# ERF Types Reference Guide

EDM11-01



#### **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.

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## Introduction

#### **Overview**

This document identifies and explains the following:

- The Endace Extensible Record Format (ERF) (page 3).
- Extension Headers (EH) (page 36).

### Support

If any problems are encountered with Endace hardware, firmware or supplied software, contact Endace Technical Support via the email address <u>support@endace.com</u>.

Supplying detailed information about a problem enables a more concise first response.

## **Extensible Record Format**

#### Introduction

Endace DAG monitoring interface cards produce trace files in their own native format, known as the Extensible Record Format (ERF). The ERF file contains of a series of records. Each record describes one packet.

An ERF file consists only of ERF records; there is no special file header. This allows concatenation and splitting to be performed arbitrarily on ERF record boundaries.

### **DAG Card Extensible Record Format Types**

The Endace DAG cards produce extensible record format types that include:

Number	Туре	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

#### **ERF Types for each DAG card**

The Extensible Record Format (ERF) types used by each DAG card are listed below.

DAG 3.7D         Type 1         POS HDLC Record           DAG 3.7GP/GF         Type 2         Ethernet Record           DAG 3.7GP/GF         Type 4         Reassembled AALS Frame Record           Type 5         Multi-channel ALD C Frame Record         Type 6           Type 6         Multi-channel RAW Time Slot Link Data Record         Type 7           Multi-channel AALD C Frame Record         Type 9         Multi-channel AALS : Multi-channel AALS Frame           Type 9         Multi-channel AALS : Multi-channel AALS Frame         Type 9           DAG 3.85         Type 1         POS HDLC Record         Type 4           Reassembled AALS Frame Record*         Type 10         Colored POS HDLC Record           DAG 4.3GE         Type 1         Colored POS HDLC Record*           DAG 4.3GE         Type 1         Colored POS HDLC Record*           DAG 4.3GE         Type 1         Colored POS HDLC Record           Type 1         Colored POS HDLC Record         Type 10           DAG 4.3GE         Type 1         POS HDLC Record           Type 1         POS HDLC Record         Type 10           Colored POS HDLC Record         Type 10         Colored POS HDLC Record*           Type 10         Colored POS HDLC Record         Type 11           Type 10	Card	Туре	Extensible Record Format Type
DAG 3.7GP/GF     Type 2     Ethernet Record       DAG 3.7T     Type 4     Reassembled AALS Frame Record       Type 5     Multi-channel HDLC Frame Record       Type 6     Multi-channel RAW Time Slot Link Data Record       Type 7     Multi-channel ATM Cell Record       Type 9     Multi-channel AAL2: Multi-channel AAL2 Frame       Type 9     Multi-channel AAL2: Multi-channel AAL2 Frame       Type 1     POS HDLC Record       Type 1     POS HDLC Record*       Type 1     POS HDLC Record*       DAG 4.3GE     Type 1       Colored POS HDLC Record*       Type 10     Colored POS HDLC Record*       DAG 4.3GE     Type 1       POS HDLC Record     Type 1       DAG 4.3S     Type 2       Ethernet Record     Type 3       ATM Cell Record     Type 4       Reassembled AAL5 Frame Record*     Type 10       Colored POS HDLC Record     Type 2       DAG 5.0SG2     Type 1       POS HDLC Record     Type 11       Colored POS HDLC Record     Type 10       Colored POS HDLC Record     Type 11       Colored POS HDLC Record     Type 10       Colored POS HDLC Record     Type 11       Colored POS HDLC Record     Type 10       Colored POS HDLC Record     Type 11       Co	DAG 3.7D	Type 1	PoS HDLC Record
DAG 3.7T     Type 4     Reassembled ALS Frame Record       Type 5     Multi-channel HDLC Frame Record       Type 7     Multi-channel RAW Time Stot Link Data Record       Type 8     Multi-channel RAW Channel: Multi-channel RAW Link Data       Type 9     Multi-channel ALS: Multi-channel ALS Frame       Type 10     PoS HDLC Record       Type 11     PoS HDLC Record       Type 12     Multi-channel ALS: Multi-channel ALS Frame       DAG 3.8S     Type 1       PoS HDLC Record     Type 1       DAG 4.3GE     Type 2       Ethernet Record     Type 4       Reassembled ALS Frame Record*       Type 1     Colored POS HDLC Record       Type 2     Ethernet Record       Type 3     ATM Cell Record       Type 4     Reassembled ALS Frame Record*       Type 5     DAM Cell Record       Type 4     Reassembled ALS Frame Record*       Type 5     DAM Cell Record       Type 10     Colored POS HDLC Record       Type 11     Colored POS HDLC Record       Type 12     Colored POS HDLC Record with Hash Load Balancing       Type 13     C		Type 3	ATM Cell Record
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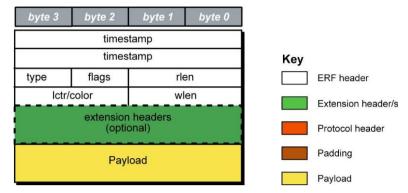
DAG 5.4GA     Type 1     Ethernet Record       Type 11     Colored Ethernet Record       Type 120     Colored Ethernet Record       Type 10     POS HDLC Record       Type 11     Colored POS HDLC Record       Type 120     Colored POS HDLC Record       Type 13     Colored POS HDLC Record       Type 14     POS HDLC Record       Type 15     DSM Color HDLC POS Record       DAG 5.4SGA-48     Type 2       Type 10     Colored POS HDLC Record*       Type 11     Colored POS HDLC Record       Type 12     Colored POS HDLC Record       Type 13     Colored POS HDLC Record       Type 14     Colored POS HDLC Record       Type 15     DSM Color Ethernet Record       Type 16     DSM Color HDLC POS Record       Type 17     POS HDLC Record       Type 18     Colored Des HDLC Record       Type 19     Colored Ethernet Record       Type 10     Colored Ethernet Record       Type 11     POS HDLC Record       Type 12     DSM Color Ethernet Record       Type 13     DSM Color Ethernet Record       Type 14     POS HDLC Record       Type 24     Raw Link Record       DAG 6.1SE     Type 1       Type 1     POS HDLC Record       Type 3     ATM Cell Record	Card	Туре	Extensible Record Format Type
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Type 25     Infiniband Link record       DAG 9.2X2     Type 2     Ethernet Record       DAG 9.2SX2     Type 1     POS HDLC Record       Type 2     Ethernet Record	DAG 8.4I	Type 21	InfiniBand
DAG 9.2X2     Type 2     Ethernet Record       DAG 9.2SX2     Type 1     PoS HDLC Record       Type 2     Ethernet Record	DAG 8.5I	Type 21	InfiniBand
DAG 9.2X2     Type 2     Ethernet Record       DAG 9.2SX2     Type 1     PoS HDLC Record       Type 2     Ethernet Record			Infiniband Link record
DAG 9.2SX2 Type 1 PoS HDLC Record Type 2 Ethernet Record	DAG 9.2X2		Ethernet Record
Type 2 Ethernet Record			
			Raw Link Record

\* Requires Endace Co Processor and appropriate Firmware.

#### **Generic ERF header**

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

The generic ERF header is shown below:



The fields are described below:

timestamp		The time	The time of arrival of the cell, an ERF 64-bit timestamp.		
type	Bit 7	Extension	header present.		
Bit 6		Extension header type. See table below:			
flags		This byte	is divided into several fields as follows:		
		Bits	Description		
		1-0:	Binary enumeration of capture interface:11Interface 3 or D10Interface 2 or C01Interface 1 or B00Interface 0 or ACards with more than four interfaces typically use Multichannel ERF types(type 5 to 9, 12 and 17) which provide a separate larger interface field.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		
		3:	<ul> <li>Truncated record - insufficient buffer space.</li> <li>wlen is still correct for the packet on the wire.</li> <li>rlen is still correct for the resulting record. But, rlen is shorter than expected from snap length or wlen values.</li> </ul>		
		4: 5:	Truncation is depreciated and this bit is unlikely to be set in an ERF record.RX error. An error in the received data. Present on the wireDS error. An internal error generated inside the card annotator. Not present on the wire.		
		6: 7:	Reserved Reserved		
rlen		The times	ngth in bytes. Total length of the record transferred over the PCI bus to storage. stamp of the next ERF record starts exactly rlen bytes after the start of the p of the current ERF record.		
lctr		counter r due to ov previous	Depending upon the ERF type this 16 bit field is either a loss counter or color field. The loss counter records the number of packets lost between the DAG card and the stream buffer due to overloading on the PCI bus. The loss is recorded between the current record and the previous record captured on the same stream/interface. The color field is explained under the appropriate type details.		
wlen			th. Packet length "on the wire" including some protocol overhead. The exact ation 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).
	<i>Note:</i> <i>There can be more than one Extension header attached to a ERF record.</i>
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

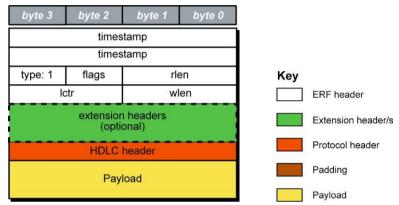
## ERF header types

Number	Туре	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

#### ERF 1. TYPE\_POS\_HDLC

Туре	Bit 7	1 = Extension header present. See Extension Headers (page 36).		
	Bits 6:0	Туре 1		
Short description	TYPE_POS_H	IDLC		
Long description	Type 1 PoS H	IDLC Record		
Use	This record format is for HDLC data links. For example:			
	Packet o	over SONET		
	Point-to	Point-to-Point Protocol [PPP] over SONET		
	Frame R	Relay		
	• MTP2 (SS7)			
	May be used	with EH 12. Channelisation (page 41) when created by software.		

The TYPE\_POS HDLC record is shown below:



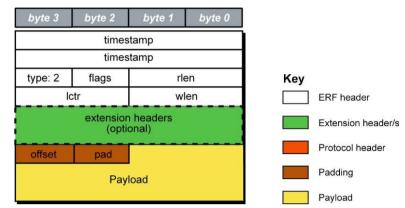
The following is a description of the TYPE\_POS\_HDLC record format:

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

#### ERF 2. TYPE\_ETH

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).
	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 (page 41) when created by software.	

## The TYPE\_ETH record is shown below:



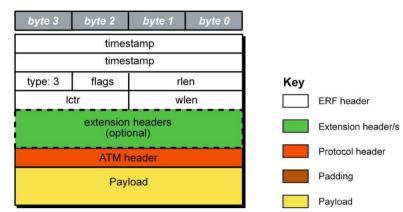
The following is a description of the TYPE\_ETH record format:

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

#### ERF 3. TYPE\_ATM

Туре	Bit 7	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).	
	Bits 6:0	Туре 3	
Short description	TYPE_ATM		
Long description	Type 3 ATM Cell Record		
Use	This record format is for ATM cell capture.		

The TYPE\_ATM record is shown below:



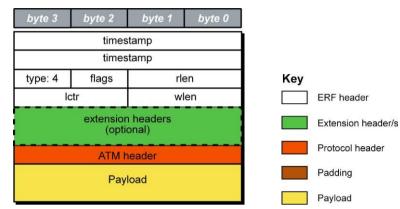
The following is a description of the TYPE\_ATM record format:

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

#### ERF 4. TYPE\_AAL5

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре	
Short description	TYPE_AAL5		
Long description	Type 4 Reassembled AAL5 Frame Record		
Use	This record format is for reassembled ATM AAL5 frames.		

The TYPE\_AAL5 record is shown below:



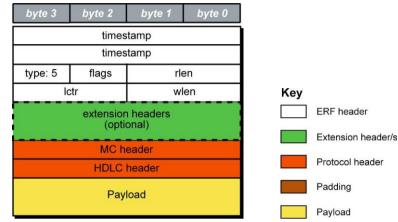
The following is a description of the TYPE\_AAL5 record format:

Field	Description
ATM header (4 bytes)	Protocol header of first cell in the frame not including the 8-bit HEC, all other cells in fame must have identical headers so are not included.
Payload (4 bytes)	Payload contains all cells in the frame: • trailing padding (0 - 47 bytes) • 1 byte cpcs-un field • 1 byte cpi field • 2 byte length filed, and • 4 byte crc field
Flags (1 byte)	The rx error flag in the ERF haders is set should the AAL5 crc fail.
Payload (bytes of AAL5 frame)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (4 bytes)

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре 5	
Short description	TYPE_MC_HDLC		
Long description	Type 5 Multi-channel HDLC Frame Record		
Use	This record format is for channelized HDLC data links. For example E1, T1 and J1.		
The TVPE MC UPIC recerd is shown helpeut			

#### ERF 5. TYPE\_MC\_HDLC

The TYPE\_MC\_HDLC record is shown below:



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

Field	Description		
flags	This field	is the same as normal ERF types but capture interface is always zero.	
(1 byte)	Fixe	d length mode not supported.	
	• RX E	rror is set if any MC Header Error bit is set.	
MC header	Protocol I	Header. This field is divided into the following:	
(4 bytes)	Bits	Attribute	
	0-9	Connection Number [0-1023].	
	10-15	Reserved.	
	16-23	Reserved.	
	24	FCS Error.	
	25	Short Record Error [<5 Bytes].	
	26	Long Record Error [>2047 Bytes].	
	27	Aborted Frame Error.	
	28	Octet Error. The closing flag was not octet aligned after bit stuffing.	
	29	Lost Byte Error. The internal data path had an unrecoverable error.	
	30	$1^{ST}$ Rec. This is the first record received since this connection was configured.	
	31	Reserved	
HDLC header (4 bytes)	Protocol header. Length may vary depending on protocol.		
Payload (bytes of packet)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (8 bytes)		

#### Note:

When using this record type with the DAG 3.7T card the Interface number is 0, and the connection number is defined by the programmed context. When using this record type with the DAG 7.1S card the interface number is used for the four ports, and

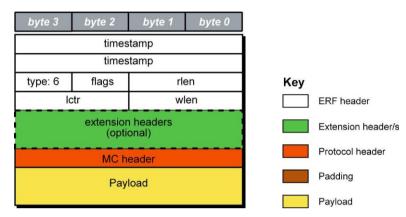
When using this record type with the DAG 7.1S card the interface number is used for the four ports, and the connection number is the VC identifier, as defined in the EDM01-17 DAG 7.1S Card User Guide.

#### ERF 6. TYPE\_MC\_RAW

ERF Type 6 records have two formats, one for the DAG 3.7T and one for the DAG 7.1S. Their individual descriptions follow.

Туре	Bit 7	1 = Extension header present. See Extension Headers (page 36).	
	Bits 6:0	Туре 6	
Short description	TYPE_MC_RAW		
Long description	Type 6 Multi-Channel RAW Time Slot Link Data Record		
Use	This record format is for the RAW capture from data links. For example; E1, T1 and J1.		

#### The TYPE\_MC\_RAW record is below:



The following is a description of the DAG 3.7T TYPE\_MC\_RAW record format:

Field	Description		
Flags	This field is the	same as normal ERF types but capture interface is always zero.	
(1 byte)	Fixed lengt	th mode not supported.	
	RX Error is	set if any MC Header Error bit is set.	
MC header	Protocol header	. This field is divided into the following:	
(4 bytes)	Bits	Attribute	
	0-3: P	hysical Interface [0-15].	
	4-28: R	eserved.	
	29: L	ost Byte. The internal datapath had an unrecoverable error.	
		st Rec. This is the first record received since this connection was onfigured.	
	31: R	eserved.	
Payload	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header		
(bytes of raw link data)	(4 bytes) This field is divided into the following:		
	Data type	Description	
	T1:	24 bytes for 24 time slots.	
	E1:	32 bytes for time slots 0-31.	
	Framed E1:	30 bytes of data for time slots 1-31, slot 0 used for framing is not captured.	

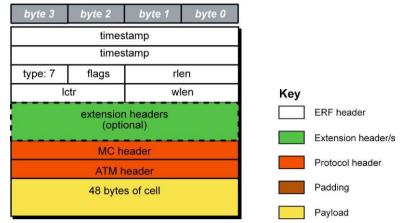
#### The following is a description of the DAG 7.1S TYPE\_MC\_RAW record format:

Field	Description		
Flags	This field is the	same as normal ERF types but capture interface is always zero.	
(1 byte)	Fixed lengt	h mode not supported.	
	RX Error is	set if any MC Header Error bit is set.	
MC header	Protocol header	. This field is divided into the following:	
(4 bytes)	Bits	Attribute	
	0-9: C	onnection number.	
	10-28: R	eserved.	
	29: L	ost byte. The internal datapath had an unrecoverable error.	
		irst record. This is the first record received since this connection was onfigured.	
	31: R	eserved.	
Payload (bytes of raw link data)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (4 bytes) This field is divided into the following:		
	Data type	Description	
	T1: PCM24	24 bytes for 24 time slots.	
	E1: PCM31	31 bytes for time slots 1-31.	
	Framed E1: PCM30	30 bytes of data for time slots 1-15, 17-31, slot 0 used for framing is not captured. Slot 16 is signaling information.	

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре 7	
Short description	TYPE_MC_ATM		
Long description	Type 7 Multi-	channel ATM Cell Record	
Use	This record format is for ATM cells on channelized data links. For example; E1, T1 and J1.		

#### ERF 7. TYPE\_MC\_ATM

The TYPE\_MC\_ATM record is shown below:



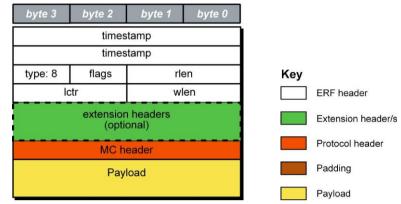
The following is a description of the TYPE\_MC\_ATM record format:

Field		Description			
flags	This field	This field is the same as normal ERF types but capture interface is always zero.			
(1 byte)	• Fixe	ed length mode not supported.			
	• RX	Error is set if any MC Header Error bit is set.			
MC header	Protocol	header. This field is divided into the following:			
(4 bytes)	Bit	Description			
	0-9:	Connection number (0-1023). 512 connections are supported by DAG 3.7T card. For the DAG 7.1S card refer to <i>EDM01-17 DAG 7.1S Card User Guide</i> for details. Refer to the <u>Channelized Configuration &gt; Configuration File</u> .			
	10-14:	Reserved.			
	15:	Multiplexed from IMA group into ATM stream. When bit 15 of the MC Header is set the bottom 9 bits (Connection Number/IMA ID) shall be treated as an IMA Group ID instead of a connection number.			
	16-19:	Physical port [0-15] cell was captured on. Physical ID is interpreted from the firmware perspective. For example, if a cable is plugged into port 0, examining the ERF MC Header field will give a Physical ID of 11. This is a little counter-intuitive and reflects the internal processing required. From the software/user perspective, this could be interpreted as the Logical ID, and as such, we can convert from the Logical to Physical ID using the provided dagutil function, dagutil_37t_line_get_logical which will return the Software Physical ID/Firmware Logical ID. In this case, assuming data is coming in on a cable plugged into port 0, we will convert 11 back to 0.			
	20-23:	Reserved.			
	24:	Lost Byte. The internal datapath had an unrecoverable error.			
	25:	HEC corrected.			
	26:	OAM Cell CRC-10 Error [not implemented].			
	27:	OAM Cell.			
	28:	$1^{st}$ Cell. This is the first cell received since this connection was configured.			
	29-31:				
ATM header (4 bytes)		Protocol header. The ATM HEC channel is not captured. This record has a fixed length of 72 bytes. This does not include the 8-bit HEC.			
Payload (bytes of cell)	Payload = 48 bytes of cell - HEC (1 byte)				

Туре	Bit 7	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре 8		
Short description	TYPE_MC_RA	TYPE_MC_RAW_CHANNEL		
Long description	Type 8 Multi-	Type 8 Multi-channel RAW Channel Multi-channel RAW Link Data Record		
Use	This record format captures complete RAW channelized data links. For example, E1, T1 and J1.			

#### ERF 8. TYPE\_MC\_RAW\_CHANNEL

The TYPE\_MC\_RAW\_CHANNEL record is shown below:



The following is a description of the TYPE\_MC\_RAW\_CHANNEL record format:

Field		Description		
flags		I is the same as normal ERF types but capture interface is always zero.		
(1 byte)	• Fixe	ed length mode not supported.		
	• RX	Error is set if any MC Header Error bit is set.		
MC header	Protocol	header. This field is divided into the following:		
(4 bytes)	Bits	Attributes		
	0-9:	Connection number (0-1023).		
	10-28:	Reserved.		
	29:	Lost Byte Error. The internal datapath had an unrecoverable error.		
	30:	$1^{st}$ Rec. This is the first record received since this connection was configured.		
	31:	Reserved.		
Payload	Payload	Payload = rlen - ERF header (16 bytes) - Extension headers (optional)		
(bytes of data)	- Protoco	- Protocol header (4 bytes)		

#### Note:

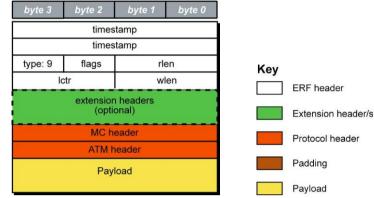
When using this record type with the DAG 3.7T card the Interface number is 0, and the connection number is defined by the programmed context.

When using this record type with the DAG 7.1S card the interface number is used for the four ports, and the connection number is the VC identifier, as defined in the DAG 7.1S Card User Guide.

Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
Bits 6:0	Туре 9	
TYPE_MC_AAL5		
Type 9 Multi-channel AAL5: Multi-channel AAL5 Frame Record		
This record format for reassembled ATM AAL5 frames from channelized data links.		
For example; E1, T1, J1.		
	Bits 6:0 TYPE_MC_AA Type 9 Multi- This record for	

#### ERF 9. TYPE\_MC\_AAL5

#### The TYPE\_MC\_AAL5 record is shown below:



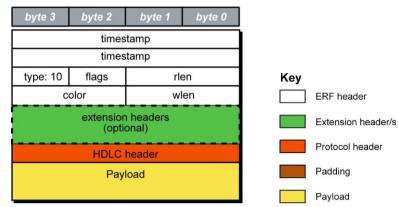
The following is a description of the TYPE\_MC\_AAL5 record format:

Field		Description	
flags (1 byte)		This field is the same as normal ERF types but capture interface is always zero.	
(1 byte)		ed length mode not supported. Error is set if any MC. Header Error bit is set.	
wlen (2 bytes)	Header. the recor	tains the length of the AAL5 frame including the ATM Header but not including the ERF The ERF record will always be 64 bit aligned, if the AAL5 frame is not 64 bit aligned rd will be padded at the end of the record with the value 0x00. This padding will not led in the wlen count.	
MC header	Protocol	Header. This field is divided into the following:	
(4 bytes)	Bits	Attributes	
	0-10:	Connection number (0-2047). 512 connections are supported by DAG 3.7T card.	
	11-15:	Reserved.	
	16-19:	Physical port (0-15) cell was captured on. Physical ID is interpreted from the firmware perspective. For example, if a cable is plugged into port 0, examining the ERF MC Header field will give a Physical ID of 11. This is a little counter-intuitive and reflects the internal processing required. From the software/user perspective, this could be interpreted as the Logical ID, and as such, we can convert from the Logical ID using the provided dagutil function, dagutil_37t_line_get_logical which will return the Software Physical ID/Firmware Logical ID. In this case, assuming data is coming in on a cable plugged into port 0, we will convert 11 back to 0. For the 7.1S this field is always 0.	
	20:	CRC checked.	
	21:	CRC error.	
	22:	Length checked.	
	23:	Length error.	
	24-27:	Reserved.	
	28:	$1^{st}$ Cell. This is the first cell received since this connection was configured.	
	29-31:	Reserved.	
ATM header (4 bytes)	Protocol	Header. This does not include the 8-bit HEC.	
Payload (bytes of AAL5 frame)		= rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (8	

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре 10	
Short description	TYPE_COLOR_HDLC_POS		
Long description	Type 10 Colored PoS HDLC Record		
Use	This record format is for data links, incorporating filter results. The record format is the same type as the <u>Type 1 POS_HDLC</u> (page 8) record, with the exception that the <i>lctr</i> field is reassigned as <i>color</i> . Requires Endace Coprocessor and appropriate firmware.		

#### ERF 10. TYPE\_COLOR\_HDLC\_POS

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



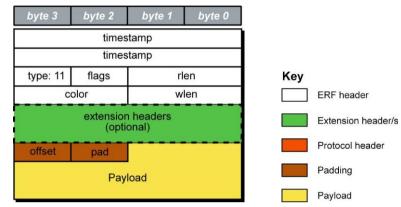
The following is a description of the TYPE\_COLOR\_HDLC\_POS record format:

Field		Description			
color (2 bytes)	The color field is a hardware generated tag indicating the result of a filtering or classification operation. This field is divided into the following:				
	Bit	Bit Description			
	0:	Set if the record should have been sent to receive stream 0.			
	1:	1: Set if the record should have been sent to receive stream 2.			
	2-15:	A 14-bit unsigned integer that corresponds to the filter rule this packet matched.			
HDLC header (4 bytes)	Protocol he	Protocol header. Length may vary depending on protocol.			
Payload	Payload =	Payload = rlen - ERF header (16 bytes) - Extension headers (optional)			
(bytes of record)	- Protocol	- Protocol header (4 bytes)			

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).			
	Bits 6:0	Type 11		
Short description	TYPE_COLOR_ETH			
Long description	Type 11 Cold	Type 11 Colored Ethernet Record		
Use	This record format is for the Ethernet links [802.3], incorporating filter results. The record format is the same type as the <u>Type 2 TYPE ETH</u> (page 9) record, with the exception that the <i>lctr</i> field is reassigned as <i>color</i> . Requires Endace Coprocessor and appropriate firmware.			

## ERF 11. TYPE\_COLOR\_ETH

#### The TYPE\_COLOR\_ETH variable length record is shown below:



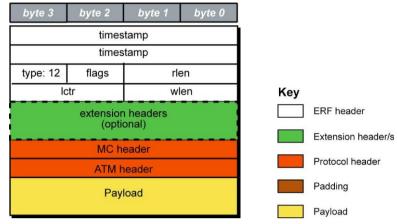
The following is a description of the TYPE\_COLOR\_ETH record format:

Field	Description				
color (2 bytes)	The color field is a hardware generated tag indicating the result of a filtering or classification operation. This field is divided into the following:				
	Bit	Description			
	0:	Set if the record should have been sent to receive stream 0.			
	1:	1: Set if the record should have been sent to receive stream 2.			
	2-15:	A 14-bit unsigned integer that corresponds to the filter rule this packet matched.			
offset (1 byte)	link layer	of bytes <b>not</b> captured from the start of the frame. This is typically used to skip headers when they are not required in order to save bandwidth and space.			
Ded	<i>Note:</i> 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. This is typically used to skip link layer headers when they are not required in order to save bandwidth and space.				
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Padding (2 bytes)				

Туре	Bit 7	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).			
	Bits 6:0	ype 12			
Short description	TYPE_MC_A	TYPE_MC_AAL2			
Long description	Type 12 Multi-channel AAL25: Multi-channel AAL2 Frame Record				
Use	This record format is for channelized links is the same as the normal ERF Types but capture				
	interface is always zero.				

#### ERF 12. TYPE\_MC\_AAL2

The TYPE\_MC\_AAL2 record is shown below:



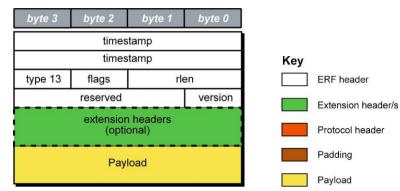
The following is a description of the TYPE\_MC\_AAL2 record format:

Field		Description			
flags		I is the same as normal ERF types but capture interface is always zero.			
(1 byte1)		ed length mode not supported.			
	• RX	RX Error is set if any MC Header Error bit is set.			
MC header	Protocol	header. This field is divided into the following:			
(4 bytes)	Bits	Attribute			
	0-9	Connection number (0-1023).			
		512 connections are supported by DAG 3.7T card.			
	10-12	Reserved for possible extra connection numbers			
	13-15	Reserved for indication of AAL2 type (a value of 0x0 indicates a SSSAR packet).			
	16-19	Physical port (0-15) cell was captured on.			
		Physical ID is interpreted from the firmware perspective. For example, if a cable is plugged into port 0, examining the ERF MC Header field will give a Physical ID of 11. This is a little counter-intuitive and reflects the internal processing required. From the software/user perspective, this could be interpreted as the Logical ID, and as such, we can convert from the Logical to Physical ID using the provided dagutil function, dagutil_37t_line_get_logical which will return the Software Physical ID/Firmware Logical ID. In this case, assuming data is coming in on a cable plugged into port 0, we will convert 11 back to 0. For the 7.1S this field is always 0.			
20		Reserved			
	21	1st Cell. This is the first cell received since this connection was configured.			
	22	MAAL Error (errnum as specified in ITU I.363.2 is copied to the data part of this record)			
	23	Length Error			
	24-31	Channel Identification Number (cid)			
ATM header (4 bytes)	Protocol	header. This does not include the 8-bit HEC.			
Payload (bytes of AAL5 frame)		= rlen - ERF header (16 bytes) - Extension headers (optional) ol header (8 bytes)			

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре 13	
Short description	TYPE_IP_COUNTER		
Long description	Type 13 IP Counter ERF Record		
Use	This record format counts IP address records.		

## ERF 13. TYPE\_IP\_COUNTER

The TYPE\_IP\_COUNTER record is shown below:



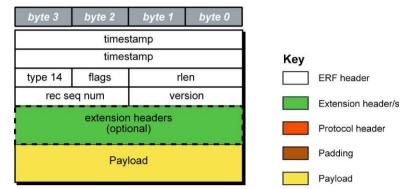
The following is a description of the TYPE\_IP\_COUNTER record format:

Field	Description					
Version (1 byte)	4 bits to identify the version of the counter record used.					
Payload	If version $= 1$ the follo	wing is the	e record for	mat:		
(bytes of record)		byte 3	byte 2	byte 1	byte 0	]
		IP address				
		Counter as source address				1
		Cou	1			
		IP address				
		Counter as source address				1
	ľ	Counter as destination address				
					1	
	1					

ERF 14. TYPE_	_TCP_FLOW_	_COUNTER
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Bit 7	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).	
Bits 6:0	its 6:0 Type 14	
TYPE_TCP_FLOW_COUNTER		
TCP Flow Counter ERF Record		
This record format counts TCP flow records		
	Bits 6:0 TYPE_TCP_F TCP Flow Co	

The TYPE\_TCP\_FLOW\_COUNTER record is shown below:



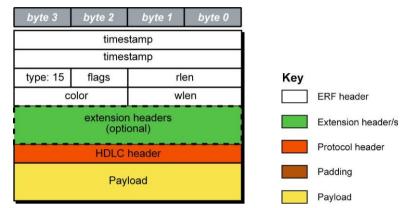
The following is a description of the TYPE\_TCP\_FLOW\_COUNTER record format:

Field	Description						
rec seq num (2 bytes)	This is the record counter so the user can tell how many flow records have been received so far.						
version (2 bytes)	4 bits to identify the ve	ersion of the	e counter r	ecord used.			
Payload	If version = 1 the follow	wing is the	record for	mat:			
(bytes of record)		byte 3	byte 2	byte 1 byte 0			
		Source IP address					
		Destination IP address					
	Ī	IP Protocol		RSVD			
		Destinatio	on Port	Source Port			
	- -		Packet	Counter			
			Source IF	e address			
			Destination	IP address			
	Ī	IP Protocol		RSVD			
	-	Destinatio	on Port	Source Port			
			Packet	Counter			

#### ERF 15. TYPE\_DSM\_COLOR\_HDLC\_POS

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).	
	Bits 6:0	Type 15	
Short description	TYPE_DSM_COLOR_HDLC_POS		
Long description	Type 15 DSM Color HDLC PoS Record		
Use	This record format is for HDLC data links, incorporating filter results. The record format is the same type as the Type 10 TYPE COLOR HDLC POS (page 18) record, with the		
		at the <i>lctr</i> field is reassigned as <i>DSM</i> type <i>color</i> .	

The TYPE\_DSM\_COLOR\_HDLC\_POS variable length record is shown below:



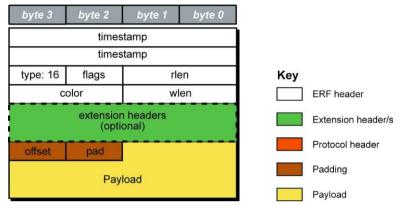
The following is a description of the TYPE\_DSM\_COLOR\_HDLC\_POS record format:

Field	Description		
color (2 bytes)	The color field is a hardware generated tag indicating the result of a filtering or classification operation. This field is divided into the following:		
	Bits	Bits Description	
	0-5	0-5 Receive stream number (0-63)	
	6-13	Filter match bits (bit6 = filter0, bit7 = filter1 and so on).	
	14	hlb0 (CRC calculation) output bit.	
	15	hlb1 (parity calculation) output bit.	
HDLC header (4 bytes)	Protocol header. Length may vary depending on protocol.		
Payload	Payload = rlen - ERF header (16 bytes) - Extension headers (optional)		
(bytes of record)	- Protocol	header (4 bytes)	

Туре	Bit 7	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Type 16		
Short description	TYPE_DSM_	TYPE_DSM_COLOR_ETH		
Long description	Type 16 DSI	Type 16 DSM Color Ethernet Record		
Use	record forma	This record format is for Ethernet [802.3] data links, incorporating filter results. The record format is the same type as the <u>Type 2 TYPE ETH</u> (page 9) record, with the exception that the <i>lctr</i> field reassigned as <i>DSM</i> type <i>color</i> .		

#### ERF 16. TYPE\_DSM\_COLOR\_ETH

The TYPE\_DSM\_COLOR\_ETH record is shown below:



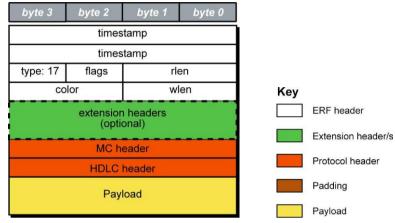
The following is a description of the TYPE\_DSM\_COLOR\_ETH record format:

Field		Description
Color (2 bytes)		r field is a hardware generated tag indicating the result of a filtering or tion operation.
(2 bytes)		is divided into the following:
	Bit	Description
	0-5	Receive stream number (0-63)
	6-13	Filter match bits (bit6 = filter0, bit7 = filter1 and so on).
	14	hlb0 (CRC calculation) output bit.
	15	hlb1 (parity calculation) output bit.
Offset		of bytes <b>not</b> captured from the start of the frame. This is typically used to skip
(1 byte)	-	headers when they are not required in order to save bandwidth and space. <i>his field is currently not implemented; contents should be disregarded.</i>
Pad	The Ethernet frame begins immediately after the pad byte so that the layer 3 [IP]	
(1 byte)	header is 32-bit aligned. This is typically used to skip link layer headers when they are not required in order to save bandwidth and space.	
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Padding (2 bytes)	

Туре	Bit 7	1 = Extension header present. See Extension Headers (page 36).		
	Bits 6:0	Type 17		
Short description	TYPE_COLO	TYPE_COLOR_MC_HDLC_POS		
Long description	Type 17 Mul	Type 17 Multi-channel HDLC Frame with Color Record		
Use	This record format is for channelized HDLC data links, incorporating filter results. The record format is the same type as the <u>Type 5 TYPE_MC_HDLC</u> (page 12) record, with the exception that the <i>lctr</i> field reassigned as <i>color</i> .			

#### ERF 17. TYPE\_MC\_HDLC\_POS

The TYPE\_COLOR\_MC\_HDLC\_POS record is shown below:



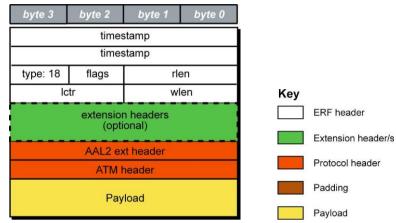
The following is a description of the TYPE\_COLOR\_MC\_HDLC\_POS record format:

Field		Description		
flags	Same as no	Same as normal ERF Types but capture interface is always zero.		
(1 byte)	Fixed le	ength mode not supported.		
	RX Erro	or is set if any MC header Error bit is set.		
Color	This field is	divided into the following:		
(2 bytes)	Bits	Description		
	0-1	Stream number of the record, this should match the stream that the packet record was received on.		
	2-15	Filter rule match, user defined value that is used to indicate which filter rule matched the packet record.		
MC header	Protocol Hea	ader. This field is divided into the following:		
(4 bytes)	Bits	Description		
	0-9	Connection number (0-511).		
	10-15	Reserved		
	16-23	Reserved		
	24	FCS Error		
	25	Short Record Error (<5 Bytes)		
	26	Long Record Error (>2047 Bytes)		
	27	Aborted Frame Error		
	28	Octet Error. The closing flag wasn't octet aligned after bit unstuffing.		
	29	Lost Byte Error. The internal datapath had an unrecoverable error.		
	30	1 <sup>st</sup> Rec. This is the first record received since this connection was configured.		
	31	Reserved		
HDLC header (4 bytes)	Protocol Hea	Protocol Header. Length may vary depending on protocol.		
Payload (bytes of packet)		Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (8 bytes)		

#### ERF 18. TYPE\_AAL2

Туре	Bit 7 1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Type 18	
Short description	TYPE_AAL2		
Long description	Type 18 Reassembled AAL2 Frame Record		
Use	This record is for reassembled ATM AAL2 frames.		

The TYPE\_AAL2 record is shown below:



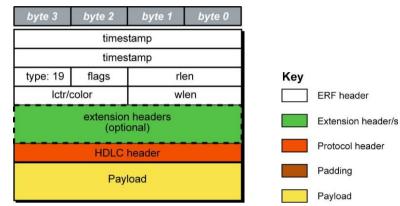
The following is a description of the TYPE\_AAL2 record format:

Field	Description		
flags	This field is divided into the following:		
(1 byte)	Bit	Description	
	0	MAAL Error Indication, will be set if the frame has a MAAL error otherwise it is cleared.	
	1	1st Frame Indicator, will be set if this is the first frame reassembed on the Interface/Channel/VPI/VCI/CID.	
	2-7	Reserved	
AAL2 ext header	Protocol Header. This field is divided into the following:		
(4 bytes)	Field	Description	
	0-7	Channel Identification Number (cid)	
	8-15	MAAL Error (errnum as specified in ITU I.363.2 is copied to the data part of this record)	
	16-23	AAL2 flags, see above.	
	24-31	Reserved	
ATM header (4 bytes)	Protocol Header. This does not include the 8-bit HEC.		
Payload (bytes of AAL2 frame)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (8 bytes)		

#### ERF 19. TYPE\_COLOR\_HASH\_POS

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).		
	Bits 6:0	Туре 19		
Short description	TYPE_COLOF	TYPE_COLOR_HASH_POS		
Long description	Type 19 Cold	Type 19 Colored PoS HDLC record with Hash load balancing.		
Use	This record format is for data links, incorporating filter results. The record format is the same type as the <u>Type 1 POS HDLC</u> (page 8) record, but with IPF color and hash value instead of the loss counter field.			

The TYPE\_COLOR\_HASH\_POS record is shown below:



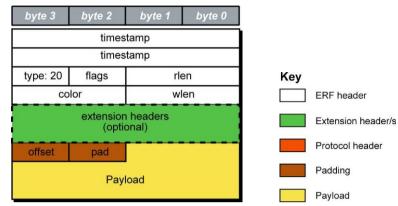
The following is a description of the TYPE\_COLOR\_HASH\_POS record format:

Field		Description	
color (2 bytes)	classificati	The color field is a hardware generated tag indicating the result of a filtering or classification operation. This field is divided into the following:	
	Bit	Bit Description	
	0-3	Hash Value	
	4-16	IPF Color	
HDLC header (4 bytes)	Protocol header. Length may vary depending on protocol.		
Payload (bytes of record)		Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (4 bytes)	

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).	
	Bits 6:0	Туре 20	
Short description	TYPE_COLOR_HASH_ETH		
Long description	Type 20 Colored Ethernet variable length record with hash load balancing.		
Use	This record is like <u>Type 2 TYPE_ETH</u> (page 9), but with IPF color and hash value instead of the loss counter field.		

#### ERF 20. TYPE\_COLOR\_HASH\_ETH

The TYPE\_COLOR\_HASH\_ETH record is shown below:



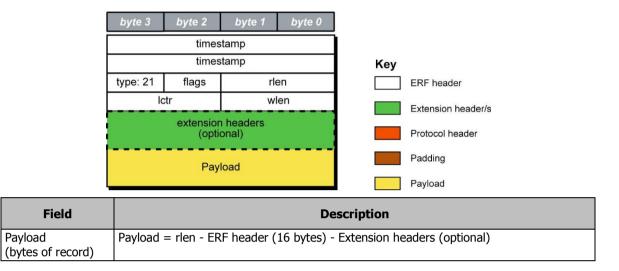
The following is a description of the TYPE\_COLOR\_HASH\_ETH record format:

Field		Description
color (2 bytes)	The color field is a hardware generated tag indicating the result of a filtering or classification operation.	
	This field is divided into the following:	
	Bit	Description
	0-3	Hash Value
	4-16	IPF Color
Offset (1 byte)	to skip link space.	bytes that were not captured from the start of the frame. This is typically used layer headers when they are not required in order to save bandwidth and currently not implemented; contents should be disregarded.
Pad (1 byte)	The Color Ethernet frame begins immediately after the pad byte so that the layer 3 [IP] header is 32-bit aligned. This is typically used to skip link layer headers when they are not required in order to save bandwidth and space.	
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional) - Protocol header (2 bytes)	

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).
	Bits 6:0	Type 21
Short description	TYPE_INFINIBAND	
Long description	Type 21 InfiniBand Variable Length Record.	
Use	This record format captures InfiniBand data. Used in conjunction with EH 3.	
	Classification (page 38).	

#### ERF 21. TYPE\_INFINIBAND

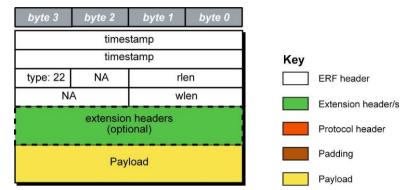
The TYPE\_INFINIBAND record is shown below:



#### ERF 22. TYPE\_IPV4

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).
	Bits 6:0	Type 22
Short description	TYPE_IPV4	
Long description	Type 22 IPV4 Variable Length Record.	
Use	This is a layer III single packet record.	

The TYPE\_IPV4 record is shown below:



The following is a description of the TYPE\_IPV4 record format:

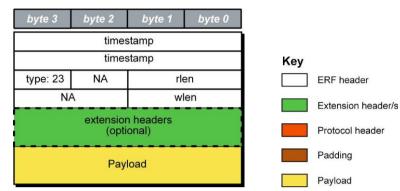
This is a layer-III ERF record. Payload consists of a single IPV4 packet. Layer-II information such as MPLS Tags, VLAN Tags and MAC addresses, POS Headers etc are not present.

Field	Description
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional)

#### ERF 23. TYPE\_IPV6

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).
	Bits 6:0	Type 23
Short description	TYPE_IPV6	
Long description	Type 23 IPV6 Variable Length Record	
Use	This is a layer III single packet record.	

The TYPE\_IPV6 record is shown below:



The following is a description of the TYPE\_IPV6 record format:

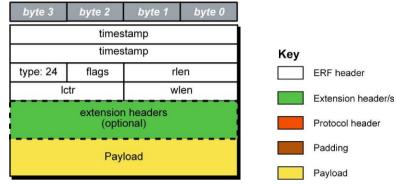
This is a layer-III ERF record. Payload consists of a single IPV6 packet. Layer-II information such as MPLS Tags, VLAN Tags and MAC addresses, POS Headers etc are not present.

Field	Description
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional)

Туре	Bit 7	1 = Extension header present. See Extension Headers (page 36).
	Bits 6:0	Type 24
Short description	TYPE_RAW_LINK	
Long description	Type 24 Raw link data, typically SONET or SDH Frame	
Use	Used in Raw SONET/SDH capture.	
	Used with EH 5. Raw_Link and EH 12. Channelisation (page 41).	

#### ERF 24. TYPE\_RAW\_LINK

The TYPE\_RAW\_LINK record is shown below:



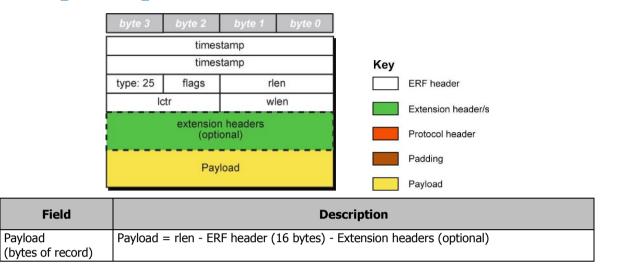
The following is a description of the TYPE\_RAW\_LINK record format:

Field	Description
Payload (bytes of record)	Payload = rlen - ERF header (16 bytes) - Extension headers (optional)

Туре	Bit 7	1 = Extension header present. See Extension Headers (page 36).	
	Bits 6:0	Type 25	
Short description	TYPE_INFIN	TYPE_INFINIBAND_LINK	
Long description	Type 25 InfiniBand link data.		
Use	Used in InfiniBand capture. Used in conjunction with EH 3. Classification (page 38).		
The TYPE INFINIPAND I INK record is shown below			

### ERF 25. TYPE\_INFINIBAND\_LINK

The TYPE\_INFINIBAND\_LINK record is shown below:



### ERF 48. TYPE\_PAD

Туре	Bit 7	1 = Extension header present. See <u>Extension Headers</u> (page 36).	
	Bits 6:0	Type 48	
Short description	TYPE_PAD	TYPE_PAD	
Long description	Type 48 Pad record		
Use	This record type is for pad records in DAG-II (and anywhere else that needs it).		

The TYPE\_PAD record is shown below:

byte 3	byte 2	byte 1	byte 0	Key	
	times	stamp			ERF header
	times	stamp			Extension header/s
type 48	flags	rle	en		
lctr/o	color	w	en		Protocol header
	extension (option				Padding
	(opin				Payload

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

Field	Description
timestamp (4 bytes)	All zeroes
type (1 byte)	48 (0x30)
flags (1 byte)	A value of 0
rlen (2 bytes)	16 in the first version (Currently, all pad records are 16 bytes for simplicity. This could change in the future, as other uses are made of these records.)
loss counter/color (2 bytes)	A value of 0
wlen (2 bytes)	A value of 0

### **Extensible Record Format Timestamps**

### **Overview**

The Extensible Record Format (ERF) incorporates a hardware generated timestamp of the packet's arrival.

The format of this timestamp is a single little-endian 64-bit fixed point number, representing whole and fractional seconds since midnight on the first of 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.

Another advantage of the ERF timestamp format is that a difference between two timestamps can be found with a single 64-bit subtraction.

It is not necessary to check for overflows between the two halves of the structure as is needed when comparing UNIX time structures, which are also available to Windows users in the Winsock library.

### **DAG card resolutions**

Different DAG cards have different actual resolutions. This is accommodated by the lowermost 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.

### **Example code**

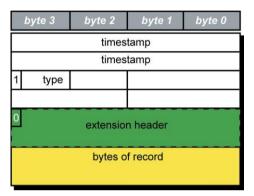
The following is example code showing how a 64-bit ERF timestamp (erfts) can be converted into a struct timeval representation (tv).

### 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'.

by	yte 3	byte 2	byte 1	byte 0
		times	tamp	
		times	tamp	
1	type			
1		extensior	n header	
0		extensior	n header	
		bytes o	of record	

### **Extension Headers Types**

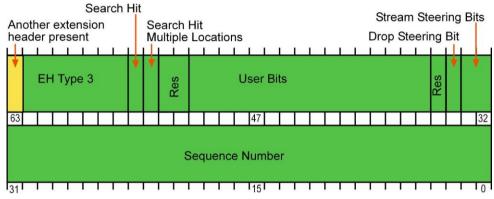
Number	Туре	Description
0:	Reserved	Reserved.
1:	Reserved	Reserved.
2:	Reserved	Reserved.
3:	Classification	Used to report filter and steering results. Used in conjunction with ERF 21. TYPE INFINIBAND (page 29)
4:	Intercept_ID	Used to identify packet as associated with a unique ID.
5:	Raw_Link	Used in Raw SONET/SDH capture. Additional information for <u>ERF 24. TYPE_RAW_LINK</u> (page 32) records.
12	Channelised	Used in Raw SONET/SDH capture of channelised links. It describes the origin channel, fragmentation and, type of traffic captured.

### EH 3. Classification

Туре	Bit 7	Extension header present	
	Bits 6:0	Type 3	
Short description	Classification	1	
Long description	-	-	
Use	Used with ERF 21. TYPE_INFINIBAND (page 29).		
	Entries marked Metadata are derived by firmware. Entries marked SRAM are stored in		
	the TCAM A	ssociated SRAM.	

*Note:* The following is provisional and subject to change.

The Classification extension header is shown below:



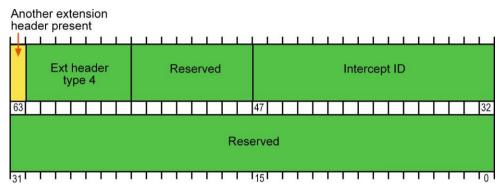
The following details the format of the Classification Extension Header:

Bit	Length	Meaning
63	1	More Extension Headers present (1 = more)
62:56	7	Extension header type.
55	1	Search Hit, rest of bits are meaningful.
54	1	Search Hit Multiple Locations, lowest-numbered shown.
53:52	2	Reserved.
51:36	16	User Bits.
35	1	Reserved.
34	1	Drop Steering Bit. May have Stream Steering bits set too.
33:32	2	Stream Steering Bits. Binary encoded.
31:0	32	Sequence Number from the framer chip.

### EH 4. Intercept ID

Туре	Bit 7	Extension header present
	Bits 6:0	Туре 4
Short description	Intercept ID	
Long description	ID attached to intercepted packet.	
Use	Used to identify packet as associated with a unique ID.	

The Intercept\_ID extension header is shown below:



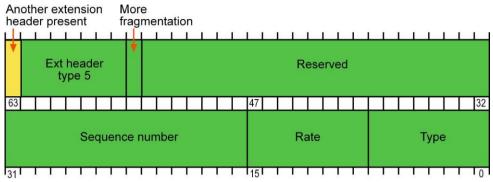
The following details the format of the Intercept\_ID Extension Header:

Bit	Length	Meaning
63	1	More Extension Headers present (1 = more).
62:56	7	Extension header type.
55:48	8	Reserved.
47:32	16	InterceptID. Integer. Unique ID.
31:0	16	Reserved.

#### EH 5. Raw\_Link

Туре	Bit 7	Extension header present
	Bits 6:0	Туре 5
Short description	Raw_Link	
Long description	Extra information for TYPE_RAW_LINK records	
Use	Used in Raw SONET/SDH capture. Used with ERF 24. TYPE RAW LINK (page 32).	

The Raw\_Link extension header is shown:



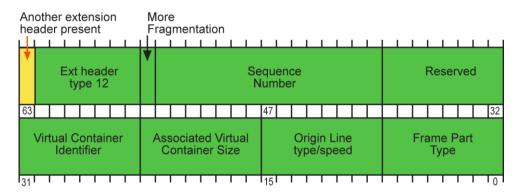
The following details the format of the Raw\_Link Extension Header:

Bit	Length	Meaning		
63	1	More Extension Headers bit (1=more headers)		
62:56	7	0x05 - Assigned type code		
55	1	More fragmentation.		
		(0 = Start of Frame, 1 = More Fragmentation)		
54:44	13	More fragment (1 = More Fragment Expected; 0 = End of Frame (no more fragment expected		
43:42	1	Scrambling of data indication ("00" = Unknown, "01" = Data is definitely scrambled, "10" = Data is definitely descrambled).		
31:16	16	Sequence number (starting at 0)		
15:8	8	Rate.		
		• 0x00 = reserved		
		• 0x01 = OC3		
		• 0x02 = OC12		
		• 0x03 = OC48		
		• 0x04 = OC192		
		• 0x05 = 0C768		
		• 0x06 = ds3		
		As defined in the SONET control register.		
7:0	8	Туре.		
		• 0x00 = raw SONET		
		• 0x01 = raw SDH		
		• 0x02 = SONET spe		
		• 0x03 = SDH spe		
		• $0x04 = ds3 (c-bit)$		
		• 0x05 = SONET spe w/o POH		
		• 0x06 = SDH spe w/0 POH		
		• 0x07 = SONET line mode 2		
		• 0x08 = SDH line mode 2		
		• 0x09 = bit-level raw (no alignment)		
		• 0x10 = raw 10GbE 66b		
		Others are reserved for future use.		

Туре	Bit 7	Extension header present	
	Bits 6:0	Type 12	
Short description	Channelisation		
Long description	Channelisation and fragmentation information for TYPE_RAW_LINK records and derived records ERF 1, ERF 3 and ERF 24.		
Use	Used in Raw SONET/SDH capture of channelised links. It describes the origin channel, fragmentation and type of traffic captured. Used with <u>ERF 1 TYPE POS HDLC</u> (page 8), <u>ERF 3. TYPE ATM</u> (page 10) and <u>ERF 24. TYPE RAW LINK</u> (page 32).		

### EH 12. Channelisation

The Channelisation extension header is shown below:



The following details the format of the Channelisation Extension Header:

Bit	Length	Meaning			
63	1	More Extension Headers present (1 = more).			
62:56	7	Extension header type.			
55	1	More fragments.			
		1 = More Fragments of this frame part expected, $0 =$ Last fragment of this frame part.			
54:40	15	Sequence Number			
		The sequence number identifies this record in the sequence of fragments belonging to a frame part. It is indexed starting at 0 from a fixed point. The fixed point is defined for each part type as follows:			
		Туре	Fixed Point		
		ТОН	Start of the SDH Frame – i.e. A1 A2 bytes.		
		РОН	Start of the Virtual Container – i.e. the J1 byte associated with the given VC.		
		Container	Start of the Container – i.e. the first byte of the Container (or TUG) occurring after the start of the POH associated with the given VC.		
		POS Packet	Start of the POS packet.		
		ATM Cell	Start of the ATM cell.		
		RAW	Start of the SDH Frame – i.e. A1 A2 bytes		
		The value 0 is given to the first fragment of the given part type that occurs begins at the fixed point, and each subsequent fragment has a incrementing sequence number $-$ i.e. 1,2,3,4.			
		For example, the TOH is associated with the SDH frame – hence, the TOH part containing the A1 A2 bytes will be labeled zero, and each TOH part beyond this will be labeled 1,2,3 etc.			
39:32	8	Reserved.			

Bit	Length		Meaning				
31:24	8	Virtual Container Identifier This value identifies the Virtual Container associated with the frame part. This value is defined as a bitfield, representing the AU-n numbering scheme defined in ITU-T G.707, barring that each number shall range from 0-3 (Or 0-2 for AU-3s), rather than 1-4. In addition, where a bitfield is unused, the field shall be set to zero, meaning that only four values are used (0-3), rather than the five values in ITU-T G.707 (0-4, where 0 means 'unused'), as whether the value is unused or not can be determined from the Associated Virtual Container Size field. For later extension, the highest order AUG will be placed in the highest bitfield position. The bitfield is assigned as such:					
		Bits	AU	ITU-T Address letter			
		7:6	AU-4-16c	D			
		5:4	AU-4-4c	С			
		3:2	AU-4	В	]		
		0:1	AU-3	A			
		frame. If this fi	eld is unused, t	hen it shall be set to a value of			
		For example, the channel defined in G.707 as VC(1,2,3,0,0) is given the virtual contidentifier $0b0110\_0000 = 0x60$ . This is distinguished from the channel VC(1,2,3,1,0) the Associated Virtual Container Size field of the extension header.					
		Note:	concult rocporti	up DAC Card Upar Cuida for au	ported configurations		
23:16	8		ted Virtual Cont	<i>ve DAG Card User Guide for su</i> j ainer Size	pportea configurations.		
Set to one of the following values to frame part:					al Container size associated with the		
		-	00 – Indicates fi				
			01 – VC-3 (STS-	-			
			02 – VC-4 (STS-	-			
			• 0x03 – VC-4-4c (STS-12)				
		• 0x04 - VC-4-16c (STS-48)					
		• 0x05 - VC-4-64c (STS-192)					
		Other values are reserved. Note:					
		<i>Note:</i> Please consult respective DAG Card User Guide for supported configurations.					
15:8	8	Origin Line Type/Speed					
		Set to one of the following values to indicate what physical line type and speed this fra			ysical line type and speed this frame		
			s captured from	:			
		• 0x00 - Reserved					
			01 – STM-0 (ST				
			02 – STM-1 (ST	-			
			03 – STM-4 (ST	-			
			04 – STM-16 (S	-			
			05 – STM-64 (S <sup>-</sup>	,			
7:0	8		alues are reserv Part Type	eu.			
7.0	0			ing values to indicate the cont	ent of the record		
			00 - TOH (de-m	-			
			00 - TOH (de-iii 01 - POH	anipicacuji			
			02 - Container				
			03 - POS Packet				
			03 - POS Packet 04 - ATM Cell				
				stification bytes - Reserved - PC	)] is not supported		
			05 - RAW(de-mi	-	ss is not supported.		
			her - Reserved	andpierea			
		- Ul					

## Version History

Version	Date	Reason
1 - 2	-	Previous versions
3	October 2005	
4	August 2007	Added new data formats and updated existing data formats.
5	November 2007	Added Extension Headers 3,4 and records 19,20,22,23.
6	December 2007	Added ERF Type 21 and updated ERF types per DAG card
7	February 2008	Added ERF type 24 and EH 5. Defined Payload field in ERF types.
8	June 2008	Corrected ERF types per card information for the 5.4 and 5.4A DAG cards.
9	August 2009	Added DAG 8.5IF, ERF Type 25 and EH 6, updated ERF 6. Updated for DAG software release 3.4.1.
10	September 2010	4.0.1 Release. Rebrand. Added 7.5G2/G4 and 9.2X2 information. Changed name of 7.4S and 8.5I.
11	August 2011	Updated title. Added EH 12. Updated ERF types per DAG card list and added DAG 9.2SX2 to list.
12	October 2011	Updated EH 5. Raw_link section with new parameters for DAG 4.6 Bit-level-raw additions.



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