. To decode higher level protocols, Endace recommends using a third party application, see [Using third party applications](#) (page 38).

### Examples

Test live traffic on `dag0`, stream 0 for 60 seconds running the `lctr`, `flags` and `fcs` tests:

```
dagbits -vvc -d0:0 -s60 lctr flags fcs
```

To read a trace log file using `dagbits`:

```
dagbits -vvc print -f logname.log | less
```

To check for errors in the trace:

```
dagbits -vvc lctr flags fcs -f logname.log
```

If `dagbits` reaches the end of the traffic and prints its report then the ERF records were valid.

## dagbits

`dagbits` is a software utility used to view and test ERF records. `dagbits` can receive data from either:

- directly from the DAG card (using the `-d` option), or
- a ERF data file created by `dagsnap`.

The following is a list options available in `dagbits`:

Options	Description
-0	ERF records contain no Link-Layer CRCs.
-16	ERF records contain 16 bit Link-Layer CRCs (PoS).
-32	ERF records contain 32 bit Link-Layer CRCs (PoS and Ethernet).
-a	Set legacy format to ATM (this is the default).
-b	Treat ERF timestamps as big-endian.
-c	Print real-time progress reports as <code>dagbits</code> captures traffic. This is a useful indicator that a test is running correctly.
-C NUM	Sets CRC correction factor for BTX test (0, 16 or 32 bits).
-d DEVICE --device DEVICE	Use the DAG device referred to by DEVICE. Supported syntax includes 0, <code>dag1</code> , and <code>/dev/dag3</code> to refer to DAG cards, and <code>0:2</code> , <code>dag1:1</code> , and <code>/dev/dag2:0</code> to refer to specific streams on cards.
-D NUM	Introduces a NUM nanosecond delay between processing each record.
-e	Set legacy format to Ethernet (default: ATM).
-E NUM	Halt operation after a maximum of NUM errors. This option prevents <code>dagbits</code> from creating extremely large output files when being redirected to a file.
-f FILE	Read captured data from FILE.
-h, -? --help, --usage	Display usage (help) information.
-i API	Use "API" interface for live DAG API capture. Possible options are: 0 DAG 2.4 legacy API interface [ <code>dag_offset(3)</code> ]. 1 DAG 2.5 API interface [ <code>dag_advance_stream(3)</code> ]. 2 DAG 2.5 API interface [ <code>dag_rx_stream_next_record(3)</code> ].
-I	Assume the ERF contains color information in the pad and offset bytes (for Ethernet ERFs) or HDLC header bytes (for PoS ERFs) and display this information as a packet classification and destination memory buffer.
-j NUM	Set the threshold for the jitter test to NUM microseconds.
-m NUM	Print the first NUM errored records only, and then continue to count errors silently for the duration of the session.

-n NUM	Expected number of packets to receive. Returns an error if the actual number is different.
-p	Set legacy format to PoS (default: ATM).
-P PARAMS	DAG 3.5S capture parameters.
-q	Quiet. This instructs <code>dagbits</code> to suppress summary information when terminating. Error messages are not affected by this option.
-r NUM	Set legacy format record lengths to NUM.
-R NUM	When used in conjunction with the <code>rlen</code> test, indicates the RLEN of ERF records to match against. NUM.
-s	Check for strictly monotonic (increasing) timestamps, rather than monotonic (non-decreasing). Affects the behavior of the <code>mono</code> test. With strict checking it is an error for consecutive timestamps to be equal; they must always increase.
-S NUM	Terminate <code>dagbits</code> after NUM seconds of capture. This option only makes sense when capturing packets from a DAG card (i.e. when used in conjunction with the <code>-d</code> flag).
-t NUM	Terminate <code>dagbits</code> if any ERF record type does not match NUM.
-U NUM	Process at most NUM records in one pass. This option enables the user to reduce the performance of <code>dagbits</code> for various purposes. See also <code>-D</code> .
-v -vv --verbose	Increase verbosity of <code>dagbits</code> . This option increase the amount of data displayed when printing an ERF record due to the <code>print</code> test or errors in other tests. <code>-v</code> will print payload contents, <code>-vv</code> will print payload contents and an accompanying ASCII dump of the packet payload.
-V, --version	Display version information.
-w	Instruct <code>dagbits</code> to treat all warnings as errors.
-W NUM	When used in conjunction with the <code>wlen</code> test, the wire length of ERF records must be exactly NUM bytes.
-z	Stop when no traffic is received for one second.

`dagbits` takes several options that serve as parameters to particular tests. Available tests include monotonic time-stamp increment and frame checksum (FCS, aka CRC) validation. See the `dagbits help` for further details.

## Converting captured data

`dagconvert` is the software utility that converts captured data from ERF format to Pcap (and other formats). Once in non ERF format the data can be read using [third party applications](#) (page 38).

`dagconvert` can also be used to capture data directly into pcap format.

### Examples

To read from DAG card 0 and save to a file in ERF format:

```
dagconvert -d0 -o outfile.erf
```

To read from DAG card 0 and save to a file in pcap format:

```
dagconvert -d0 -T dag:pcap -o outfile.pcap
```

To convert a file from ERF format to pcap format:

```
dagconvert -T erf:pcap -i infile.erf -o outfile.pcap
```

To convert a file from pcap format to ERF format, ensuring the ERF records are 64-bit aligned (and therefore suitable for transmission using `dagflood`):

```
dagconvert -T pcap:erf -A 8 -i infile.pcap -o outfile64.erf
```

To capture from DAG Card 0 using a BPF filter:

```
dagconvert -d0 -o outfile.erf -b "host 192.168.0.1 and tcp port 80"
```

To capture from DAG card 0 using ERF filtering:

```
dagconvert -d0 -o outfile.erf -f "rx,a"
```

To capture from DAG card 0 to a series of files of size 128 MB:

```
dagconvert -d0 -o outfile.erf -r 128m
```

The first file created is labeled `outfile0000.erf`, once the file size reaches 128MB, a second file is created. The second is labeled `outfile0001.erf` etc.

ATM traffic filtering (ATM, AAL5, MC\_AAL5 record types) by VPI and VCI is also possible by using the SUNATM DLT, which includes VPI/VCI information. The following example shows how to use `dagconvert` to achieve this:

```
dagconvert -v -i atm.erf -o atm_filtered.erf -y SUNATM -b "vpi 10 and vci 12"
```

## Dagconvert

dagconvert is a software utility for converting data to various file formats. Supported formats are:

File format	Description
dag	Read ERF records directly from DAG card (input only).
erf	ERF (Extensible Record Format) file (input and output).
atm	Legacy ATM files (input only).
eth	Legacy Ethernet files (input only).
pos	Legacy PoS files (input only).
null	Produces no input or output.
pcap	pcap(3) format file (input or output).
prt	ASCII text packet dump (output only).

Data can be input from a file or captured from a DAG card. dagconvert can be used for converting data captured from a DAG card to pcap format. This allows the trace file to be used with tools that support the pcap file format. Also the reverse is possible, where data can be converted to ERF format for use in other dag utilities. The following is a list of options available in dagconvert.

Options	Description								
-A NUM	Set the record alignment of the ERF to NUM bytes (ERF only).								
-b EXPRESSION	Specify a tcpdump(1) style BPF expression to be applied to the packets.								
-c 0 16 32	Specify the size (in bits) of the frame checksum (FCS) (pcap(3) only).								
-d DEVICE --device DEVICE	Use the DAG device referred to by DEVICE. Supported syntax includes 0, dag1, and /dev/dag3 to refer to DAG cards, and 0:2, dag1:1, and /dev/dag2:0 to refer to specific streams on cards.								
-f FILTERS	A comma-delimited list of filters to be applied to the data. Supported filters are: <ul style="list-style-type: none"> <li>rx Filter out rx errors (link layer).</li> <li>ds Filter out ds errors (framing).</li> <li>trunc Filter out truncated packets.</li> <li>a,b,c,d Filter on indicated port/interface(s).</li> </ul>								
-F	Select fixed length output (ERF only).								
-G NUM	Set the GMT offset to NUM seconds (pcap(3) only).								
-h, -?, --help, --usage	Display usage (help) information.								
-i FILES	Name(s) of the input file(s). If more than one filename is given, the ERF records from the files will be merged in timestamp order to the output.								
-o FILE	Name of the output file.								
-r NUM	Rotate the output file after NUM bytes. Add k (kilobytes), m (megabytes), g (gigabytes) and t (terabytes) suffixes.								
-s NUM	Set the snap length to NUM bytes.								
-t NUM	Capture from the DAG card for NUM seconds.								
-T atm dag erf eth  pcap pos : erf pcap prt	Input and output types. See the DESCRIPTION section above for more information about the input and output types.								
-v, --verbose	Increase output verbosity.								
-V, --version	Select variable length output (ERF only). Display version information.								
-y <DLT>	This sets the pcap data link type to be used for BPF filtering (-b) and for pcap output. Previously only one DLT was mapped to each ERF type. Supported DLT types (case insensitive): <table style="width: 100%; border: none;"> <tr> <td>EN10MB: Ethernet</td> <td>DOCSIS: Ethernet</td> </tr> <tr> <td>CHDLC: HDLC</td> <td>PPP_SERIAL: HDLC</td> </tr> <tr> <td>MTP2: HDLC</td> <td>ATM_RFC1483: ATM, AAL5</td> </tr> <tr> <td>SUNATM: ATM, AAL5</td> <td></td> </tr> </table>	EN10MB: Ethernet	DOCSIS: Ethernet	CHDLC: HDLC	PPP_SERIAL: HDLC	MTP2: HDLC	ATM_RFC1483: ATM, AAL5	SUNATM: ATM, AAL5	
EN10MB: Ethernet	DOCSIS: Ethernet								
CHDLC: HDLC	PPP_SERIAL: HDLC								
MTP2: HDLC	ATM_RFC1483: ATM, AAL5								
SUNATM: ATM, AAL5									

**Note:** Not all options are applicable to all DAG cards.

## Using third party applications

Once the captured data is in Pcap format you can use third party applications to examine and process the data. The third party applications include:

- Wireshark /Tshark (formerly Ethereal /Tethereal)
- TCPDump
- Libpcap
- SNORT
- Winpcap, etc.

**Note:** Wireshark can also read ERF formatted data.

# Synchronizing Clock Time

---

## Overview

DAG cards have sophisticated time synchronization capabilities. This allows for high quality timestamps and optional synchronization to an external time standard.

The core of the DAG synchronization capability is known as the DAG Universal Clock Kit (DUCK).

A clock in each DAG card runs independently from the computer clock. The DAG card's clock is initialized using the computer clock, and then free-runs using a crystal oscillator.

Each DAG card's clock can vary relative to a computer clock, or other DAG cards.

## DUCK Configuration

The DUCK (DAG Universal Clock Kit ) is designed to reduce time variance between sets of DAG cards or between DAG cards and coordinated universal time [UTC].

You can obtain an accurate time reference by connecting an external clock to the DAG card using the time synchronization connector. Alternatively you can use the host computer's clock in software as a reference source without any additional hardware.

Each DAG card can also output a clock signal for use by other DAG cards.

## Common Synchronization

The DAG card time synchronization connector supports a Pulse-Per-Second (PPS) input signal, using RS-422 signaling levels.

Common synchronization sources include GPS or CDMA (cellular telephone) time receivers.

Endace also provides the TDS 2 Time Distribution Server modules and TDS 6 expansion units that enable you to connect multiple DAG cards to a single GPS or CDMA unit.

For more information, please refer to the Endace website at <https://www.endace.com/support>, or the *EDM05-01 Time Distribution Server User Guide*.

## Network Time Protocol

NTP (Network Time Protocol) can be used to synchronize a computer clock to a network based reference. When the NTP daemon starts, it exchanges packets with network time servers to establish the correct time. If the computer clock is significantly different, the NTP can adjust the computer clock in a single large 'step'. Over time, NTP adjusts the rate of computer clock to minimize the offset from its reference. It can take several days for NTP to fully synchronize the computer clock.

The DAG card clock is initialized from the computer's clock rather than from the NTP. Using NTP to synchronize the computer's clock ensures the DAG card clock remains accurate.

DAG cards can also be synchronized to external references such as GPS or to the computer clock directly. In both cases the computer clock time is loaded onto the DAG clock when the DAG card is started (`dagload`, `dagreset`, `dagrom -p`).

When clock synchronization is enabled, the DAG card time is compared to the computer time once per second, regardless of the synchronization source. If the times differ by more than 1 second, the DAG card clock is reloaded from the computer clock and synchronization is restarted. For this reason, the computer clock should be maintained with better than 1 second accuracy.

If the DAG card clock is synchronized to the computer clock, then small 'step' adjustments of the computer clock by the NTP daemon can cause the DAG driver to emit warning messages to the console and system log files if the adjustment exceeds the warning threshold. These messages are intended to allow the user to monitor the quality of the clock synchronization over time.

The best synchronization is achieved when the DAG card is synchronized to an external GPS reference clock, and the computer clock is synchronized to a local NTP server.

## Timestamps

ERF files contain a hardware generated timestamp of each packet's arrival.

The format of this timestamp is a single little-endian 64-bit fixed point number, representing the number of seconds since midnight on the 1<sup>st</sup> January 1970.

The high 32-bits contain the integer number of seconds, while the lower 32-bits contain the binary fraction of the second. This allows an ultimate resolution of  $2^{-32}$  seconds, or approximately 233 picoseconds.

Different DAG cards have different actual resolutions. This is accommodated by the lower most bits that are not active being set to zero. In this way the interpretation of the timestamp does not need to change when higher resolution clock hardware is available. The DAG 3.7D implements the 24 most significant bits which provides a time resolution of 59.6 nanoseconds.

The ERF timestamp allows you to find the difference between two timestamps using a single 64-bit subtraction. You do not need to check for overflows between the two halves of the structure as you would need to do when comparing Unix time structures.

### Example

Below is example code showing how a 64-bit ERF timestamp (erfts) can be converted into a `struct timeval` representation (tv):

```
unsigned long long lts;
struct timeval tv;

lts = erfts;
tv.tv_sec = lts >> 32;
lts = ((lts & 0xffffffffULL) * 1000 * 1000);
lts += (lts & 0x80000000ULL) << 1;      /* rounding */
tv.tv_usec = lts >> 32;
if(tv.tv_usec >= 1000000) {
    tv.tv_usec -= 1000000;
    tv.tv_sec += 1;
}
```

## Dagclock

The DUCK is very flexible and can be used with or without an external time reference. It can accept synchronization from one of several input sources and also be made to drive its synchronization output from one of several sources.

Synchronization settings are controlled by the `dagclock` utility.

**Note:** You should only run `dagclock` after you have loaded the appropriate FPGA images. If at any stage you reload the FPGA images you must rerun `dagclock` to restore the configuration.

**Note:** when you run `dagconfig -d0 default` the `dagclock` inputs and outputs are also reset to defaults.

A description of each argument is shown below:

Option	Description
<code>-d DEVICE</code> <code>--device DEVICE</code>	Use the DAG device referred to by DEVICE. Supported syntax includes 0, dag1, and /dev/dag3 to refer to DAG cards.
<code>-h, -?</code> <code>--help, --usage</code>	Display the information on this page
<code>-k</code> <code>--sync</code>	Wait for DUCK synchronization before exiting
<code>-K NUM</code>	Set the synchronization timeout in seconds (default is 60 seconds)
<code>-l NUM</code>	Set the Health threshold in nanoseconds. (default is 596ns)
<code>-v</code>	Increase output verbosity
<code>-V</code>	Display version information
<code>-x</code> <code>--clearstats</code>	Clear clock statistics

Command	Description
<code>default</code>	Set the <code>dagclock</code> input and output to RS422 in and none out.
<code>none</code>	Clears the input and output settings.
<code>rs422in</code>	Sets the <code>dagclock</code> input to RS422.
<code>hostin</code>	Sets the <code>dagclock</code> input to Host (unused)
<code>overin</code>	Sets the <code>dagclock</code> input to Internal input
<code>auxin</code>	Sets the <code>dagclock</code> input to Auxiliary input (unused)
<code>rs422out</code>	Sets the <code>dagclock</code> output to repeat the RS422 input signal
<code>loop</code>	Output the selected input
<code>hostout</code>	Sets the <code>dagclock</code> output to host (unused)
<code>overout</code>	Internal output (master card)
<code>set</code>	Sets the DAG card's clock to computer clock time and clears clock statistics. The DAG card takes approximately 20 to 30 seconds to re-synchronize.
<code>reset</code>	Full clock reset. Load time from computer, set RS422in, none out. Clears clock statistics. The DAG card takes approximately 20 to 30 seconds to re-synchronize.

**Note:** By default, all DAG cards listen for synchronization signals on their RS-422 port, and do not output any signal to that port.

## Dagclock Statistics reset

Statistics are reset to zero when the following occur:

- Loading a DAG driver
- Loading firmware
- `dagclock` with a `-x` option
- `dagclock` with a `set` or `reset` command.

### Example

To view the default `dagclock` configuration:

```
dagclock -d0
```

The following is the output from DAG card that has its clock reference connected. The clock statistics have been reset since the card was last synchronized. **Note:** Values will differ for each DAG card type.

```
muxin    rs422
muxout   none
status   Synchronised Threshold 596ns Failures 0 Resyncs 0
error    Freq -30ppb Phase -60ns Worst Freq 75ppb Worst Phase 104ns
crystal  Actual 100000028Hz Synthesized 67108864Hz
input    Total 3765 Bad 0 Singles Missed 5 Longest Sequence Missed 1
start    Thu Apr 28 13:32:45 2007
host     Thu Apr 28 14:35:35 2007
dag      Thu Apr 28 14:35:35 2007
```

**Note:** For a description of the `dagclock` output see [Dagclock output explained](#) (page 44).

## Dagclock output explained

### Muxin

Lists the `dagclock` time input source for this DAG card. The options are `RS422in`, `Hostin`, `Overin` or `Auxin`.

#### Example

```
muxin rs422
```

### Muxout

Lists the `dagclock` time output source for this DAG card. The options are `RS422out`, `Hostout`, `Overout` or `Loop`.

#### Example

```
muxout none
```

### Status

This line reports on the status of the DAG card.

Output	Description
<b>Synchronised / Not synchronised</b>	This indicates whether this DAG card is synchronized to the time source listed ( <code>Muxin</code> ). The DAG card becomes <b>Not Synchronized</b> when the absolute <a href="#">Phase error (page 44)</a> is above the <a href="#">Threshold</a> value for 10 consecutive seconds.
<b>Threshold</b>	This is the value above which the DAG card port is considered <b>Not Synchronized</b> . The <a href="#">Threshold</a> value changes depending on the type of input time synchronization. The defaults are: <ul style="list-style-type: none"> <li>• 596 for RS422 synchronization</li> <li>• 12000 for host synchronization (Unix)</li> <li>• 50000 for host synchronization (Windows)</li> </ul> This value can be adjusted using the <code>dagclock -l</code> option.
<b>Failures</b>	This is a count of the number of times the DAG card has become <b>Not Synchronized</b> .
<b>Resyncs</b>	This is a count of the number of times the DAG card Phase error has exceeded 1 second. See <a href="#">Error (Dagclock)</a> (page 44). If the DAG card is <b>Not Synchronized</b> for more than 10 seconds the DAG card automatically runs the following command to update the time on the DAG card: <pre>dagclock -d0 set</pre> Where "0" is the device number.

#### Example

```
status Synchronised Threshold 596ns Failures 0 Resyncs 0
```

### Error

This line reports on the synthesized frequency of the DAG card.

Output	Description
Freq	An estimate of the synthesized frequency error over the last second in parts per billion.
Phase	The difference between the DAG card's clock and the reference clock at the last time pulse.
Worst Freq	Highest absolute value of the <a href="#">Frequency error</a> since statistic collection began. Reset to zero when statistics are reset, see <a href="#">Dagclock Statistics reset</a> (page 43).
Worst Phase	Highest absolute value of the <a href="#">Phase error</a> since statistic collection began. Reset to zero when statistics are reset, see <a href="#">Dagclock Statistics reset</a> (page 43)

#### Example

```
error Freq -30ppb Phase -60ns Worst Freq 75ppb Worst Phase 104ns
```

## Crystal

This line reports on the DAG card crystal oscillator.

Output	Description
Actual	The DAG card's crystal frequency calculated based on the reference clock.
Synthesized	The target time stamping frequency. Different for each DAG card type.

### Example

```
crystal Actual 100000028Hz Synthesized 67108864Hz
```

## Input

This line reports on the time pulses received by the DAG card.

Output	Description
Total	The total number of time pulses received. Reset to zero when statistics are reset, see <a href="#">Dagclock Statistics reset</a> (page 43).
Bad	The number of time pulses that were rejected (considered Bad) by the DAG card. Reset to zero when statistics are reset, see <a href="#">Dagclock Statistics reset</a> (page 43). Time pulses are considered <i>Bad</i> if they were not received 1 second (approximately) after the last time pulse. These may be caused by noise.
Singles missed	The number of times a single time pulse failed to be received by the DAG card (i.e. a two second gap). Reset to zero when statistics are reset, see <a href="#">Dagclock Statistics reset</a> (page 43).
Longest Sequence Missed	This displays the longest time gap (in seconds) between a pair of time pulses. Reset to zero when statistics are reset, see <a href="#">Dagclock Statistics reset</a> (page 43).

### Example

```
input Total 3765 Bad 0 Singles Missed 5 Longest Sequence Missed 1
```

## Start / Host / DAG

Output	Description
Start	This is the time statistics collection started. See <a href="#">Dagclock Statistics reset</a> (page 43)
Host	Current Host (computer) time.
DAG	The DAG card time at the last time pulse. If the DAG card has never been synchronized, the following displays: No active input - free running.

### Example

```
start Thu Apr 28 13:32:45 2007
host Thu Apr 28 14:35:35 2007
dag Thu Apr 28 14:35:35 2007
```

## Card with Reference

### Overview

To obtain the best timestamp accuracy you should connect the DAG card to an external clock reference, such as a GPS or CDMA time receiver.

To use an external clock reference source, the host computer's clock must be accurate to UTC to within one second. This is used to initialize the DUCK.

When the external time reference source is connected to the DAG card time synchronization connector, the DAG card automatically synchronizes to a valid signal.

### Pulse Signal from External Source

The DAG time synchronization connector supports an RS-422 (PPS) signal from an external source. This is derived directly from an external reference source or distributed through the Endace TDS 2 (Time Distribution Server) module which allows two DAG cards to use a single receiver. It is also possible for more than two DAG cards to use a single receiver by "daisy-chaining" TDS-6 expansion modules to the TDS-2 module. Each TDS-6, module provides outputs for an additional 6 DAG cards.

Synchronize to an external source as follows:

```
dagclock -d0
```

Output:

```

muxin   rs422
muxout  none
status  Synchronised Threshold 596ns Failures 0 Resyncs 0
error   Freq 30ppb Phase -15ns Worst Freq 238ppb Worst Phase 326ns
crystal Actual 100000023Hz Synthesized 67108864Hz
input   Total 225 Bad 0 Singles Missed 1 Longest Sequence Missed 1
start   Thu Apr 28 14:55:20 2007
host    Thu Apr 28 14:59:06 2007
dag     Thu Apr 28 14:59:06 2007

```

### Connecting the Time Distribution Server

You can connect the TDS 2 module to the DAG card using [DUCK crossover cable](#) (page 50) (**Note:** A 4-pin to RJ45 adapter may be required). The TDS may be located up to 600m (2000ft) from the DAG card depending upon the quality of the cable used, possible interference sources and other environmental factors. Please refer to the *EDM05-01 Time Distribution Server User Guide* for more information.

#### Caution:

Never connect a DAG card and/or the TDS 2 module to active Ethernet equipment or telephone equipment.

### Testing the Signal

For Linux and FreeBSD, when a synchronization source is connected the driver outputs messages to the console log file `/var/log/messages`.

To test the signal is being received correctly and has the correct polarity use the `dagpps` tool as follows:

```
dagpps -d0
```

`dagpps` measures the input state many times over several seconds, displaying the polarity and length of input pulse.

## Single Card No Reference

When a single DAG card is used with no external reference, the DAG card can be synchronized to the host computer clock. Most computer clocks are not very accurate by themselves, but the DUCK drifts smoothly at the same rate as the computer clock.

The synchronization achieved with this method is not as accurate as using an external reference source such as GPS.

The DUCK clock is synchronized to a computer clock by setting input synchronization selector to overflow as follows:

```
dagclock -d0 none overin
```

### Output

```

muxin   overin
muxout  none
status  Synchronised Threshold 11921ns Failures 0 Resyncs 0
error   Freq 1836ppb Phase 605ns Worst Freq 147ppb Worst Phase 324ns
crystal Actual 49999347Hz Synthesized 16777216Hz
input   Total 87039 Bad 0 Singles Missed 0 Longest Sequence Missed 0
start   Wed Apr 27 14:27:41 2007
host    Thu Apr 28 14:38:20 2007
dag     Thu Apr 28 14:38:20 2007

```

## Two Cards No Reference

### Overview

If you are using two DAG cards in a single host computer with no reference clock, you must synchronize the DAG cards using the same method if you wish to compare the timestamps between the two DAG cards. You may wish to do this for example if the two DAG cards monitor different directions of a single full-duplex link. You can synchronize the DAG cards in two ways:

- One DAG card can be a clock master for the second. This is useful if you want both DAG cards to be accurately synchronized with each other, but not so for absolute time of packet time-stamps, or
- One DAG card can synchronize to the host and also act as a master for the second DAG card.

### Synchronizing with Each Other

Although the master DAG card's clock drifts against UTC, the DAG cards will be locked together. This is achieved by connecting the time synchronization connectors of both DAG cards using a [DUCK crossover cable](#) (page 50) (**Note:** A 4-pin to RJ45 Adapter may be required).

Configure one of the DAG cards as the master so that the other defaults to being a slave as follows:

```
dagclock -d0 none overout
```

Output:

```
muxin   none
muxout  over
status  Not Synchronised Threshold 596ns Failures 0 Resyncs 0
error   Freq 0ppb Phase 0ns Worst Freq 213ppb Worst Phase 251ns
crystal Actual 100000000Hz Synthesized 67108864Hz
input   Total 0 Bad 0 Singles Missed 0 Longest Sequence Missed 0
start   Thu Apr 28 14:48:34 2007
host    Thu Apr 28 14:48:34 2007
dag     No active input - Free running
```

**Note:** The slave DAG card configuration is not shown as the default configuration will work.

## Synchronizing with Host

To prevent the DAG card clock time-stamps drifting against UTC, the master DAG card can be synchronized to the host computer's clock which in turn utilizes NTP. This provides a master signal to the slave DAG card.

Configure one DAG card to synchronize to the computer clock and output a RS-422 synchronization signal to the second DAG card as follows:

```
dagclock -d0 none overin overout
```

### Output:

```
muxin    over
muxout   over
status   Synchronised Threshold 11921ns Failures 0 Resyncs 0
error    Freq -691ppb Phase -394ns Worst Freq 147ppb Worst Phase 424ns
crystal  Actual 49999354Hz Synthesized 16777216Hz
input    Total 87464 Bad 0 Singles Missed 0 Longest Sequence Missed 0
start    Wed Apr 27 14:27:41 2007
host     Thu Apr 28 14:59:14 2007
dag      Thu Apr 28 14:59:14 2007
```

**Note:** The slave DAG card configuration is not shown, the default configuration is sufficient.

## Connector Pin-outs

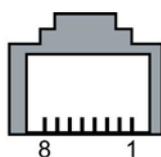
### Overview

DAG cards have an 8-pin RJ45 connector for time synchronization. The connector has two bi-directional RS422 differential circuits, A and B. The Pulse Per Second (PPS) signal is carried on circuit A, and the SERIAL packet is connected to the B circuit.

### Pin Assignments

The 8-pin RJ45 connector pin assignments and plugs and sockets are shown below:

1.	Out PPS+
2.	Out PPS-
3.	In PPS+
4.	In SERIAL+
5.	In SERIAL-
6.	In PPS-
7.	Out SERIAL+
8.	Out SERIAL-



**RJ45 socket**

Normally, you connect the GPS input to the PPS (A) channel input (pins 3 and 6).

The DAG card can also output a synchronization pulse for use when synchronizing two DAG cards (i.e. without a GPS input). The synchronization pulse is output on the Out PPS channel (pins 1 and 2).

To connect two DAG cards, use a [DUCK crossover cable](#) (page 50) to connect the two time synchronization sockets.

### DUCK Crossover cable

To synchronize two DAG cards together use a cable with RJ45 plugs and the following wiring.

TX PPS+	1	3	RX PPS+
TX PPS-	2	6	RX PPS-
RX PPS+	3	1	TX PPS+
RX SERIAL+	4	7	TX SERIAL+
RX SERIAL-	5	8	TX SERIAL-
RX PPS-	6	2	TX PPS-
TX SERIAL+	7	4	RX SERIAL+
TX SERIAL-	8	5	RX SERIAL-

**Note:** This wiring is the same as an Ethernet crossover cable (Gigabit crossover, All four pairs crossed).

## Overview

The DAG Card produces trace files in its own native format called ERF (Extensible Record Format). The ERF type depends upon the type of connection you are using to capture data.

The DAG 3.7D supports the following ERF Types:

ERF Type	Description
1	TYPE_HDLC_POS PoS HDLC Variable Length Record
3	TYPE_ATM ATM Cell Record

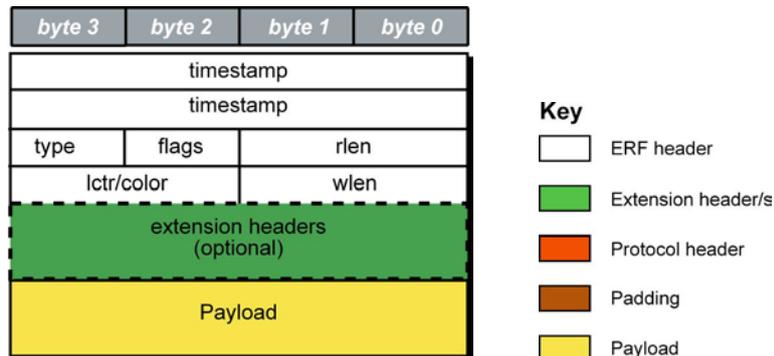
The ERF file contains a series of ERF records with each record describing one packet. ERF files consists only of ERF records, there is no file header or trailer. This allows for simple concatenation and splitting of files to be performed on ERF record boundaries.

For information on other ERF types, please refer to *EDM11-01 ERF types*.

## Generic ERF Header

All ERF records share some common fields. Timestamps are in little-endian (Pentium® native) byte order. All other fields are in big-endian (network) byte order. All payload data is captured as a byte stream in network order, no byte or re-ordering is applied.

The generic ERF header is shown below:



The fields are described below:

timestamp		The time of arrival of the cell, an ERF 64-bit timestamp.
type	Bit 7	Extension header present.
	Bit 6:0	Extension header type. See table below:
flags	This byte is divided into several fields as follows:	
	<b>Bits</b>	<b>Description</b>
	1-0:	Binary enumeration of capture interface: 11 Interface 3 or D 10 Interface 2 or C 01 Interface 1 or B 00 Interface 0 or A Cards with more than four interfaces typically use Multichannel ERF types (type 5 to 9, 12 and 17) which provide a separate larger interface field.
	2:	Varying length record. When set, packets shorter than the snap length are not padded and rlen resembles wlen. When clear, longer packets are snapped off at snap length and shorter packets are padded up to the snap length. rlen resembles snap length. Setting novarlen and slen greater than 256 bytes is wasteful of bandwidth
	3:	Truncated record - insufficient buffer space. <ul style="list-style-type: none"> <li>wlen is still correct for the packet on the wire.</li> <li>rlen is still correct for the resulting record. But, rlen is shorter than expected from snap length or wlen values.</li> </ul> <b>Note:</b> truncation is depreciated and this bit is unlikely to be set in an ERF record.
	4:	RX error. An error in the received data. Present on the wire
	5:	DS error. An internal error generated inside the card annotator. Not present on the wire.
	6:	Reserved
7:	Reserved	
rlen		Record length in bytes. Total length of the record transferred over the PCI bus to storage. The timestamp of the next ERF record starts exactly rlen bytes after the start of the timestamp of the current ERF record.
lctr		Depending upon the ERF type this 16 bit field is either a loss counter or color field. The loss counter records the number of packets lost between the DAG card and the stream buffer due to overloading on the PCI bus. The loss is recorded between the current record and the previous record captured on the same stream/interface. The color field is explained under the appropriate type details.

wlen		Wire length. Packet length "on the wire" including some protocol overhead. The exact interpretation of this quantity depends on physical medium. This may contain padding.
extension headers		Extension headers in an ERF record allow extra data relating to each packet to be transported to the host. Extension header/s are present if bit 7 of the type field is '1'. If bit 7 is '0', no extension headers are present (ensures backwards compatibility). <b>Note:</b> There can be more than one Extension header attached to a ERF record.
Payload		Payload is the actual data in the record. It can be calculated by either : <ul style="list-style-type: none"> <li>• Payload = rlen - ERF header - Extension headers (optional) - Protocol header - Padding</li> </ul>

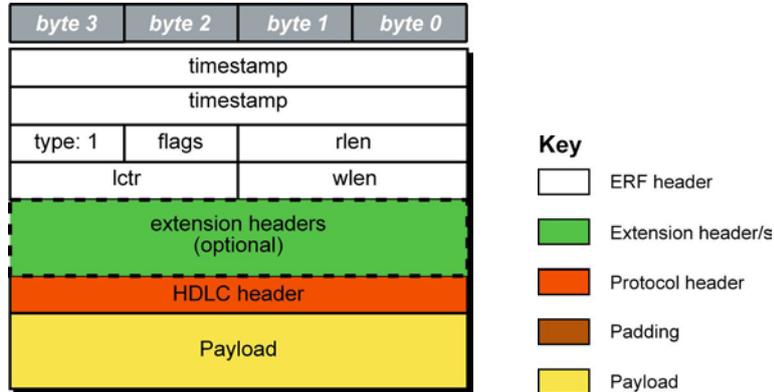
## Extension header types

Number	Type	Description
0:	TYPE_LEGACY	Old style record
1:	TYPE_HDLC_POS	Packet over SONET / SDH frames, using either PPP or CISCO HDLC framing.
2:	TYPE_ETH	Ethernet
3:	TYPE_ATM	ATM cell
4:	TYPE_AAL5	reassembled AAL5 frame
5:	TYPE_MC_HDLC	Multi-channel HDLC frame
6:	TYPE_MC_RAW	Multi-channel Raw time slot link data
7:	TYPE_MC_ATM	Multi-channel ATM Cell
8:	TYPE_MC_RAW_CHANNEL	Multi-channel Raw link data
9:	TYPE_MC_AAL5	Multi-channel AAL5 frame
10:	TYPE_COLOR_HDLC_POS	HDLC format like TYPE_HDLC_POS, but with the LCNTR field reassigned as COLOR
11:	TYPE_COLOR_ETH	Ethernet format like TYPE_ETH, but with the LCNTR field reassigned as COLOR
12:	TYPE_MC_AAL2	Multi-channel AAL2 frame
13:	TYPE_IP_COUNTER	IP Counter ERF Record
14:	TYPE_TCP_FLOW_COUNTER	TCP Flow Counter ERF Record
15:	TYPE_DSM_COLOR_HDLC_POS	HDLC format like TYPE_HDLC_POS, but with the LCNTR field reassigned as DSM COLOR
16:	TYPE_DSM_COLOR_ETH	Ethernet format like TYPE_ETH, but with the LCNTR field reassigned as DSM COLOR
17:	TYPE_COLOR_MC_HDLC_POS	Multi-channel HDLC like TYPE_MC_HDLC, but with the LCNTR field reassigned as COLOUR
18:	TYPE_AAL2	Reassembled AAL2 Frame Record
19:	TYPE_COLOR_HASH_POS	Colored PoS HDLC record with Hash load balancing
20:	TYPE_COLOR_HASH_ETH	Colored Ethernet variable length record with Hash load balancing
21:	TYPE_INFINIBAND	Infiniband Variable Length Record
22:	TYPE_IPV4	IPV4 Variable Length Record
23:	TYPE_IPV6	IPV6 Variable Length Record
24:	TYPE_RAW_LINK	Raw link data, typically SONET or SDH Frame
32-47:	-	Reserved for CoProcess Development Kit (CDK) Users and Internal use
48:	TYPE_PAD	Pad Record type

## ERF 1. TYPE\_POS\_HDLC

Type	Bit 7	1 = Extension header present. See <a href="#">Extension Headers</a> (page 56).
	Bits 6:0	Type 1
Short description	TYPE_POS_HDLC	
Long description	Type 1 PoS HDLC Record	
Use	This record format is for HDLC data links. For example: <ul style="list-style-type: none"> <li>• Packet over SONET</li> <li>• Point-to-Point Protocol [PPP] over SONET</li> <li>• Frame Relay</li> <li>• MTP2 (SS7)</li> </ul>	

The *TYPE\_POS\_HDLC* record is shown below:



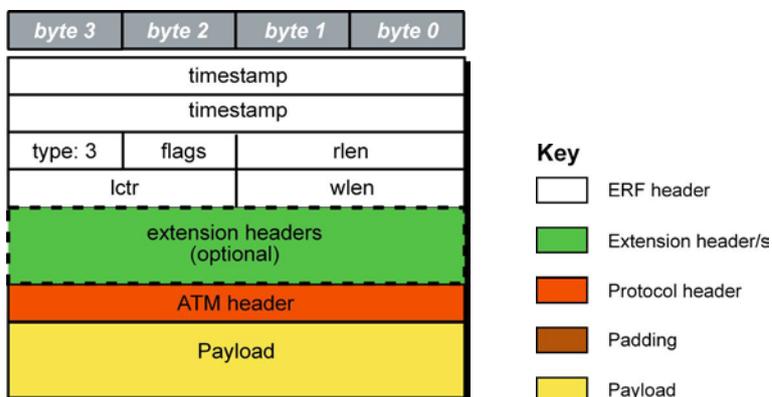
The following is a description of the *TYPE\_POS\_HDLC* record format:

Field	Description
HDLC Header (4 bytes)	Protocol Header. Length may vary depending on protocol, typically 4 bytes.
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (4 bytes)

### ERF 3. TYPE\_ATM

Type	Bit 7	1 = Extension header present. See <a href="#">Extension Headers</a> (page 56).
	Bits 6:0	Type 3
Short description	TYPE_ATM	
Long description	Type 3 ATM Cell Record	
Use	This record format is for ATM cell capture.	

The *TYPE\_ATM* record is shown below:



The following is a description of the *TYPE\_ATM* record format:

Field	Description
ATM Header (4 bytes)	Protocol header. Does not include the 8-bit HEC.
Flags (1 byte)	ATM cells should not have the variable length flag set.
Payload (bytes of cell)	Payload = 48 bytes of cell + HEC (1 byte)

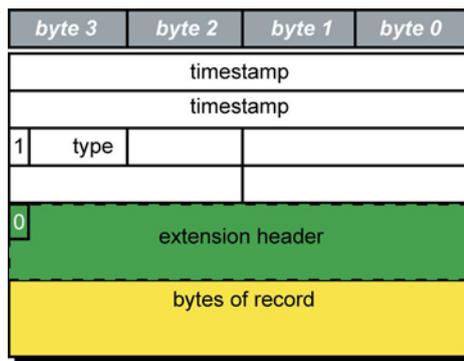
## Extension Headers (EH)

### Introduction

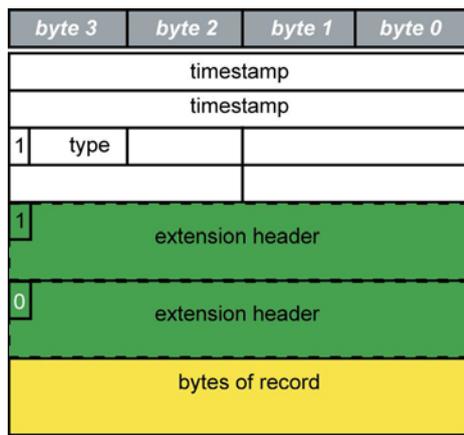
The addition of an Extension Header into the ERF record allows extra data relating to the packet to be transported to the host. The extension header allows certain features to be added independently of ERF types, for example, features shared by different ERF records do not have to be implemented separately. This results in automatic support across ERF types.

Bit 7 of the ERF type field is used to indicate that Extension Header's are present. If set to '1' Extension Headers are present. The Extension Header type field indicates the type and format of the Extension Header. It also indicates whether further Extension Headers are present. If bit 7 of the Extension Header is set to '1' further Extension Headers exist in the record. The Extension Headers are 8 bytes in length.

The following diagram shows presence of an Extension Header in addition to the ERF record.



The following diagram shows presence of two Extension Headers with Bit 7 of the first Extension Header set to '1'.



## Reporting Problems

If you have problems with a DAG 3.7D card or Endace supplied software which you are unable to resolve, please contact Endace Customer Support at [support@endace.com](mailto:support@endace.com).

Supplying as much information as possible enables Endace Customer Support to be more effective in their response to you. The exact information available to you for troubleshooting and analysis may be limited by nature of the problem.

The following items may assist in a quick resolution:

- DAG 3.7D card[s] model and serial number.
- Host computer type and configuration.
- Host computer operating system version.
- DAG software version package in use.
- Any compiler errors or warnings when building DAG driver or tools.
- For Linux and FreeBSD, messages generated when DAG device driver is loaded. These can be collected from command `dmesg`, or from log file `/var/log/syslog`.
- Output of `daginf`.
- Firmware versions from `dagrom -x`.
- Physical layer status reported by: `dagconfig`
- Link statistics reported by: `dagconfig -si`
- Statistics either (depending on the DAG card):
  - Extended statistics reported by: `dagconfig -ei`
  - Universal statistics reported by: `dagconfig -ui`
- Network link configuration from the router where available.
- Contents of any scripts in use.
- Complete output of session where error occurred including any error messages from DAG tools. The `typescript` Unix utility may be useful for recording this information.
- A small section of captured packet trace illustrating the problem.
- If you have just rebooted and the system can not see any DAG cards, you need to load the DAG drivers. Run `dagload`.



## Version History

Version	Date	Reason
1	March 2006	First Release
2	October 2006	Additional configuration detail for separate firmware versions. Extensive layout and formatting changes.
3	December 2007	Imported into AuthorIT and general revision.
4	June 2008	Updated to dagconfig. Updated tokens list. Added card features and firmware image list. Updated statistics. Updated Overview section. Depreciated dagthree. Added ERF Extension header information.
5	November 2008	Updated Buffer_size and mem dagconfig tokens and associated cross references. Updated front matter. Update dagconfig options table. Added new dagrom options. Supported OS information now in release notes. Added card description to the overview.

Status	Description
Preliminary	The products described in this technical document are in development and have yet to complete final production quality assurance.
Released	The products described in this technical document have completed development and final production quality assurance.

