DAG 9.2X2 Card User Guide

EDM01-36

Protection Against Harmful Interference

When present on equipment this document 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 document, 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.

Extra Components and Materials

The product that this manual pertains to may include extra components and materials that are not essential to its basic operation, but are necessary to ensure compliance to the product standards required by the United States Federal Communications Commission, and the European EMC Directive. Modification or removal of these components and/or materials, is liable to cause non compliance to these standards, and in doing so invalidate the user's right to operate this equipment in a Class A industrial environment.

Disclaimer

Whilst every effort has been made to ensure accuracy, neither Endace Technology Limited nor any employee of the company, shall be liable on any ground whatsoever to any party in respect of decisions or actions they may make as a result of using this information.

Endace Technology Limited has taken great effort to verify the accuracy of this document, but nothing herein should be construed as a warranty and Endace shall not be liable for technical or editorial errors or omissions contained herein.

In accordance with the Endace Technology Limited policy of continuing development, the information contained herein is subject to change without notice.

Website

http://www.endace.com

Copyright 2010 - 2012 Endace Technology Ltd. All Rights reserved.

Contents

Introduction

The Purpose of this User Guide

The purpose of this user guide is to provide you with an understanding of the Endace DAG 9.2X2 card architecture, functionality and to guide you through the following:

- Installing the card software.
- Installing the firmware.
- Installing the physical card.
- 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 9.2X2 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 dagfwddemo User Guide*
- *EDM04-06 Daggen User Guide*
- *EDM04-19 DAG Programming Guide*
- *EDM04-21 Libpcap and Third party applications*
- *EDM04-25 Counters and Statistics API*
- *EDM04-30 dagfilter-loader Software Guide*
- *EDM04-31 Enhanced Packet Processing v2*
- *EDM04-32 dagmem Software Guide*
- *EDM04-33 dag_irigb Software Guide*
- *EDM04-34 Configuration & Status API Overview*
- *EDM04-37 Windows DAG Software Installation Guide*
- *EDM05-01 Time Distribution Server User Guide*
- *EDM05-02 TDS 24 Installation Guide*
- *EDM11-01 ERF Types*
- *PN01-13 DAG Card Quick Start Guide*

This user guide and the following installation guides are also available in PDF format on the installation CD shipped with your DAG 9.2X2 card.

- *EDM04-01 DAG Software Installation Guide*
- *EDM04-37 Windows DAG Software Installation Guide*

Overview

The Endace DAG 9.2X2 is a two port, PCIe Gen 2.0 card designed for capture and transmission of network traffic.

It transfers data at the full speed of the network into the memory of the host computer, with zero packet loss in even worst-case conditions. Unlike a NIC (Network Interface Card), it actively manages the movement of network data into memory while 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 Endace DAG 9.2X2 is designed for use with optical interfaces. The DAG 9.2X2 provides full line rate capture of 1 Gigabits per second and 10 Gigabits per second Ethernet per port.

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 15).*

- 100% capture into host memory at full line rate for IP packets from 48 to 9600 bytes.
- 1GE, 10GE LAN and 10GE WAN.
- Timed Release TERF (TR-TERF) & Triggered Timed Release TERF (TR-TERF).
- Enhanced Packet Processing v2 with 32 Stream buffers.
- IRIG-B (Inter Range Instrumentation Group mod B) decoding.
- Conditioned clock with PPS input and local synchronization capability.
- Two SFP+ ports for 1, 10 Gigabit Ethernet.
- PCIe Gen 2.0 bus, 8 lanes.

System requirements

General

The minimum system requirements for the DAG 9.2X2 card are:

- A computer, with at least a Intel Xeon or AMD Opteron 1.8GHz or faster and a minimum of 1GB RAM.
- At least one free PCIe Gen 2.0 slot supporting 8-lane operation.
- Ensure good airflow across the DAG 9.2X2 card heatsink, at least 200 meters per minute (656 linear feet per minute). Also see Warning - Thermal trip (page 3).
- Software distribution requires 60MB free space.
- For details of the supported operating systems, refer either of the following documents.
  - *EDM04-01 DAG Software Installation Guide*.
  - *EDM04-37 Windows DAG Software Installation Guide* .
  - The current Release Notes, available on the Endace Documentation and Software CD or the Endace support website at https://support.endace.com/.

Operating system

This document assumes you are installing the DAG 9.2X2 card in a computer which already has an operating system installed.

For any queries regarding operating systems, contact Endace Customer Support: support@endace.com.

Other operating 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.

Warning - thermal trip

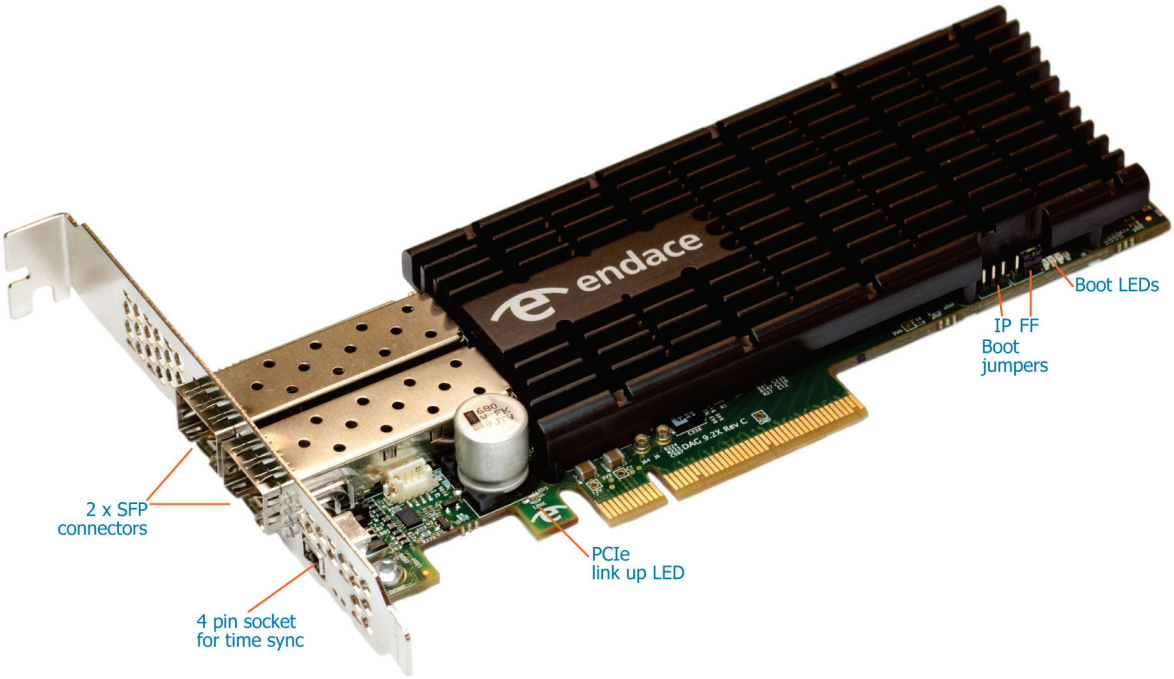
In order to prevent damage to the DAG 9.2X2 card, the DAG 9.2X2 card has an emergency thermal response function (thermal trip). Should the internal temperature of the DAG 9.2X2 card exceed 85 ºC (185 ºF) or fall below 0 ºC (32 ºF), the FPGA will be unloaded, causing the power utilization of the DAG card to drop. This action may cause the host system to crash and the system requires a power cycle to recover.

To display the internal temperature of the DAG card, use the `dagconfig -m` command, see dagconfig (page 33).

Card description

The DAG 9.2X2 has two optical 10 Gigabit Small Form Factor Pluggable (SFP+) interfaces. The two transceivers can be operated simultaneously allowing a single card to monitor one or both directions of a full-duplex link. SFP+ transceivers are also backwards compatible with standard SFP interfaces in 1GE mode.

Note:
Performance will be reduced if the DAG 9.2X2 card is inserted in a PCIe Gen 1.0 slot, or if the 8 lane bus has less than 8 lanes connected. Please check the host computer motherboard specifications.



Note:
For further information on Boot jumpers, see Boot jumper settings (page 11).

DO NOT REMOVE THE BATTERY

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

If battery is removed then the DAG card must be returned to Endace for servicing.

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 optical data received by the SFP+ optical interfaces flows in to the Field Programmable Gate Array (FPGA).

The FPGA contains the packet processor and the DAG Universal Clock Kit (DUCK) timestamp engine. The DUCK provides high resolution per-packet timestamps which can be accurately synchronized to an external Pulse Per Second (PPS) source.

Note:
For further information on the DUCK and time synchronization see Synchronizing Clock Time (page 51).

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 9.2X2 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 following options listed to apply to your network, contact your Network Administrator for further information.

Supported Line Types

The line types supported by the DAG 9.2X2 card are described below.

Type	Description
1000Base-T	1000Mbps over four pairs of balanced Cat5 or Cat6 copper cable.
1000Base-SX	1000Mbps over single mode or multi mode fiber optic cable with short wavelength laser driver (850nm).
1000Base-LX	1000Mbps over single mode or multi mode fiber optic cable with long wavelength laser driver (1310nm).
10GBase-SR	10 Gigabit per second over Ethernet multi mode fiber optic cable with short wavelength laser driver (850nm).
10GBase-LR	10 Gigabit per second over Ethernet single mode fiber optic cable with long wavelength laser driver (1310nm).
10GBase-ER	10 Gigabit per second over Ethernet single mode fiber optic cable with extended wavelength laser driver (1550nm).

Note:
For more detailed information regarding Ethernet line types and speeds, please refer to IEEE Standard 802.3AE available from the IEEE website at www.ieee.org.

Extended functions

Enhanced Packet Processing v2

With the Enhanced Packet Processing v2 capability the following types of enhanced capabilities can be achieved:

1. **Filtering:** Filtering compares the fields in the packet's protocol headers to a list of user defined filter rules. As a result, the packets matching the filter are tagged with a user defined color value. This color value is subsequently used to steer the packet to specific stream buffer(s) or to drop the packet.
2. **Hash Load Balancing (HLB):** The HLB module takes the packets and applies one of a number of user selectable load balancing algorithms. This results in each packet being tagged with a bin number. The bin number is used to help determine the stream the packets are sent to. The user can choose the number of bins used in the packet tagging.
   HLB is typically used to optimize the parallel processing done by multi-core servers, since each core will only see a subset of the full traffic load. The user normally wants to distribute traffic equally (or roughly equally) across the stream buffers while preserving "flow coherence", meaning, all packets associated with a single TCP/IP session must always go to the same stream buffer. Hashing is the tool used to classify the flow coherent streams and mathematically assign a "bin number" to each packet. Bin numbers are then associated with specific stream buffers to achieve the desired load balancing. The hashing algorithms are "flow coherent" so all packets that are a part of a particular session will be tagged with the same bin number.
3. **Steering:** This is where the results of the previous steps are used to determine which stream the packet should be steered to. Optionally, the interface / port number the packet originated from can also be used in the steering process. The rules that determine how the packet steering is accomplished are defined by the user. This gives a large amount of flexibility in the packet steering process. The user can choose to use some, all or none of the color, HLB bin value and interface / port numbers in the steering process.
4. **Duplication:** One of the unique benefits of the Steering feature is the ability to steer the same packet to multiple streams. Packet duplication can simplify software architectures where different applications need to process the same packet. For example, all traffic can be sent to stream buffer 0 for use by a capture to disk application, while only a subset of traffic is sent to stream buffer 2 for handling by a traffic analysis application. For this document, packet duplication is defined as writing a single packet into more than one stream buffer. It does not mean writing the packet twice into the same stream buffer.

For further details refer to the following documents:

- *EDM04-30 dagfilter-loader Software Guide*
- *EDM04-31 Enhanced Packet Processing v2*
- *EDM04-35 dagcat-setup Software Guide v2*

Inline forwarding

The DAG 9.2X2 card supports inline forwarding which enables the card to receive and transmit packets directly from a single memory buffer. This allows you to forward packets from the DAG card receive interface(s) to the DAG cards transmit interface(s) without the requirement to copy them. Using inline forwarding you can receive, inspect, filter and forward packets between ports.

`dagfwddemo` which is a tool supplied with your DAG card demonstrates how you can apply a user-defined Packet Filter (BPF) to the traffic forwarded by the DAG card. Packets which match the filter are forwarded, while packets that do not match are dropped.

For more detailed information on inline forwarding and using `dagfwddemo` please refer to the *EDM04-04 dagfwddemo User Guide* available from the support section of the Endace website at http://www.endace.com.

Timed Release TERF (TR-TERF)

The Timed Release TERF (TR-TERF) module is an option that enables you to retransmit an ERF packet trace while reproducing the time intervals of the packets within that stream. It is able to transmit on all channels.

TR-TERF has two modes of operation.

- No Delay Mode.
- Relative Timed Release Mode.

Triggered Timed Release TERF (TR-TERF)

The Triggered Timed Release TERF (TR-TERF) module extends the functionality of TR-TERF by setting an absolute time at which to start the transmission is to start. This enables synchronization of multiple replay sessions across multiple DAG cards and even systems, provided that the DAG card clocks are synchronized.

Installation

Caution:
The DAG 9.2X2 card software must be installed before the card itself is physically installed into the computer.

DAG software package

The latest DAG Software package must be installed before you install the DAG 9.2X2 card itself. For details on installing the latest DAG Software package, refer to the following:

- *EDM04-01 DAG Software Installation Guide*
- *EDM04-37 Windows DAG Software Installation Guide*

PCIe Gen 2.0 Slot

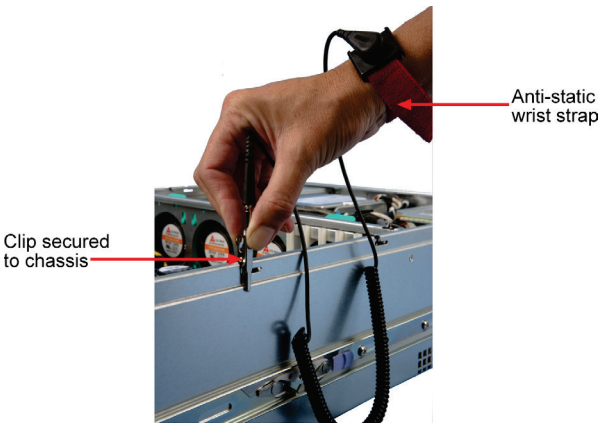
The DAG 9.2X2 card operates on an 8 lane PCIe Gen 2.0 bus and can be installed in any free 8 lane PCIe Gen 2.0 slot.

The PCIe Gen 2.0 bus architecture allows multiple DAG cards to be installed without affecting the bandwidth used by each DAG 9.2X2 card.

Inserting the DAG card

Warnings:
Electro-Static Discharge (ESD): It is very important to protect both the computer and the DAG 9.2X2 card from damage by ESD. Failure to do so could cause damage to components and subsequently cause the card to partially or completely fail.
DO NOT hold the DAG 9.2X2 card by the battery cage. The battery cage can be easily damaged and can cause your DAG 9.2X2 to need reprogramming. DO NOT REMOVE THE BATTERY (page 4).

1. Turn power to the computer OFF.
2. Remove the PCIe Gen 2.0 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. Hold the DAG 9.2X2 card with one hand on the front bracket and two or three fingers on the card edge. This ensures damage does not occur to the card or its components.
6. Insert the DAG 9.2X2 card into PCIe Gen 2.0 bus slot ensuring it is firmly seated.
7. 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.
8. Check the free end of the card fits securely into the card-end bracket that supports the weight of the card.
9. Secure the card with the bus slot cover screw.
10. Turn power to the computer ON.
11. Ensure the blue (FPGA successfully programmed) LED on the DAG card illuminates.

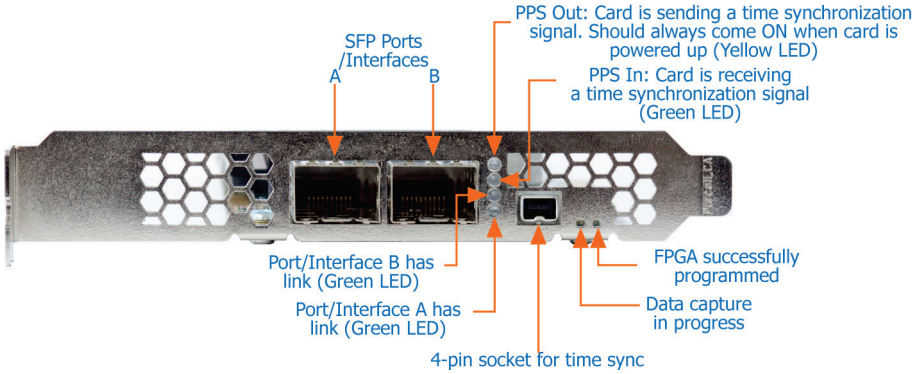
Caution:
Ensure good airflow across the DAG 9.2X2 card heatsink, at least 200 meters per minute (656 linear feet per minute).

Ports and Status LEDs

The DAG 9.2X2 card has two industry standard port connectors for network connections.

In addition there is a 4-pin socket located beside the port connectors for connection to an external time synchronization source.

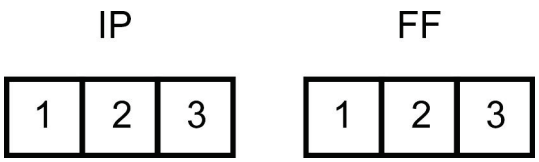
Warning:
Connect only a PPS input to the 4 pin time synchronization socket.
Connecting anything else to this socket may damage the DAG card.



Boot jumper settings

The DAG 9.2X2 has two sets of jumpers mounted on the DAG card which control the card's boot behavior:

- IP (Inhibit Program)
- FF (Force Factory)



IP Jumper settings

Jumper set between	Definition
1 & 2	Used in development. Do not use.
2 & 3 or jumper not fitted	Normal operation of the DAG card.

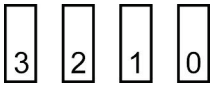
FF jumper settings

Jumper set between	Definition
1 & 2	Loads the factory image into the FPGA at power on.
2 & 3 (or jumper not fitted)	Loads the user defined image into the FPGA at power on.

Boot LEDs

The following tables describe the Boot LED configurations of the DAG 9.2X2. The Boot LED's are to the right of the Boot Jumpers.

Boot LED numbering:



LED	Color
3	Green
2	Green
1	Green
0	Red

Notes:

- *If the blue 'FPGA programmed' LED (on the front of the DAG card) is off or flashing - contact Endace Support.*
- *If the red Boot LED is flashing, contact Endace Support.*

Pluggable optical transceivers

Overview

The DAG card's SFP+ optical transceivers consist of the following two parts.

- Mechanical chassis attached to the circuit board.
- Transceiver unit which may be inserted into the chassis.

You can connect the transceiver to the network via LC-style optical connectors. For further information on pluggable optical transceivers please refer to the Endace website at http://www.endace.com.

Caution:
To prevent damage to the DAG card, ensure you select the correct transceiver type for the optical parameters of the network to which you want to connect.

Optical modules

The optical power range depends on the particular SFP+ module that is fitted to the DAG card. Optics modules are supplied in either Single or Multi mode. See the following table for details.

Optical power is measured in dBm, decibels relative to 1 mW where 10 dB is equivalent to a factor of 10 in power. A negative optical power value indicates power that is less than 1 mW. The most sensitive devices can work at power levels down as low as -30dBm or 1µW.

To confirm card port light levels, use an optical power meter.

Note:
Covering the card ports with LC-style plugs when they are not in use is highly recommended, to prevent dust and mechanical hazards affecting optics.

Product Number	Network Support	Receive Characteristics				Transmit Characteristics			
		Wavelength (nm)		Sensitivity dBm (OMA)		Wavelength (nm)		Tx Power dBm (OMA)	
		Min	Max	Min	Max	Min	Max	Min	Max
TXR-1000SX	1000BASE-SX Multi mode	770	860	-20	0	830	860	-9	-3.5
TXR-1000LX	1000BASE-LX Single mode	1270	1600	-22	0	1270	1360	-9.5	-3
TXR-10G 850 MM SFP+	10GBASE-SR Multi mode	840	860	-11.1	0.5	840	860	-5	-1
TXR-10G 1310 SM SFP+	10GBASE-LR/LW Single mode	1260	1600	-12.6		1260	1355	-5.2	0.5
TXR-1G/10G 850 MM SFP+	1G/10G BASE-SR Multi mode	840	860	-17	0.5	840	860	-9.5	-1
TXR-1G/10G 1310 SM SFP+	1G/10G BASE-LR Single mode	1260	1600	-19		1260	1355	-11	-3
TXR-10G 1550 SM SFP+	10GBASE-ER Single mode	1260	1600	-15.8	-1	1530	1565	-4.7	4

Transmit power and the receive sensitivity is specified as OMA - Optical Modulation Amplitude.

Power input

Note:
The optical power input to the DAG card must be within the receiver's dynamic range. See the previous table for details. 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.

When power is above the upper limit the optical receiver saturates and fails to function. When power is below the lower limit the bit error rate increases until the device is unable to obtain lock and fails. In extreme cases, excess power can damage the receiver.

When you set up the DAG card you should measure the optical power at the receiver and ensure that it is within the specified power range. If it is not, adjust the input power as follows:

- Insert an optical attenuator if power is too high, or
- Change the splitter ratio if power is too high or too low.

Splitter losses

Splitters have the insertion losses either marked on their packaging or described in their accompanying documentation. General guidelines are as follows:

- A 50:50 splitter will have an insertion loss of between 3 dB and 4 dB on each output.
- 90:10 splitter will have losses of about 10 dB in the high loss output, and <2 dB in the low loss output.

Note:
Endace recommends that you do not use a combination of single-mode and multi-mode fibers and optics modules on the same link, as the quality of the received signal cannot be guaranteed.
If you have no choice but to mix single-mode and multi-mode, please be aware that a single mode input connected to a multi-mode fiber will have some attenuation but may still be acceptable. However a multi-mode input connected to a single-mode fiber will likely have large and unpredictable losses.

Pluggable copper transceivers

The DAG card supports industry standard Small Form-factor pluggable (SFP) copper transceivers.

The transceivers consist of two parts:

- Mechanical chassis attached to the circuit board
- Transceiver unit which may be inserted into the chassis

Endace recommends that you use Cat6 copper cable. The DAG card copper module specification is shown below:

Part	Type	Data Rate
TXR-1000TX	1000 Base-T	less than 1.25 Gbps (RJ-45 IEEE 802.3)

Note:
If a copper transceiver is unplugged and then plugged in again you must run `dagconfig default` *to initialize the transceiver for the link configuration. It also checks the compatibility of all the modules with the DAG card, and will not power on mismatched modules.*

Configuring the DAG card

Introduction

Configuring the DAG 9.2X2 card requires the following steps:

- Setting up the FPGA (page 19).
- Preparing the DAG card for use (page 22).
- Configuring the DAG Card (page 23).
- Viewing the DAG card statistics (page 34).

Once the DAG 9.2X2 is configured, you can begin using it.

See Using your DAG card (page 37) for details on capturing data.

Firmware images

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

FPGA image (Software version string)	1 Gigabit Ethernet	10 Gigabit Ethernet LAN	10 Gigabit Ethernet WAN	Enhanced Packet Processing v2	TR-TERF	TTR-TERF
`dag92x2pci-bfs-eth.efb (dag92x2pci-bfs-eth...)`	✔	✔	✔	✔	✔	✔

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.

Resetting DAG card to Operational Settings

To ensure a DAG card has the correct operational settings, the `dagconfig -dX default` command must be run after any of the following operations. (Where X is the device number of the DAG card you want to configure).

- booting the host system,
- installing or updating the DAG drivers,
- disabling and re-enabling the DAG driver,
- programming the DAG card firmware (i.e. dagrom -p), or
- resetting the DAG card (dagreset).
- after inserting a new XFP/SFP/SFP+ transceiver module.

This command resets the specified DAG card to operational settings for the DAG cards default network mode.

Once this command is run, the DAG card is ready to capture and transmit using the default network mode settings (i.e. 10 G, Ethernet, SONET etc).

For further details on DAG tools, see Accessing DAG tools in Windows (page 16).

Note:
Depending on your current network's mode, you may need to change the network mode settings.

Differences between Windows and Linux installs

With the following few exceptions, everything about using the DAG software and API in the Linux and Windows environments are the same:

- The registry editing capabilities of DAG Devices replaces the functionality of Linux's dagmem and dagload.
- winpcap replaces libpcap.
- Only DAG tools applicable to the supported DAG cards are available in this release. For a list of supported tools see the following list.

Note:
Not all DAG software releases support MS Windows, refer to the applicable release notes for specific details.

Supported DAG tools in Windows

The following is a list of the DAG tools supported under the Windows operating system.

• dagbits	• dagdetect	• dag_irigb	• dagsnapbis
• dagcat-setup	• dagfilter-loader	• dagpps	• dagsort
• dagclock #	• dagflood	• dagreset	• dsm_loader
• dagconfig	• daggen	• dagrom	
• dagconvert	• daginf	• dagsnap	

Notes:

- *# - These DAG tools operate differently from the Unix equivalent.*
- *dagdetect runs automatically each time the WinDAG Command Prompt window opens.*

Windows only DAG tools

The following DAG tools are available only within the Windows environment:

- DAG Devices - replaces the functionality of dagmem and dagload.
- dagsrat - an information tools that allows the user to view the ACPI Static Resource Affinity Table if it exists on the system where the tool is run.
- daguninstall - Correctly uninstalls the dag software (forcing it if necessary).
- dagwpcap - Updates WinPcap with DAG enabled components which allow WinPcap to see live traffic from a DAG card.

For further details refer to *EDM04-37 Windows DAG Software Installation Guide*.

Accessing DAG tools in Windows

Once the DAG software is installed you can start to use the DAG tools via a command prompt.

To access a command prompt in the Windows Server operating system(2003 or 2008), use the WinDAG Command Prompt tool. This tool opens a command window in the appropriate directory. The window is configured to display a wider than normal command window with orange text.

WinDAG Command Prompt

The WinDAG Command Prompt tool opens a custom command window which enables you access to the supported DAG tools. It opens in the directory containing the DAG tools.

When the WinDAG Command Prompt tool opens it:

- provides a wider command window in order to see the DAG tool outputs.
- automatically displays details about the installed DAG cards.

Note:
The DAG tools use the Unix style operands, i.e. they use "-" instead of "/".

Before configuring the DAG card

Before configuring the FPGA, ensure the following actions have been completed on each installed DAG card:

- memory allocated to each DAG card.
- DAG drivers installed for each DAG card.

Note:
Before using the DAG card to capture or transmit traffic remember to run `dagconfig -dX default` *(Where X is the device number of the DAG card you want to configure).*
For further details, see *Resetting DAG card Operational Settings (page 15).*

Linux operating systems

In Linux operating systems, use the following applications:

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

Note:
`dagmem` *controls the amount of memory assigned to each DAG card. To change the memory assignments* `dagmem` *must be reloaded, which may require a reboot. Refer to* EDM04-32 dagmem Software Guide*.*

For further details, refer to the *Installing the drivers* section for the required operating system in *EDM04-01 DAG Software Installation Guide*.

Windows Server operating systems

In Windows Server operating systems, use the DAG Devices tool to allocate memory to each installed DAG card, and install DAG drivers for each installed DAG card.

For further details, refer to the *Configuring DAG card parameters* section in *EDM04-37 Windows DAG Software Installation Guide*.

daginf

`daginf` is the information utility for DAG cards. By default `daginf` displays summary information about all DAG cards installed in the system. The available options in `daginf` are as follows:

Option	Description
`-d,--device <device>`	The DAG device to use. Default is `d0`.
`-h,--help`	Displays the MAN pages help for this tool.
`-v,--verbose`	Sets the verbosity level of the displayed information. 0 (basic) to 3 (full).
`-V,--version`	Display version number of `daginf` and of the installed DAG software.

The following is an example `daginf` output for the DAG 9.2X2:

Linux

```
id          1
model       DAG 9.2X2
device      0x920e
board rev   2
phy addr    0xbd400000
buf size    33554432 (32MB)
iom size    65536 (64kB)
bus addr    0000:07:00.0
Memory at node 0: 8192 pages (32MB)
copro       Built-in
rxstreams   32
txstreams   1
```

Windows

```
id            1
model         DAG 9.2X2
device        0x920e
board rev     3
bus addr      0x00000005205d9000
buf size      1073741824 (1024MB)
iom size      65536 (64kB)
mem NUMA node 1
copro         Built-in
rxstreams     32
txstreams     1
```

Note:

- *Depending on the installed operating system, some options do not display.*
- *The "mem NUMA node" will be displayed if the system is able to determine the NUMA node for the stream buffer.*

dagdetect

dagdetect displays the currently installed DAG cards and associated details.

This includes the following details:

- current device number on this system.
- the number of ports on this DAG card.
- the card code specific to this DAG card.
- the DAG card type and specific board revision.

Option	Description
`-c,--count`	Displays the number of installed DAG cards in the system.
`-d,--device <device>`	DAG device to use.
`-h,--help, -?,--usage`	Displays the help associated with this software.
`-i,--ifaces`	Displays the number of physical interfaces on the specified DAG card.
`-n,--name`	Displays the name of a specified DAG card.
`-p,--path`	Displays the name of a specified DAG card in a form suitable for use as a filesystem path (i.e. no whitespace). Implies '--name'.
`-v,--verbose`	Increase verbosity.
`-V,--version`	Display version information.

Note:
Dagdetect runs automatically each time the WinDAG Command Prompt window opens.

Setting up the FPGA

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

For the FPGA on the DAG 9.2X2 there are up to four firmware images stored in ROM:

- The factory image - contains fixed basic functionality for operating the DAG card. It cannot be overwritten by the user.
- The user images in slots 1 to 3 - User image #1 is programmed at the factory. Other user images may or may not be pre-programmed. User images can be updated by the user either to update to a new release, or to load an user image with different functionality than that originally shipped from the factory.

By default, the DAG 9.2X2 card boots using the **user image in slot 1**, unless the Force Factory jumper is fitted. For more details on the Force Factory jumper, see Boot jumper settings (page 11).

Booting from the factory image is only required if the DAG card cannot boot from any of the user images as a result of a ROM programming error.

Selecting the firmware image to load at power up

By default, the DAG 9.2X2 card loads user image from slot 1 at power up.

Note:
This setting is overridden if the Force Factory jumper is set.

To change the power up user image slot number, use the following command:

```
dagrom -dX -qY
```

- Where X is the device number of the DAG card you want to configure.
- Where Y is the number of the new default power up user image.

For details on the dagrom options, see dagrom (page 21).

Slot (Y)	Image loaded
0	Factory image
1	User image 1
2	User image 2
3	User image 3

For example, to set the user image in slot 3 as the power up image, type:

```
dagrom -d0 -q3
```

Loading new firmware images onto a DAG Card

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

Endace recommends you use the `dagrom -ryv` command when loading images from the computer to the FPGA 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 21). This eliminates unnecessary reprogramming of the FPGA and extends its life.

Programming the FPGA

If required you can program new user images into any of the three user image slots on the FPGA.

For example, for the DAG 9.2X2 card use:

1. Type the following command:
   ```
   dagrom -dX -rv -y -qY -f dag92x2pci-bfs-eth.efb
   ```
   - Where X is the device number of the DAG card you want to configure
   - Where Y is the user image slot number in which to load the new user image. This image is marked `to be loaded`.

   The filename of the firmware image may differ from the above depending on the version required.
2. Power cycle the chassis.

On power cycle the user image marked `to be loaded` becomes active - provided the boot jumpers are not set to Force Factory (FF), see Boot jumper settings (page 11).

For more information see dagrom (page 21).

Note:
Before using the DAG card to capture or transmit traffic remember to run `dagconfig -dX default`
(Where X is the device number of the DAG card you want to configure).
For further details, see Resetting DAG card Operational Settings (page 15).

dagrom

`dagrom` is a software utility to configure the FPGA on Endace DAG cards. The following table lists `dagrom` options.

Option	Description
`-a,--alternate-half`	Use alternate (stable) half. [Default is current half.] Factory / User. ***Note:*** *Not applicable to DAG 7.4S, 7.5G2/G4, 9.2X2 or 9.2SX2 .*
`-A,--entire-rom`	Entire ROM. [Default is current half only.] ***Note:*** *Not applicable to DAG 7.4S, 7.5G2/G4, 9.2X2 or 9.2SX2 .*
`-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, a=all.
`--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. Use only on the advice of Endace.
`-f,--file <filename>`	File to be read when programming ROM. There are multiple FGPA images per DAG card, covering the different versions, ERF, BFS, DAM etc.
`--force`	Force loading firmware. Not recommended unless absolutely necessary - use only with extreme caution. ***Caution:*** *May prevent DAG card operation or even damage the DAG card.*
`-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).
`-I,--incr`	Increment ROM. [Default is read.] Use only on the advice of Endace.
`-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).
`-n,--fpga-number <FPGA number>`	Specify which FPGA to load the specified image into on next power cycle. Default FPGA number is 0.
`-o,--swid-rom-read`	Read SWID from ROM.
`-p,--program-current`	Program current User 1 Xilinx image into FPGA. ***Caution:*** *Do not use with DAG 7.4S, 7.5G2/G4, 9.2X2, 9.2SX2 DAG 9.2X2, 9.2SX2, see `-q` below.*
`-q,--image-number <image number>`	Specify the image number for operations (`-w`, `-r`, `-y`, `-e`). • 0.factory image • 1. user image 1, • 2. user image 2 • 3. user image 3 When used with the `-r` or `-w` options, `-q` changes into which slot the image is loaded. When used without the `-r` or `-w` options, `-q` does not change the image itself, rather it sets the "boot next" flag. ***Note:*** *Use with DAG 7.4S, 7.5G2/G4, 9.2X2, 9.2SX2 only.*
`-r,--reprogram`	Reprogram ROM (may imply erase and write).

`--reset-method <reprogram method>`	Specify the method to reprogram the card. • 1.Immediate / Rude Reprogram • 2.Negotiated Link Disable, Reprogram, Retrain • 3.Negotiated Bus Hot Reset, Reprogram (default)]. ***Caution:*** *Do not use with DAG 7.4S, 7.5G2/G4, 9.2X2 or 9.2SX2*
`-s,--swid-rom-write <swid>`	Write given SWID to ROM. The key must be supplied with the `-m` option.
`--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)
`-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. Not recommended unless absolutely necessary - use only with extreme caution. ***Caution:*** *May prevent DAG card operation or even damage the DAG card.*
`-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.]

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

To view the FPGA image revision strings, type the following:

```
dagrom -dX -x
```

Where X is the device number of the DAG card you want to configure

```
factory: d92x2pci_bfs-eth ...
user  1: d92x2pci_bfs-eth...
user  2: d92x2pci_bfs-eth ... (active)
user  3: d92x2pci_bfs-eth ...
User Image 1 will load on power up cycle
Card Serial: 922
```

Preparing the DAG card for use

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

Note:
Ensure you do this each time the FPGA is reprogrammed.

```
dagconfig -dX default
```

(Where X is the device number of the DAG card you want to configure).
The current DAG 9.2X2 configuration displays and the firmware is verified as correctly loaded. See dagconfig (page 33) for more information.

DAG card Configuration and Status

Display Current Configuration

Once you have loaded the firmware 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 default configuration for the first card, use:

```
dagconfig -dX
```

Where X is the device number of the DAG card you want to configure.
A description of applicable dagconfig tokens follows.

Note:
Not all commands are displayed in the following outputs.

Ethernet LAN

```
Card Information:
Firmware: d92xpci_bfs-eth ... (user 2)
Serial : 8002434
MAC Address A : 00:00:00:00:00:00
MAC Address B : 00:00:00:00:00:00

Port A:
  laser tx_crc nic enablea nofcl noeql master 10G lan
Port B:
  laser tx_crc nic enableb nofcl noeql master 10G lan

Stream 0: stream_drop_count = 765746
Stream 2: stream_drop_count = 0
```

... *(output truncated)*

```
Stream 60: stream_drop_count = 0
Stream 62: stream_drop_count = 0
PCI Burst Manager:
PCI-e 2.0 x8 (32Gbs)
buffer_size=1024 rx_streams=32 tx_streams=1 drop nooverlap
Memory Streams:
mem=48:512:48:0:48:0:48:0:48:0:48:0:48:0:48:0:48:0:0:0:0:0:0:0:0:0:0:0:0:0:
0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0
TERF:
terf_strip32
rx_error_a: off
rx_error_b: off
time_mode: no_time_mode
Hash Load Balancer:
hat=0.0-100.0
```

Ethernet WAN

```
Card Information:
Firmware: d92xpci_bfs-eth ... (user 2)
Serial : 8002434
MAC Address A : 00:00:00:00:00:00
MAC Address B : 00:00:00:00:00:00

Port A:
  laser tx_crc nic enablea nofcl noeql master 10G wan
Port B:
  laser tx_crc nic enableb nofcl noeql master 10G wan

Stream 0: stream_drop_count = 765746
Stream 2: stream_drop_count = 0
```

... *(output truncated)*

```
Stream 60: stream_drop_count = 0
Stream 62: stream_drop_count = 0

PCI Burst Manager:
PCI-e 2.0 x8 (32Gbs)
buffer_size=1024 rx_streams=32 tx_streams=1 drop nooverlap
Memory Streams:
mem=48:512:48:0:48:0:48:0:48:0:48:0:48:0:48:0:48:0:0:0:0:0:0:0:0:0:0:0:0:0:
0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0
TERF:
terf_strip32
rx_error_a: off
rx_error_b: off
time_mode: no_time_mode
Hash Load Balancer:
hat=0.0-100.0
```


dagconfig tokens explained

dagconfig tokens

1000

Sets the DAG card into 1000BaseTX (1GE) mode.

Example

```
dagconfig 1000
```

10G

Sets the DAG card into the 10G receive mode.

Example

```
dagconfig 10G
```

Note:
10G and lan may be used interchangeably.

auto_neg / noauto_neg

Note:
From DAG software 3.1.0 onwards `nic/nonic` *is replaced by* `auto_neg/noauto_neg`*. Both options are valid and still can be used.* `auto_neg/noauto_neg` *is not supported by some older cards.*

For 1G Ethernet only. The DAG card operates in either "`auto_neg`" or "`noauto_neg`" mode.

In `auto_neg` mode you must connect the DAG card directly to a Ethernet switch or card with a full-duplex cable, in which case the DAG card will perform Ethernet auto-negotiation.

The `noauto_neg` mode is intended for use with optical fiber splitters. In this mode you must connect the receive socket of the DAG port to the output of an optical splitter inserted into a network link between two other devices. The transmit socket of the DAG should be unconnected.

In `noauto_neg` mode, Ethernet auto-negotiation is not performed. This allows you to use one splitter on each DAG receive port to monitor each direction of a full-duplex Ethernet link.

Example

```
dagconfig auto_neg
dagconfig noauto_neg
```

buffer_size

The buffer size=*n*MB indicates the total amount of memory allocated to the DAG card. Memory allocation occurs at boot time.

In Linux operating systems

`dagmem` is used to allocate the memory to each installed DAG card. For details on how to allocate memory, refer to *EDM04-32 dagmem Software Guide*.

In Windows operating systems

Memory is allocated using the DAG Devices tool For details on how to allocate memory, refer to *EDM04-37 Windows DAG Software Installation Guide*.

For information on calculating the required stream buffer size, see Guidance for stream buffer sizing (page 71).

crc32 / nocrc

Enables CRC checking on the DAG card which allows detection of corrupted data within the entire frame. Sets the checking to None or 32 bits.

Example

```
dagconfig nocrc
dagconfig crc32
```

Note:
Only applicable to 1G Ethernet - Not applicable to 10G Ethernet LAN or WAN.

default

The `default` command initializes the DAG card configuration and sets all operational settings to the default network mode values. The command also undoes any user customizations and resets the DAG card configuration back to its default state.

Note:
When you run `dagconfig -dX default` the `dagclock` inputs and outputs are also reset to defaults. (Where X is the device number of the DAG card you want to configure).

Example

```
dagconfig -d0 default
```


drop/nodrop

Determines if the DAG card's memory holes are de-coupled.

In `drop` mode, the memory holes are de-coupled. If the data rate on one memory hole slows, the data rate on any other memory holes is not affected. The dropping of packets occurs at the individual stream's burst manager.

In `nodrop` mode, the memory holes are coupled. The speed of the slowest memory hole determines the overall speed of the data rate. The dropping of packets occurs at the port.

Example

```
dagconfig drop
dagconfig nodrop
```

enable/disable

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

Example

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

Notes:

- *DAG card 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.*
- *On some firmware images changes to this option may not be applicable.*

eql/noeql

Sets or unsets equipment loopback. For testing set to `eql` mode and normal operation set to `noeql` mode.

`eql` mode loops transmit data from the host back to the PCIe Gen 2.0 bus.

Example

```
dagconfig eql
dagconfig noeql
```

eth

Sets framer into ETH receive mode. Image dependent - only operates in Ethernet images

Example

```
dagconfig eth
```

fcl/nofcl

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
```

Hash Load Balancer

Hash Load Balancing configuration. Each stream is allocated a percentage of incoming traffic.

Example

```
hat=x1-x2:x3-x4:..
```

Note:
For further details, refer to EDM04-31 Enhanced Packet Processing v2*.*

lan

Set the DAG card into LAN receive mode.

Example

```
dagconfig lan
```

Note:
10G and lan may be used interchangeably.

laser/nolaser

Enables/disables the transmit laser for the optical transceivers.

Example

```
dagconfig laser
dagconfig nolaser
```

lock/nolock

Read only. Indicates that the card is receiving a signal at the appropriate frequency (`lock`), or there is no signal being received (`nolock`).

master/slave

Defines whether the data transmitted is clocked with the recovered clock from the input (Slave) or if it uses the synthesized reference clock on the card (Master).

mem

It is possible to split the DAG card's allocated memory between the receive and transmit stream buffers to suit specific requirements. Where a DAG card does not support transmit, set the transmit stream buffers to 0 (zero). 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. Only applicable if the DAG card supports transmit.

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 26) and rx and tx Streams (page 31) 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 cannot change the stream memory allocations while packet capture or transmission is in progress.

For information on calculating the required stream buffer size, see Guidance for stream buffer sizing (page 71).

nic/nonic

Modes: 10G Ethernet only.

Note:
This token operates very differently from the previous nic/nonic token.

In `nic` mode, the DAG card must have a receive signal present to transmit packets. The DAG card transmits the 'Remote Fault' ordered set when no signal is present on its receiver (compliant mode).

In `nonic` mode this behavior is disabled, allowing the DAG card to transmit packets without having a receive signal present (non compliant mode).

Examples

```
dagconfig nic
dagconfig nonic
```

Note:
For 1G Ethernet use auto_neg / noauto_neg (page 26)

nodelay

Applicable to TR-TERF. Disables Relative Timed Release mode (No Delay Mode).

In *No Delay Mode* all packets are transmitted at the maximum rate permitted by the line interface, using only minimum gaps between packets.

See also relative (page 30), time_mode (page 32).

Example

```
dagconfig nodelay
```

overlap/nooverlap

Configures the `rx` and `tx` memory hole to be overlapped. This enables in-line forwarding without copying the data between the stream buffers.

Example

```
dagconfig overlap
dagconfig nooverlap
```

Note:
This option is only applicable on firmware images containing TX.
For further details refer to EDM04-04 dagfwddemo User Guide*.*

PCI

Describes the following information about the DAG card.

- Bus speed - 1.0, 2.0 or 3.0.
- Number of lanes - x1, x2, x4 or x8.
- Data throughput - dependent on the bus speed and number of lanes.

Example

```
PCI Burst Manager:
PCI-e 2.0 x8 (32Gbs)
```

relative

Applicable to TR-TERF - set to Relative Timed Release mode.

In Relative Timed Release Mode, each packet is transmitted according to its timestamp, relative to the first packet in the transmit stream. This is shown in the following example where Packet A will be transmitted immediately, Packet B will be transmitted one second later and Packet C will be transmitted one second after that:

```
Packet A: Timestamp = 2006-07-24 03:45:55.9720326 UTC
Packet B: Timestamp = 2006-07-24 03:45:56.9720326 UTC
Packet C: Timestamp = 2006-07-24 03:45:57.9720326 UTC
```

If for any reason the transmission of Packet B is delayed, the module will still attempt to transmit Packet C two seconds after Packet A. It will do this even if it means reducing the gap between Packet B and Packet C.

When using multiple output ports in this mode the timing for both ports is maintained. This is shown in the following example where on port A Packet 4 is transmitted three second after Packet 1 and on port B Packet 3 is transmitted one second after Packet 2. The Packet 2 is transmitted one second after Packet 1 even when they are send out on independent ports.

```
Packet 1 (Port A): Timestamp = 2006-07-24 03:45:55.9720326 UTC
Packet 2 (Port B): Timestamp = 2006-07-24 03:45:56.9720326 UTC
Packet 3 (Port B): Timestamp = 2006-07-24 03:45:57.9720326 UTC
Packet 4 (Port A): Timestamp = 2006-07-24 03:45:58.9720326 UTC
```

See also time_mode (page 32), nodelay (page 29).

Example

```
dagconfig relative
```

Notes:

- *The previous version of Relative Mode was port independent and you will see a different release pattern transferring old files.*
- *The relative placement of the packets is accurate to ± 100ns.*

reset

Resets the ethernet framers, set auto mode.

Example

```
dagconfig -d0 reset
```

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 29).

rxonly

Configures the memory hole to receive only.

Example

```
dagconfig rxonly
```

rxtx

Enables both transmit and receive, and splits the memory hole for `rx` and tx.

This allocates 16MB of memory to each transmit stream, and divides the remaining memory between the receive streams.

Example

```
dagconfig rxtx
```

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

stream_drop_count

Details the number of packets dropped during current capture session on this stream.

Example

```
Stream 0: stream_drop_count = 0
Stream 2: stream_drop_count = 0
...
```

terf_strip16/terf_strip32/noterf_strip

Strips the CRC value (32 bits) from the packet or sends packet "as is" (`noterf_strip`). The TERF line in the current configuration indicates the current TERF option.

Note:
Only displayed if the DAG card supports transmit (i.e. has a TERF image).

Example

```
dagconfig terf_strip32
dagconfig noterf_strip
```

time_mode

Applicable to TR-TERF.

Sets the time release mode. `nodelay` sends packets out with no delay. Shows as `no_time_mode`. `relative` mode sends out packets in the same time spacing as they were received.

See also relative (page 30), nodelay (page 29).

Example

```
dagconfig nodelay
dagconfig relative
```

tx_crc/notx_crc

Modes: Ethernet, WAN only.

Enables the crc(fcs) in the transmitted packets CRC(FCS).

Example

```
dagconfig tx_crc
dagconfig notx_crc
```

txonly

Configures the memory hole to transmit only.

Example

```
dagconfig txonly
```

Notes:

- *Only displayed if the DAG card supports transmit (i.e. has a TERF image).*
- *This option is only applicable on firmware images containing TX.*

txrxerror/notxrxerror

Indicates how to process packets that are transmitted with an **RX error** flag. Packets are either discarded `(notxrxerror) on` or transmitted `(txrxerror)`.

Note:
Only displayed if the DAG card supports transmit (i.e. has a terf image).

Example

```
dagconfig txrxerror
dagconfig notxrxerror
```

wan

Set the DAG card into WAN receive mode.

Example

```
dagconfig wan
```

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).

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 table lists `dagconfig` options.

Notes:

- *For DAG cards with more than 2 ports, you can select the required port using: `-port<number>` or `--port<letter>`.*
- *Not all options listed are applicable to all DAG cards.*

Warning:
Accessing the `-m` and `-n` options simultaneously on the same DAG card may result in inaccurate results.

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.
`-I, --attribute-index <n>`	Gets or sets the attribute for the `n`th instance of a component with multiple instances. Index `n` starts from 0. Cannot be used in conjunction with `--port` options. Used with `-G` or `-S` options.
`-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.*
`--framerfirmware <framer-firmware>`	DAG 9.2X2 only. Specifies the path to the framer firmware image. Allows you to override the default path to the framer firmware.
`-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. ***Note:*** *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.
`--no-default`	Do not run default automatically after reset.
`-S,--setattribute <setattribute>=<value>`	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.

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 -dX -s
```

(Where X is the device number of the DAG card you want to configure).
For more information see dagconfig (page 33).

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

Notes:

- *`1`: condition is present on the link.*
- *`0`: condition is not present on the link.*
- *`-`: condition is not applicable.*

Condition	Definition
`Port`	Indicates the port the status conditions apply to.
`Lock`	Card is locked to the incoming signal and can capture data.
`Link`	The link is fully validated.
`Loss of Pointer`	Loss of pointer. WAN mode only.
`Loss of Frame`	Indicates `oof` has been asserted for more than 3ms. WAN mode only.
`Lof`	Indicates loss of frame. 1GE mode only.
`Auto neg complete`	Auto negotiation process has completed, Only applicable when using copper transceivers. 1GE only.

Universal counters

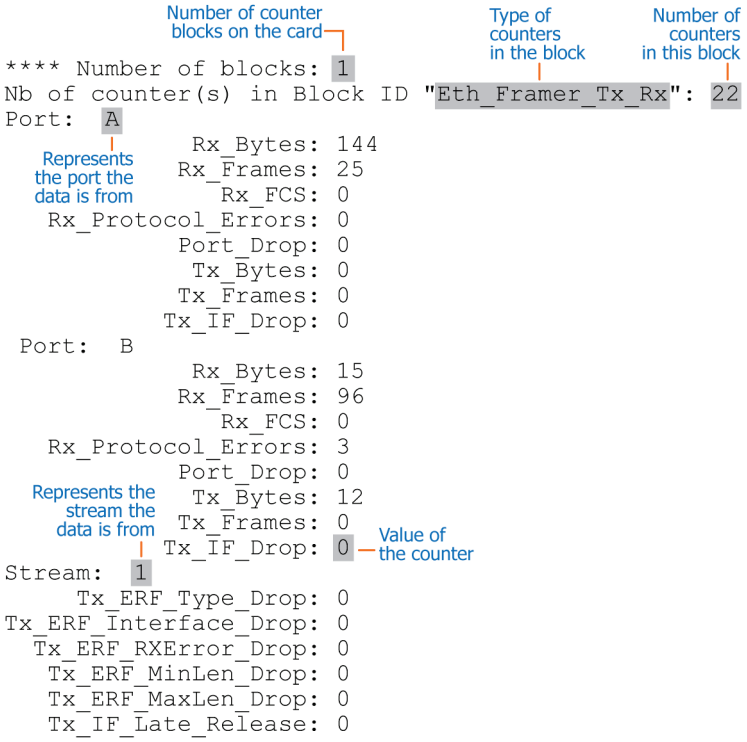
The counters contain details of the number of frames and any errors. The counters are latch and clear so values indicate the amount of data since the last time the counters were read.

```
dagconfig -dX -u
```

(Where X is the device number of the DAG card you want to configure).
For more information see dagconfig (page 33).

Example outputs are shown:

Ethernet



Counter	Definition
RX_Bytes	Number of payload bytes received from the line.
RX_Frames	Number of packets received from the line.
RX_FCS	Number of packets received from the line with errors (typically FCS errors).
RX_Protocol_Errors	Number of packets received from the line with errors. Errors can be: FCS, short packet, truncated packet, length field, length type, fsame code, or fsame invalid errors.
Port_Drop	Number or packets dropped on the port.
Tx_Bytes	Number of payload bytes transmitted to the line.
Tx_Frames	Number of packets transmitted to the line.
Tx_IF_Drop	(Port 0 or 1). A count of all packets released but not sent on the line. The packet is discarded when the DAG card is set to NIC mode and no link has been established.
Tx_ERF_Type_Drop	A count of all Packets in the transferred ERF stream that do not match the target protocol. **Example:** When the transmit ERF stream contains 10 ETH and 10 POS packets and sends that on a Ethernet Link only the Ethernet packets will be transmitted. The POS packets are discarded and counted.

`Tx_ERF_Interface_Drop`	A count of all Packets addressed to a interface that is not supported by the DAG card. **Example:** When transmitting an existing capture file from a four interface DAG card to a two interface DAG card, all packets for interface 2 and 3 are discarded.
`Tx_ERF_RXError_Drop`	A count of packets discarded with an `RX_Error` flag. When the DAG card is configured in `notxrxerror` mode all packets marked with an `RX_Error` flag are discarded.
`Tx_ERF_MinLen_Drop` `Tx_ERF_MaxLen_Drop`	Packets in the transferred ERF stream what are either to short or to long are discarded before they are released. The amount of discarded packets is shown in the `ERF_minLen` and the `ERF_MaxLen` drop counter. **Example:** For Ethernet the allowed packet size is between 32 and 9616 bytes.
`Tx_IF_Late_Release`	When operating in Time-Release mode each packet is transmitted according to its timestamp. When consecutive packets shall be released at the same time they have the same timestamp. However, because of the sequential nature of the stream the second packet is send out after the first packet. This "late" release is noted by the DAG card and each event increments the late release counter.

Using your DAG card

Introduction

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

Basic data capture

`dagsnap` is a software utility used to write to disk the 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 39).

For further information on the software utilities see:

Starting a capture session

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

```
dagsnap -dX -v -o tracefile.erf
```

(Where X is the device number of the DAG card you want to configure).

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 table lists all available options in `dagsnap`.

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

Option	Description
`-D, --delay <n>`	Delay processing by an extra n milliseconds on each burst.
`-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.
`-D <n>, --delay <n>`	Delay processing by an extra <n> milliseconds on each burst.
`-h, -?, --help, --usage`	Display usage (help) information.
`-j, --maxwrite`	Maximize disk writing performance by only writing data to disk in chunks. This option may not be available on all operating systems. Supported in Linux only.
`-m <mebibytes>, --maxdata <mebibytes>`	Write at most <mebibytes > megabytes of data per call to the DAG API (default is 4 MiB).
`-o <filename> --fname <filename>`	Write the captured packets to <filename>, in ERF format (default is standard output).
`-s <seconds> --runtime <seconds>`	Run for <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: 1. The cumulative total of data written out from the DAG card. 2. The buffer occupancy. Small values indicate no packet loss. 3. The rate at which data is currently being written.
`-V, --version`	Display version information.
`-w,--wait <waitseconds>`	Delay(wait) in seconds before capture and after the stream is initialized

Capturing data at high speed

As the DAG card captures packets from the network link, it writes a record for each packet into a 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 dropped by the DAG card.

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.

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 for further information on detecting buffer overflow and packet loss in Windows.

Detecting packet drops

Once the buffer fills, any new packets arriving will be discarded by the DAG 9.2X2 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), or examining the stream drop counters. See Stream drop count (page 31) and Data Formats (page 65) for more information.

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 26).

For information on calculating the required stream buffer size, see Guidance for stream buffer sizing (page 71).

Capturing packets using Enhanced Packet Processing v2

For information on capturing packets using Enhanced Packet Processing v2, refer to *EDM04-31 Enhanced Packet Processing v2*.

Filtering data

This DAG card uses the dagfilter-loader software with Enhanced Packet Processing v2. For details on dagfilter-loader, refer to *EDM04-30 dagfilter-loader Software Guide*.

Viewing captured data

Data captured in ERF format can be viewed with `dagbits`.

Notes:

- *`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 47).*
- *`dagbits` is also able to run a number of tests, including monotonic time-stamp increment and frame checksum (FCS, aka CRC) validation.*

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 ltcr flags fcs -f logname.log
```

For simple decoding of packets:

```
dagbits -vvc -d0:0 decode | less
```

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

dagbits

The following table lists all available options in `dagbits`.

Options	Description
`-0, --stripcrc`	ERF records contain no Link-Layer CRCs.
`-1, --crc16`	ERF records contain 16 bit Link-Layer CRCs (PoS).
`-3, --crc32`	ERF records contain 32 bit Link-Layer CRCs (PoS and Ethernet).
`-a, --atmformat`	Set legacy format to ATM (this is the default).
`-A, --align <n>`	Check the ERF record lengths are multiples of n-bits. To be used with align test
`-b, --bigendian`	Treat ERF timestamps as big-endian.
`-c, --count`	Print real-time progress reports as `dagbits` captures traffic. This is a useful indicator that a test is running correctly.
`-C --crcfactor <n>`	Sets CRC correction factor for BTX test (0, 16 or 32 bits).
`-d --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 DAG cards.
`-D, --delay <n>`	Introduces a <n> nanosecond delay between processing each record.
`-e, --ethformat`	Set legacy format to Ethernet (default: ATM).
`-E, --haltmax <n>`	Halt operation after a maximum of <n> errors. This option prevents `dagbits` from creating extremely large output files when being redirected to a file.
`-f, --fname <fname>`	Read captured data from <fname>.
`-g, --global`	Global, causes mono to test for globally increasing rather than per-port timestamps
`-H, --steer <n>`	Steering control number for steering test, DAG 4.3 and DAG 4.3GE: • 0: stream0 force • 1: test parity • 2: test CRC • 3: iface
`-h, -? --help, --usage`	Display usage (help) information.

-i --api <api>	Use "API" interface for live DAG API capture. Possible options are: • 0 DAG 2.4 legacy API interface [dag_offset(3)]. • 1 DAG 2.5 API interface [dag_advance_stream(3)]. • 2 DAG 2.5 API interface [dag_rx_stream_next_record(3)].
-I, --ipf	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, --jthresh <t>	Set the threshold for the jitter test to <t> microseconds.
-l, --maal <m>	Check for the specified MAAL error code.
-L, --idle_int <n>	For test idle, interval to detect data is <n>.
-m, --prnmaxerr <n>	Print the first <n> errored records only, and then continue to count errors silently for the duration of the session.
-n, --numpkts <n>	Expected number of packets to receive. Returns an error if the actual number is different.
-p, --posformat	Set legacy format to PoS (default: ATM).
-P, --params <params>	DAG 3.5S capture parameters.
-q, --quiet	Quiet. This instructs dagbits to suppress summary information when terminating. Error messages are not affected by this option.
-r, --reclen <n>	Set legacy format record lengths to <n>.
-R, --rlen <n>	When used in conjunction with the rlen test, indicates the RLEN of ERF records to match against. <n>.
-s, --strict	Check for strictly monotonic (increasing) timestamps, rather than monotonic (non-decreasing). Affects the behavior of the mono test. With strict checking it is an error for consecutive timestamps to be equal; they must always increase.
-S, --stop <n>	Terminate dagbits after <n> seconds of capture. This option only makes sense when capturing packets from a DAG card (i.e. when used in conjunction with the -d flag).
-t, --haltany <n>	Terminate dagbits if any ERF record type does not match <n>.
-T, --pause_timing <x:y:z>	Pause stream for testing purposes where • x is the delay to start • y is the period of pause repetition, and • z is the length of the pause
-u, --count_pad	Count pad records and strictly check -t option.
-U, --maxrec <n>	Process at most <n> records in one pass. This option enables the user to reduce the performance of dagbits for various purposes. For live DAG API capture only. See also -D.
-v, --verbose	Increase verbosity of dagbits. This option increase the amount of data displayed when printing an ERF record due to the print test or errors in other tests. -v will print payload contents, -vv will print payload contents and an accompanying ASCII dump of the packet payload.
-V, --version	Display version information.
-w, --warnings	Instruct dagbits to treat all warnings as errors.
-W, --wlen <n>	When used in conjunction with the wlen test, the wire length of ERF records must be exactly NUM bytes.
-X, --wait <n>	Wait before first packet capture from the stream extra n microseconds
-y --delay_test <n>	Start testing after <n> records have been received
-z, --idlestop	Stop when no traffic is received for one second.
--delta-min <sec.ms.us.ns>	Delta test minimum timestamp difference - any timestamp difference smaller than the value will be reported as a failure.
--delta-max <sec.ms.us.ns>	Delta test maximum timestamp difference - any timestamp difference larger than the value will be reported as a failure.
--erase_pad	Erase padding bytes from print function.
--hlb-range <min-max>	Steer hlb (hash load balance) range test range, for example: 15.0-50.0
--no_pad	Turn off pad record flushing.

`--plugin <testname:"-p1 -p2 ... -pn">`	Plug-in test to be loaded, including test parameters (p1, p2, etc) See list of tests (page 42) below.
`--rxstreams <n>`	Number of streams in capture file (for steer -H2).
`--stream <n>`	Stream number file was captured from (for steer -H2).
`--nni`	Set ATM network interface to NNI (default UNI).
`--tcp_ip_counter`	Print TCP Flow and IP Address Counter ERF records.

dagbits tests

The following `dagbits` tests are available for use. Tests not listed in the following table are for Endace use only.

Test	Description
decode	Decode and print IP, TCP, UDP and ICMP headers.
delta	Print timestamp differences, if used with `--delta-min --delta-max`, this tests timestamp differences with the provided min/max value.
fcs	Test Frame Check Sum on each ERF frame.
flags	Check and accumulate in-band packet error indications (these are considered to be errors and return 1).
ipsum	Verify IP checksum.
jitter	Check if timestamp difference variation between consecutive rec pairs is smaller than t/2^32 sec.
lctr	Check and accumulate in-band packet loss indications (not considered an error -- will return 0).
mono	Check for monotonically increasing timestamps.
print	Print rec timestamp, CRC, ATM header and payload.

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 47).

`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.

dagconvert

`dagconvert` software utility converts data to various file formats.

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.

dagconvert supported input and output formats

`dagconvert` supports the following input and output formats:

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).

dagconvert supported filters

`dagconvert` supports the following filters:

Filter	Description
rx	filter out rx errors (link layer)
ds	filter out ds errors (framing)
trunk	filter out truncated packets
a,b,c,d	filter on indicated interface(s)

dagconvert supported conversion ERF types

`dagconvert` supports the following conversion EFT types:

ERF Types	Description
pos	(eth -> pos)
ipv4/ipv6	(eth -> ipv4/ipv6)
eth	(ipv4/ipv6 -> eth)

dagconvert supported DLT types

`dagconvert` supports the following DLT types (case insensitive):

DLT type	Description
EN10MB	Ethernet
DOCSIS	Ethernet
CHDLC	HDLC
PPP_SERIAL	HDLC
FRELAY	HDLC
MTP2	HDLC
ATM_RFC1483	ATM, AAL5
SUNATM	ATM, AAL5
RAW	IPV4, IPV6

dagconvert options

The following is a list of options available in `dagconvert`.

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

Options	Description
`-a <api>`	Specify which API to use when capturing from DAG cards. • 0: DAG 2.4 legacy API [dag_offset()] • 1: DAG 2.5 API [dag_advance_stream()](default value) • 2: DAG 2.5 API [dag_rx_stream_next_record()]
`-A <int>`	Set the record alignment of the ERF to NUM bytes (ERF only).
`-b <BPF>`	Specify a tcpdump(1) style BPF (Berkeley Packet Filter) 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`	Perform defragmentation if possible.
`-d <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.
`-E`	Strip any extension headers if they exists.
`-e <type>`	Select the conversion erf type (ERF only). • `POS` (ETH -> POS) • `ipv4/ipv6` (ETH -> ipv4/ipv6) • `ETH` (ipv4/ipv6-> ETH)
`-F`	Select fixed length output (ERF only).
`-f <list>`	A comma-delimited list of filters to be applied to the data. Supported filters are: • `rx` Filter out rx errors (link layer). • `ds` Filter out ds errors (framing). • `trunc` Filter out truncated packets. • `a,b,c,d` Filter on indicated port/interface(s).
`--fnum`	Maximum Files before the counter overlaps.
`-g, --sonet-align`	Sonet frame alignment for Bit-Level capture files.
`-G`	Set the GMT offset to NUM seconds (pcap(3) only).
`-h, -?, --help, --usage`	Display usage (help) information.
`-I`	Ignore the first incomplete assemble (in defragmentation).
`-i <filename>`	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. To select multiple input files, use this option repeatedly. The redirection operator '<' can also be used for single file input, provided the input is not of PCAP format.
`-o <filename>`	Name of the output file.
`-p 0|1|2|3`	Specifies the interface ID to write into output ERF records
`-R`	Rename defragmented ERF types, if possible (eg, POS/ATM).
`-r N[k|m|g|t]`	Rotate the output file after `N` bytes. Add `k` (kilobytes), `m` (megabytes), `g` (gigabytes) and `t` (terabytes) suffixes.
`-s <snaplength>`	Set the snap length to NUM bytes.
`-T <input format> : <output format>`	Input and output types. See the section above for more information about the input and output types.
`-t <seconds>`	Capture from the DAG card for the defined number of seconds.
`-U`	Use temporary extension name to indicate current output file. Used with the `-r` command. Once a new current outfile is created change the file name extension name to `.erf`.
`-u 4|6`	Specify the output ERF type IPv4/IPv6 for DLT_RAW when converting pcap DLT_RAW to ERF..

`-V`	Select variable length output (ERF only)
`--version`	Display version information.
`-v, --verbose`	Increase output verbosity.
`-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. See above table (page 44) for a list of supported DLT types (case insensitive).

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.

For further details refer to *EDM04-21 Libpcap and Third party applications*.

Note:
Wireshark/Tshark can also read ERF formatted data directly. This provides more information than converting to pcap format.

Transmitting captured data

To transmit data out of the DAG 9.2X2 you can used either the DAG API or dagflood.

Configuration

To configure the DAG 9.2X2 card for transmission, you must allocate some memory to a transmit stream. For details on how to allocate memory see the dagconfig mem (page 29) token and refer to *EDM04-03 dagflood User Manual*.

You can capture packets at the same time as transmitting packets, using DAG capture tools such as dagsnap, dagconvert, and dagbits.

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

Explicit packet transmission

The operating system does not recognize the DAG 9.2X2 card as a network interface and will not respond to ARP, ping, or router discovery protocols.

The DAG 9.2X2 card will only transmit packets that are explicitly provided by the user. This allows you to use the DAG 9.2X2 card as a simple traffic load generator.

You can also use it to retransmit previously recorded packet traces. The packet trace can be either

- transmitted as fast as possible.
- transmitted with the original time intervals between packets (Timed Release TERF (TR-TERF))
- transmitted with the original time intervals between packets and with a specific start time (Triggered Timed Release TERF (TR-TERF)).

For further details, refer to *EDM04-03 dagflood User Manual*.

Trace files

You can use `dagflood` to transmit ERF format trace files, providing the files contain **only** ERF records of the type matching the current link configuration.

For detailed information on using `dagflood`, refer the *EDM04-03 dagflood User Manual*.

When you use DAG cards with multiple ports, ensure all ports referred to by the trace file are active. This ensures the `dagflood` traffic is not blocked when trying to delivering data to an inactive port. Check the interface status output for the DAG card and ensure the link status for all required destination ports is active. See Viewing the DAG card statistics. (page 34)

For further information on using `dagflood` please refer to the *EDM04-03 dagflood User Manual* available from Endace Customer Support at https://support.endace.com/.

In addition the length of the ERF records to be transmitted must be a multiple of 64-bits. You can configure this when capturing packets for later transmission by setting 64-bit alignment using the `dagconfig align64` command.

If packets have been captured without using the `align64` option you can convert the trace files so that they can be transmitted by using dagconvert (page 43) as shown below:

```
dagconvert -v -i tracefile.erf -o tracefile.erf -A8
```

Alternatively if you are unsure if a trace file is 64-bit aligned you can test the file using dagbits (page 40) as shown below:

```
dagbits -v align64 -f tracefile.erf
```

If you do not have any ERF trace files available, you can use `daggen` to generate trace files containing simple traffic patterns. This allows the DAG 9.2X2 card to be used as a test traffic generator.

For further information on using `daggen` please refer to the *EDM04-06 Daggen User Guide* available from Endace Customer Support at https://support.endace.com/.

TR TERF

For a description, see Timed Release TERF (TR-TERF) (page 7).

Selectable CRC length

TR-TERF can be optionally configured to strip the CRC of an incoming ERF stream, to allow the retransmitted stream to calculate and add a CRC. There are some situations where this option may be useful.

Situation 1 (Ethernet)

The ERF stream was generated without a CRC.

In this case, you should configure TR-TERF **not** to strip the last 32 bits of the packet as there is no CRC in place, and configure the MAC to add a hardware-calculated CRC. This has the effect of reducing the burden of calculating a CRC in the software.

Example

```
dagconfig noterf_strip tx_crc
```


Situation 2 (Ethernet)

The ERF stream was generated with a CRC but the CRC must be corrected on the retransmitted packet.

In this case you should configure TR-TERF to strip the original 32-bit CRC and configure the MAC to add a hardware calculated CRC as in Situation 1 above to replace it. This means even if the CRC is incorrect in the received ERF stream, a correct CRC will be generated when the packet is retransmitted.

Example

```
dagconfig terf_strip32 tx_crc
```

Situation 3 (Ethernet)

The ERF stream was generated with a CRC, and the CRC must be retransmitted exactly even if it is incorrect.

In this case you should configure TR-TERF **not** to strip the CRC, and configure the MAC **not** to add a hardware-calculated CRC, so that the original CRC is retained. This allows received packets with bad CRCs to be retransmitted which may be a useful tool for testing or diagnostic purposes.

Example

```
dagconfig noterf_strip notx_crc
```

Retransmitting errored packets

In some circumstances it may not be desirable to retransmit packets which have been incorrectly received for any reason. To allow for this, TR-TERF can be optionally configured not to retransmit any packets marked with the `rxerror` (receive error) flag.

For further details, refer to *EDM04-03 dagflood User Manual*.

Usage notes

The following points should be noted when using TR-TERF:

- When using `dagflood` to transmit an ERF stream to the card you should set the "`-l`" flag (maximum data burst length) to a value greater than the default of 1MB to achieve the highest transmit data rate. During testing Endace found a value of 16MB (16777216) to be effective. This reduces the possibility of a buffer under-run occurring if insufficient data is committed in a burst and the `dagflood` process is not scheduled by the OS to run in a timely manner.
- For best accuracy when testing, you should ensure both the sending and receiving cards are synchronized to the same time source.

TR TERF known issues

TR-TERF is less accurate when using multiple interfaces. If a large packet is transmitted to the card on a particular interface, the transmit buffers for the other interfaces may experience a buffer under-run. This is because data is only transferred to one interface at any one time, record by record as the input ERF stream is interleaved between interfaces.

This may be especially noticeable where very small packets are transmitted on one interface and very large packets transmitted on another interface.

Synchronizing clock time

Overview

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

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

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) or a single DAG card as a Time Reference Source.

Endace also provides several Time Distribution Servers that provide timing synchronization over multiple DAG cards. Currently the available Time Distribution Servers include:

- TDS 2 - for further information, refer to *EDM05-01 Time Distribution Server User Guide*.
- TDS 6 - for further information, refer to *EDM05-01 Time Distribution Server User Guide*.
- TDS 24 - for further information, refer to *EDM05-02 TDS 24 Installation Guide*.

For more information on the Time Distribution Server, refer to the *Accessories* section at http://www.endace.com.

IRIG-B

For information on synchronizing the DAG 9.2X2 with an IRIG-B device, please refer to *EDM04-33 dag_irigb Software 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 1st 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 9.2X2 implements the 28 most significant bits which provides a time resolution of 7.5 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;
}
```

Readable DUCK

The DAG 9.2X2 firmware images allow the user to read the current time directly from the DUCK clock. This can be useful for verifying clock synchronization.

To check if a firmware image supports reading the DAG clock time, check if the output from the following command includes the information about the `DUCK Reader` version.

Note:
The factory firmware may not support the DUCK Reader. Please ensure you load the current release firmware onto the DAG card first, see *Configuring the DAG card (page 15).*

Command:

```
daginf -d0 -v
```

Reading the current DAG time

You can read the current DAG time using `dagconfig`, using the following command:

Command:

```
dagconfig -G duck_timestamp
```

Output:

```
duck_timestamp = 2009-07-07 1:33:31.657349680 UTC
```

The current time is also available programmatically via the DAG Configuration and Status API.

The time-stamp format that the DUCK provides represents time as a single 64-bit fixed point number, representing seconds since midnight on January 1, 1970. The returned value can also be converted into a struct timeval representation. For more information refer to *EDM04-34 Configuration & Status API Overview*.

Performance

Reading the current DAG time requires reading hardware registers on the DAG card over the PCIe Gen 2.0 bus. This operation can take several microseconds to complete.

The DAG clock should not be read at high rates, for example after receiving or sending each packet. The additional PCIe Gen 2.0 bus accesses from reading the current time may affect packet capture/transmission performance if performed more than 1000 times per second.

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.

Notes:

- *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.*
- *When you run `dagconfig -d0 default` the `dagclock` inputs and outputs are also reset to defaults.*
- *By default, all DAG cards listen for synchronization signals on their RS-422 port, and do not output any signal to that port.*

A description of each argument is shown below:

Option	Description
`-d, --device <device>`	Use the DAG device referred to by DEVICE. Supported syntax includes 0, dag1, and /dev/dag3 to refer to DAG cards.
`-?,--usage -h,--help`	Display the information on this page
`-k,--sync`	Wait for DUCK synchronization before exiting
`-K,--timeout <timeout>`	Set the synchronization timeout in seconds (default is 60 seconds)
`-l,--threshold <threshold>`	Set the Health threshold in nanoseconds. (default is 596ns)
`-m,--monitor`	Monitors the dagclock's health and displays results each second.
`-p,--phase <phase>`	Sets the phase correction in ns. The default is 0ns.
`-v, --verbose`	Increase output verbosity
`-V, --version`	Display version information
`-x --clearstats`	Clears the dagclock statistics.

Options

Command	Description
`default`	Set the `dagclock` input and output to RS422 in and none out.
`none`	Clears the input and output settings.
`rs422in`	Sets the `dagclock` input to RS422.
`hostin`	Sets the `dagclock` input to Host (unused)
`overin`	Sets the `dagclock` input to Internal input (i.e. synchronise to host clock)
`auxin`	Sets the `dagclock` input to Auxiliary input (unused)
`rs422out`	Sets the `dagclock` output to repeat the RS422 input signal
`loop`	Output the selected input
`hostout`	Sets the `dagclock` output to host (unused)
`overout`	Internal output (master card)
`set`	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.
`reset`	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.
`sync`	Wait for duck to sync before exiting.

Note:
By default, all DAG cards listen for synchronization signals on their RS-422 port, and do not output any signals 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 -dX
```

(Where X is the device number of the DAG card you want to configure).
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 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 57).

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
`Synchronised / Not synchronised`	This indicates whether this DAG card is synchronized to the time source listed (`Muxin`). The DAG card becomes Synchronised when the absolute `Phase error` (page 57) is within the Threshold value for 10 consecutive seconds. The DAG card becomes Not Synchronised when the absolute `Phase error` (page 57) is above the Threshold value for 10 consecutive seconds.
`Threshold`	This is the value above which the DAG card port is considered `Not Synchronised`. The `Threshold` value changes depending on the type of input time synchronization. The defaults are: • 596 for RS422 synchronization • 12000 for host synchronization (Unix) • 50000 for host synchronization (Windows) This value can be adjusted using the `dagclock -l` option.
`Failures`	This is a count of the number of times the DAG card has become `Not Synchronised`.
`Resyncs`	This is a count of the number of times the DAG card Phase error has exceeded 1 second. See Error (page 57). If the DAG card is `Not Synchronised` for more than 10 seconds the DAG card automatically runs the following command to update the time on the DAG card: `dagclock -dX set` (Where X is the device number of the DAG card you want to configure).

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 Frequency error since statistic collection began. Reset to zero when statistics are reset, see Dagclock Statistics reset (page 56).
`Worst Phase`	Highest absolute value of the Phase error since statistic collection began. Reset to zero when statistics are reset, see Dagclock Statistics reset. (page 56)

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 Dagclock Statistics reset (page 56).
`Bad`	The number of time pulses that were rejected (considered `Bad`) by the DAG card. Reset to zero when statistics are reset, see Dagclock Statistics reset (page 56). When the DAG card is `Synchronised` a time pulse is considered `Bad` if it exceeds the `Threshold`. Time pulses are considered `Bad` if they were not received 1 second (approximately) after the last time pulse. This 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 Dagclock Statistics reset (page 56).
`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 Dagclock Statistics reset (page 56).

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 Dagclock Statistics reset. (page 56)
`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 timing 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 time synchronization connector supports both RS-422 (PPS) and IRIG-B (only some DAG cards) signals from an external source. This is derived directly from an external reference source or distributed through the Endace Time Distribution Server which allows two or more DAG cards to use a single Time Reference Source. For details on the available Time Distribution Server see Common Synchronization (page 51).

Warning:
Never connect a DAG card or the Time Distribution Server to active Ethernet equipment or telephone equipment.

Synchronize to an external source as follows:

```
dagclock -dX
```

(Where X is the device number of the DAG card you want to configure).

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
```

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 -dX
```

(Where X is the device number of the DAG card you want to configure).

`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 –dX none overin
```

(Where X is the device number of the DAG card you want to configure).

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 62) - 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 –dX none overout
```

(Where X is the device number of the DAG card you want to configure).

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 –dX none overin overout
```

(Where X is the device number of the DAG card you want to configure).

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

Overview

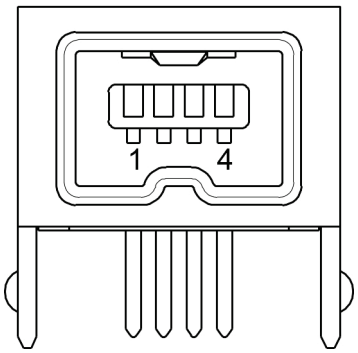
DAG cards have a 4-pin connector for time synchronization. The connector has one bi-directional RS422 differential circuit, A. The Pulse Per Second (PPS) signal is carried on circuit A.

Pin assignments

The 4-pin connector pin assignments and plugs and sockets are shown below:

1.	PPS- Out
2.	PPS+ Out
3.	PPS- In
4.	PPS+ In

Front



Normally, you connect the GPS input to the PPS (A) channel input (pins 3 and 4).

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 62) to connect the two time synchronization sockets.

Note:
The DAG card is supplied with a 4-pin to RJ45 adapter.

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).

4-pin to RJ45 adapter

A 4-pin (plug) to RJ45 (socket) adapter is supplied with your DAG card. This adapter allows you to plug a standard Ethernet RJ45 PPS signal cable into your DAG card. The 4-pin to RJ45 adaptor pin assignments are shown below:

RJ45 socket	Signal name	4 Pin plug
1	PPS Out+	2
2	PPS Out-	1
3	PPS In+	4
6	PPS In-	3

Data formats

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 9.2X2 supports the following ERF Types:

ERF Type	Description
2	TYPE_ETH Ethernet Variable Length Record

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

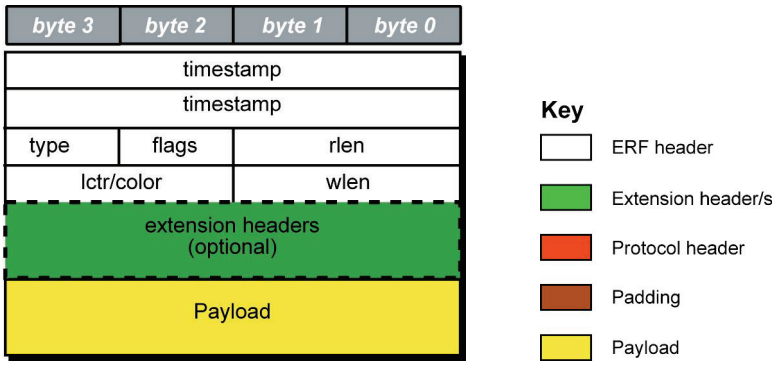
ERF records have generic headers, and optional extension headers. The DAG 9.2X2 does not by default provide extension headers to the user.

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:

<table>
<tr><td>timestamp</td><td></td><td>The time of arrival of the cell, an ERF 64-bit timestamp.</td></tr>
<tr><td>type</td><td>Bit 7</td><td>Extension header present.</td></tr>
<tr><td></td><td>Bit 6:0</td><td>ERF type. See table below:</td></tr>
<tr><td>flags</td><td></td><td>This byte is divided into several fields as follows:
<table>
<tr><th>Bits</th><th>Description</th></tr>
<tr><td>1-0:</td><td>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.</td></tr>
<tr><td>2:</td><td>Varying length record (vlen). 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</td></tr>
<tr><td>3:</td><td>Truncated record - insufficient buffer space.
• wlen is still correct for the packet on the wire.
• rlen is still correct for the resulting record. But, rlen is shorter than expected from snap length or wlen values.
Note:
Truncation is depreciated and this bit is unlikely to be set in an ERF record.</td></tr>
<tr><td>4:</td><td>RX error. An error in the received data. Present on the wire</td></tr>
<tr><td>5:</td><td>DS error. An internal error generated inside the card annotator. Not present on the wire.</td></tr>
<tr><td>6:</td><td>Reserved</td></tr>
<tr><td>7:</td><td>Reserved</td></tr>
</table></td></tr>
<tr><td>rlen</td><td></td><td>Record length in bytes. Total length of the record transferred over the PCIe Gen 2.0 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.</td></tr>
<tr><td>lctr / Colour</td><td></td><td>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 PCIe Gen 2.0 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 ERF type details.</td></tr>
</table>

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). ***Note:*** *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 : • Payload = rlen - ERF header - Extension headers (optional) - Protocol header - Padding

ERF header types

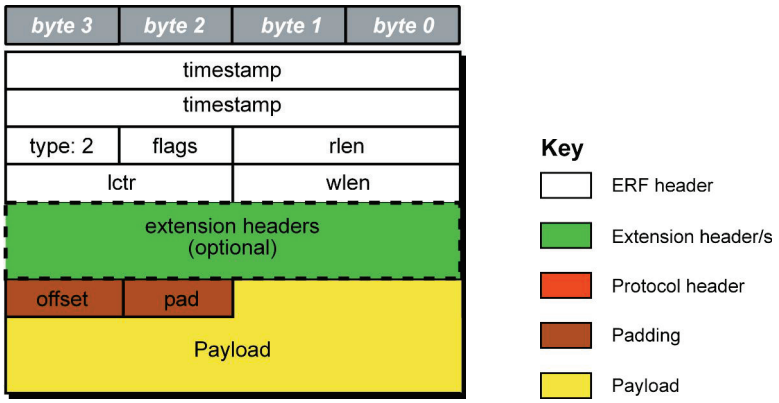
Number	Type	Description
0:	TYPE_LEGACY	Old style record
1:	TYPE_HDLC_POS	Packet over SONET / SDH frames, using either PPP or CISCO HDLC framing.
2:	TYPE_ETH	Ethernet
3:	TYPE_ATM	ATM cell
4:	TYPE_AAL5	reassembled AAL5 frame
5:	TYPE_MC_HDLC	Multi-channel HDLC frame
6:	TYPE_MC_RAW	Multi-channel Raw time slot link data
7:	TYPE_MC_ATM	Multi-channel ATM Cell
8:	TYPE_MC_RAW_ CHANNEL	Multi-channel Raw link data. Legacy ERF type - for DAG 3.7T and 7.1S only.
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
25:	TYPE_INFINIBAND_ LINK	Infiniband link data.
32-47:	-	Reserved for Co Processor Development Kit (CDK) Users and Internal use
48:	TYPE_PAD	Pad Record type

Note:
The Ethernet frame begins immediately after the pad byte so that the layer 3 (IP) header is 32-bit aligned.

ERF 2. TYPE_ETH

Type	Bit 7	1 = Extension header present. See Extension Headers (page 69).
	Bits 6:0	Type 2
Short description	TYPE_ETH	
Long description	Type 2 Ethernet Record	
Use	This record format is for Ethernet [802.3] data links. May be used with EH 12. Channelisation when created by software.	

The TYPE_ETH record is shown below:



The following is a description of the TYPE_ETH record format:

Field	Description
Offset (1 byte)	Number of bytes **not** captured from start of frame. Typically used to skip link layer headers when not required in order to save bandwidth and space. ***Note:*** *This field is currently not implemented, contents should be disregarded.*
Pad (1 byte)	The Ethernet frame begins immediately after the pad byte so that the layer 3 [IP] header is 32-bit aligned.
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Padding (2 bytes)

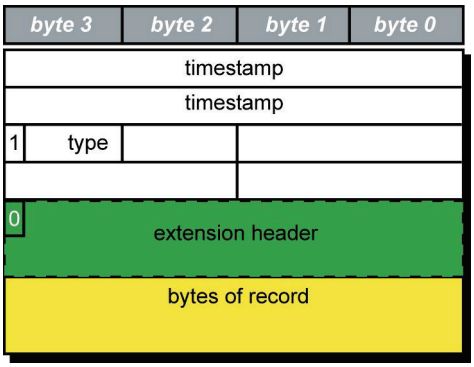
Extension Headers (EH)

Introduction

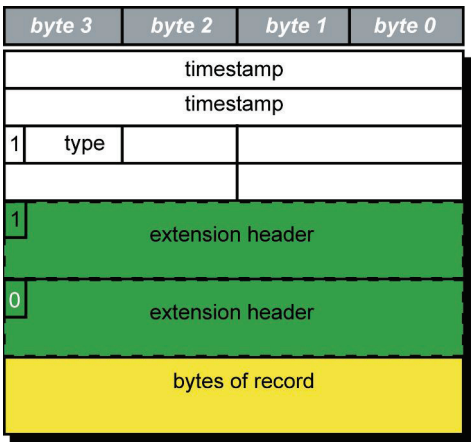
The addition of an Extension Header into the ERF record allows extra data relating to the packet to be transported to the host. The extension header allows certain features to be added independently of ERF types, for example, features shared by different ERF records do not have to be implemented separately.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

Bit 7 of the ERF type field is used to indicate that Extension Headers 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'.



Guidance for stream buffer sizing

This section describes how to calculate the required stream buffer size for each DAG card on a particular network. Once you have calculated the stream buffer requirements you need to ensure the memory allocated to the DAG card is adequate, and update if required.

How the DAG card handles bursts of traffic depends on:

- the application processing rate - when the application processing rate slows, the stream buffer starts to fill.
- the size of the stream buffer – how many packets can be held in the stream buffer before packet loss occurs.
- the data arrival rate - Data rates above the application processing rate cause the stream buffer to fill.

Selecting stream buffer size

The DAG card writes the incoming traffic into the associated stream buffer. Applications, using DAG APIs, read the data from the stream buffer.

Packet dropping occurs if the application cannot process the data fast enough and the stream buffer fills up.

The required maximum size of the stream buffer is related to the following:

- Burst duration
- Latency

Burst duration

The incoming traffic does not arrive at a constant rate. It fluctuates between maximum and minimum rates.

IF the incoming traffic rate exceeds the rate at which the application processes data, the buffer will start to fill. In many cases the maximum burst rate will be equal to the link data rate (line rate). If there is not enough room to accommodate the burst traffic, packets will be dropped.

The maximum burst duration can be defined as the maximum duration the stream buffer can receive packets before dropping packets. It can be calculated as the time required to fill the stream buffer at that maximum burst rate, with the application trying to empty the stream buffer at its processing speed.

To calculate the maximum burst duration, use the following formula:

$$\text{Maximum Burst Duration (seconds)} = \frac{\text{Stream Buffer Size (MiB)} * 1048576}{(\text{Max Network Rate (Mbps)} - \text{Average Processing Rate(Mbps)}) * 125000}$$

Where the multipliers:

- 1048576 converts MiB to bytes.
- 125000 converts Megabits per second to bytes per second.

Note:
Applications writing data to disk can experience large delays when waiting for disk writes to complete. A good rule of thumb is to size the stream buffer to accommodate a Maximum Burst Duration of at least one second for such applications.

Latency

The latency is the time delay between:

- the packet being written to the stream buffer and
- the application reading the packet from the stream buffer.

The maximum latency is the time needed to empty an almost full stream buffer. To calculate the maximum latency, use the following formula:

$$\text{Maximum Latency (seconds)} = \frac{\text{Stream Buffer Size (MiB)} * 1048576}{\text{Average Processing Rate (Mbps)} * 125000}$$

Where the multipliers:

- 1048576 converts MiB to bytes.
- 125000 converts Megabits per second to bytes per second.

Multiple streams

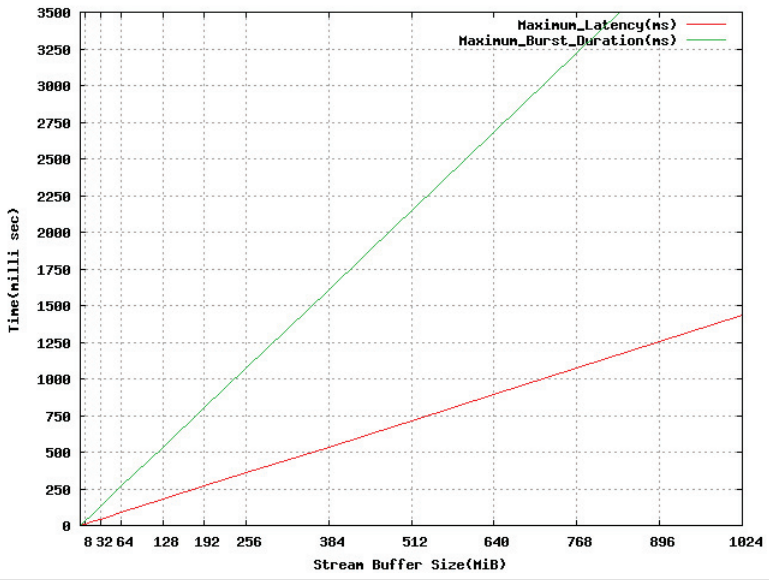
With multi-stream DAG cards, the incoming traffic can be spread across multiple streams for processing. This allows you to take advantage of multi-core processors when processing large amounts of incoming traffic.

This changes how you calculate the stream buffer size - you need to calculate the required stream buffer size on a per stream basis. For example, in an 8 stream situation (assuming equal distribution of incoming traffic over all streams) the effective incoming traffic rate to each stream is 1/8 of the original rate. Use this value when calculating the values for the Network graph similar to the one above.

Note:
This works best when the incoming data is spread evenly across all streams. Where incoming traffic cannot be spread evenly across stream you will need to adjust the stream buffer sizes for each stream.

Calculating the stream buffer size

Using the above two formulas you can calculate the Maximum Burst Duration and Maximum Latency for any network and create a Network graph similar to the following. If plotted, you get a graph similar to the following. See example 1 for the parameters for this graph.



Note:
We recommend that the stream buffers are a multiple of 4 MiB in size.

Example 1

Example network parameters:

Field	Value
Network speed	10 Gigabits per second
Stream Buffer Size	To calculate
Max Network Rate	8 Gigabits per second per stream
Average Processing Rate	6 Gigabits per second per stream
Number of streams	1

To calculate the stream buffer size range for a network with the above parameters, calculate the stream buffer size using the maximum burst duration and the maximum latency formulas as shown below.

Stream buffer burst duration

This formula calculates the minimum stream buffer size required to handle a particular burst duration.

$$\text{Stream Buffer Size (MiB)} = \frac{\text{Maximum Burst Duration (seconds)} * \left\{ \text{(Max Network Rate (Mbps)} - \text{Average Processing Rate(Mbps)}) * 125000 \right\}}{1048576}$$

Stream buffer Latency

This formula calculates the maximum stream buffer size guaranteeing a particular latency.

$$\text{Stream Buffer Size (MiB)} = \frac{\text{Maximum Latency (seconds)} * \left\{ \text{Average Processing Rate(Mbps)} * 125000 \right\}}{1048576}$$

For traffic with one second maximum burst duration and 0.4 second maximum latency:

- Stream buffer based on burst duration = 244 MiB
- Stream buffer based on latency = 292 MiB

Therefore a stream buffer size between 244 and 292 MiB is required (in a multiple of 4 MiB).

Support

This section describes how to access Endace Support for your Endace product.

Existing support documentation

To start, we recommend you visit the Endace Support website at https://support.endace.com/.

If you have a support contract with Endace you can login using your support username and password which provides access to the secure area of the website. The website contains the latest versions of software, user manuals, and release notes.

For more information about the Endace Support Package, or how to obtain (or change) your secure support website login details, please contact support@endace.com.

Endace Support is available 24 hours, 7 days.

Updates

Many problems can be resolved by updating your software or firmware. Updates are also available on a regular basis from the Endace Support website at https://support.endace.com/.

Further support

If your query is not answered by the existing documentation, or if the issue is not resolved by an update, feel free to raise a Support Case via the Endace Support website https://support.endace.com/.

If you have a **critical issue**, please call. See Contact Details (page 77).

Requesting assistance

To request assistance from Endace support, complete one of the following:

- If you have successfully installed the DAG software on a Linux based system (except FreeBSD):
  c. Run the Support Script (page 76) to gather system and DAG Card setting information.
  d. Attach the output file to an email containing the Required information (page 76) and a Severity level (page 77).
  e. Send the email to support@endace.com.
- If you have an alternative operating system or your DAG software has not been installed successfully:
  a. Fill out the Support Request Form (page 77).
  b. Submit the form.

Support script

To help gather important information on your system and DAG Card configuration, a tool is included in your DAG software. This tool can only be used on Linux based systems (except FreeBSD) and collects the following information:

- Installed DAG card(s)
- DAG card configuration(s)
- Operating system/kernel version
- Motherboard/RAM

To run this tool, use this command from the install location:

```
sh dag-stats.sh
```

This tool outputs a file called `dag-test.log` to the current directory.

Note:
Please check the contents of `dag-test.log` *and remove any information which you feel is sensitive.*

Required Information

The following information is always required by Endace Support when creating a Support Case:

1. Product description and serial number.
2. Your name.
3. Your email address.
4. Your phone number(s).
5. Your organization.
6. Your organization's full address, including physical and postal information, courier delivery information, region and country.
7. Detailed description of the query / issue.
8. Detailed description of your product environment.
9. System dump or logfile.
10. Severity level.

Severity Levels Described

A severity level is always required by Endace Support when submitting a Support Request. Please remember to add a severity level to every Support Request. The following list describes each of the severity levels.

Severity 1: Critical

Short Description: **Service completely unavailable (production networks only).**

Full Description: The Endace product is completely unavailable and there is no workaround. Service needs to be restored immediately.

Severity 2: High

Short Description: **Severely degraded service.**

Full Description: The Endace product is severely degraded and there is no workaround, the product performance is at unacceptable levels.

Severity 3: Medium

Short Description: **Performance impaired.**

Full Description: System performance is degraded, with a workaround in place. Operational performance of the product is impaired but acceptable.

Severity 4: Low

Short Description: **General assistance.**

Full Description: The customer requires assistance on the use of the Endace product, but the issue does not affect service.

This severity level is appropriate if the customer requires assistance on installation, configuration, feature requests, general capability and product questions.

Endace Support will endeavor to resolve the problem as quickly as possible. If a workaround can be achieved in a short time, it will be applied, and the priority of the case lowered while Endace Support works on implementing a more permanent solution.

Note:
*Reports subsequently made available about the case will reflect the priority of the case at the time of **closing**, and not the priority of the case when it was raised.*

Support request form

Endace has an on-line form that assists in gathering information for your support request.

The URL is: https://support.endace.com/RequestAssistance.aspx

Contact details

Endace contact details:

Email:	support@endace.com
USA (Toll Free):	+1 866 501 3356
UK (Toll Free):	+44 0800 051 3887
Australia (Toll Free):	+61 1800 144 708
New Zealand:	+64 7 959 2630
Support Website:	https://support.endace.com/

Version History

Version	Date	Reason
1	March 2010	First release. DAG 3.4.3 release.
2	March 2010	Removed IRIG-B - not in this release. Updated TDS info in time sync chapter. Updated Dag card photo.
3	July 2010	Preliminary release. Added new photo of slotted PCI bracket. Added BFS support (TR TERF, EPP v2, IRIG-B). New firmware image. Updated dagconfig tokens, Statistics Eth and WAN, universal counters. Added transmit information. Added new dagconvert section. Readable DUCK 9.2X2 example. New support section.
4	September 2010	4.0.1 release. Removed card architecture diagram. Added dagmem info. Changed image name. Added daginf sections. Updated Setting up the FPGA section. Updated dagconfig output. Updated dagrom options. Updated dagconfig tokens list. Updated dagconfig options. Updated Universal counters.
5	April 2011	DAG 4.2 release. Added 1G Ethernet and WAN support. Some restructuring of introductory sections. Updated Link Types, firmware images, transceiver types, dagconfig outputs, dagconfig token list, dagconfig interface status printouts. Updated TR-TERF CRC stripping topics. Updated DUCK output. Corrected Dagclock output tables.
6	November 2011	Updated interface status tables.
7	December 2011	DAG 4.7.0 - Windows support. Added reference to EDM04-37. Added details of the new Windows Server tools DAG Device and WinDAG Command Prompt. Added details on allocating memory and updating drivers for Windows. Updated details for the following DAG tools: dagconfig, dagsnap, dagbits, dagconvert, dagclock.
8	February 2012	Corrected typo in the Warning - Thermal Trip section.
9	May 2012	DAG 4.7.1 - Updated Windows support information. Added dagconfig default information. Updated Optical modules information. Updated Optical Modules. Updated copper transceiver information.
10	May 2012	DAG 4.2.2 release. Added TTR-TERF info, 10GBASE-ER line type, Pluggable copper transceivers change to 1000 only, dagdetect options. Updated dagrom options, dagconfig tokens list, dagconfig options, transmit description, dagclock options,

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.

endace.com