VESDA Open HLI Protocol Summary
VHX-0300 Peer-to-Peer

REVISION HISTORY

Rev	Project	Date	Description
00		1 Apr 2004	Initial Release Derived from 03192_11 which is now obsolete. Master/Slave and Peer-to-Peer have been separated into 2 documents. M/S=10553_xx, P/P=10554_xx
01		13 Apr 2004	Added detail information on the use of the airflow monitoring commands
02	V0075MJ0	16 Sep 2005	Added Fault codes from 78 to 89 (Tafazal Chaudhry)
03	V0075MJ0	4 Nov 2005	Add supplemental information and notes on behavioural changes Multiple corrections in notes to open commands.
04	V0075MJ0	15 Dec 2005	Reformatting and additional descriptive information based on feedback from Gerry and Cao-Wei. (John Low-Shang and Tafazal Chaudhry)
05	V0075MJ0	21 Dec 2005	Minor corrections on page 31 and 33 as per TI TINY00037831. (Tafazal Chaudhry)

Author	Paul Lee Caroline Chong John Low-Shang

TABLE OF CONTENTS

Glossary 4
Conventions 4
1. The Open HLI Protocol 5
1.1. Introduction 5
1.1.1. Product Family 5
1.2. Protocol Modes 6
1.2.1. Introduction 6
1.2.2. Defaults (Factory-set) 6
1.2.3. Peer-to-Peer (Unsolicited) 6
1.2.4. Master/Slave mode 7
1.3. Message Format 8
1.3.1. Transmission parameters 8
1.3.2. Message Frame Format 8
1.3.2.1. Predefined characters: 8
1.3.2.2. Zone ID 8
1.3.2.3. Sector ID 9
1.3.2.3.1. Sector Addressing Techniques 9
1.3.2.4. Data Length 10
1.3.2.5. CRC Error Correction 10
1.3.2.6. DLE Byte Stuffing: 10
1.3.2.7. ACK & NAK Messages 11
1.4. Open HLI Start-up Delay 12
1.5. Open HLI Message Processing Limit 12
1.6. Time between unsolicited messages 12
1.7. Efficient Zone Status updates 12
1.8. Alarm and Fault latching and relays 13
1.9. LaserPLUS Fire 2 and Fire confirmation 13
1.10. Required Equipment 13
1.11. Primary Reporting 14
1.12. Host/Open HLI polling rate limitation 14
2. Command ID Summary 15
3. Command Messages 16
3.1. Set HLI Operation Mode (1) 16
3.2. Get HLI Operation Mode (2) 19
3.3. HLI Response (Success / Fault) (3) 20
3.4. Zone Update Request (4) 21
3.5. Current Zone Status (5) 23
3.6. Remote Input (6) 25
3.7. HLI Refresh (7) 27
3.8. Create Display (8) 28
3.9. Display Information (HLI Response) (9) 29
3.10. Update Display Status (10) 31
3.11. Current Display Status (11) 33
3.12. Get Fault Status (12) 36
3.13. Current Fault Status (13) 37
3.14. Get Fault String (14) 38
3.15. Current Fault String (15) 39
3.16. Update Airflow Status (16) 40
3.16.1. Important note on Airflow monitoring 40
3.17. Current Airflow Status (17) 41
3.17.1. Important note on Airflow Percentage Monitoring 44
3.17.2. Recommendations on monitoring Airflow 44
3.18. HLI Enquiry (20) 45
3.19. HLI SignON (21) 46
3.20. Get Detector Type (22) 47
3.21. Current Detector Type (23) 48
Appendix 1: Protocol Summary 49
Message Format 49
Command ID Summary 50
Appendix 2: Fault ID Codes 51
Appendix 3: VESDA CRC Algorithm 53

Notation 53
Glossary of Terms 53
References 53
Algorithm 53
Appendix 4: Technical Tips when using HLI in Peer-to-Peer operation mode 54
Appendix 5: Software Implementations 55
CRC Implementation In C 55
Notes for Non C/C++ Readers: 55
Alternative CRC Implementation In C 56
Extracting the CRC Bytes 57
Appendix 6: Notes on Open HLI behaviours 58
Summary of communicating with the VHX-0300 HLI. 58
Command 7 behaviour 58
OpenHLI behaviour with LaserSCANNER 59
Behaviour when Moving Zones 60

Glossary

ACK	Acknowledgment of a valid message
Alarm	Presence of smoke detected in the sampling environment
Detector	VESDA Fire Detector (eg. LaserCOMPACT, LaserPLUS, LaserSCANNER)
Fault	Inoperative, damaged or misconfigured device is resulting in the unit not operating in its intended mode.
HLI	VESDA High Level Interface device
Host	A module communicating on a shared link (eg. a computer connected to the HLI)
LaserCOMPACT	Detector derived from LaserPLUS technology for application at smaller sites than those at which LaserPLUS is targeted (up to 800m^2 as opposed to 2,000m$^{2)}$. This is primarily achieved through use of a smaller aspirator and a single pipe, rather than four. (VLC)
LaserFOCUS	A family range of detectors targeting smaller areas from 250m^2 to 500m^2. This range of detectors shall be recognised as a VLP one pipe product by third party applications. (VLF)
LaserPLUS	Laser based smoke detection equipment developed by Vision Systems. (VLP).
LaserSCANNER	A version of the LaserPLUS which can address the 4 pipes individually. (VLS)
LLI	Low level Interface - traditional interface using analogue outputs
Master	Nominated controller on a communication link
NAK	Negative acknowledgment indicating that a received message is invalid
OEM	Original Equipment Manufacturer
Slave	Nominated servant on a communication link
VESDA	Trademark of Vision Systems Ltd
VESDA*net*	Network used to connect LaserPLUS products (including LaserCOMPACT) and maintain communication

Conventions

h	Hexadecimal number. (eg. 10h equals 16 in decimal)
0/1	Host → HLI Host can turn this command bit to either ON or OFF
HLI → Host	HLI will respond with this status bit in either ON or OFF state

Note: All values are in Decimal format unless otherwise noted.

1. The Open HLI Protocol

1.1. Introduction

The Open HLI interface provides remote access to the functionality and operation of a VESDA Detector unit or VESDAnet network. Due to the wide range of operating requirements the Open Protocol has attempted to meet the needs of each environment.

The Open HLI is available in two models. The VHX-0310 operates in a Master/Slave mode and the VHX-0300 is a Peer-to-Peer device offering the option of unsolicited messages.

NOTE: The choice of HLI operating mode between the two models is no longer configurable by Host. This is to provide optimum performance of the two operating modes.
Please ensure that you have the correct manual for the chosen HLI.

This document applies to the VHX-0300

1.1.1. Product Family

The Open Protocol is supported by the following HLI products:

Cat No.	Description
VHX-0300	Open HLI – Peer-to-Peer only
VHX-0310	Open HLI – Master / Slave only
VHX-3000-F	Open HLI (OEM)

NOTE:
The VHX-0300 & VHX-0310 are no longer switchable between Peer-to-Peer or Master/Slave mode but are optimised for better performance as a pure Peer-to-Peer or Master/Slave device.

IMPORTANT:
See Section 1.11 for an important warning about using the Open HLI products for a primary reporting path.

NOTE:
The VESDA LaserFOCUS product family shall be recognised and identified by the monitoring application as a single pipe VLP detector. It has the same level and number of alarms as a VLP detector.

1.2. Protocol Modes

1.2.1. Introduction

The Open HLI is available in two models. The VHX-0300 operates in a Master/Slave mode and the VHX-0310 is a Peer-to-Peer device offering the option of unsolicited messages.

Prior to April 2002, it was possible to switch the VHX-0300 from Peer-to-Peer mode to master/slave mode. As of April 2002, the two modes of operation were split into two different products. The two separate products are optimised for their mode of operation.

1.2.2. Defaults (Factory-set)

The VHX-0300 unit is factory-set to default to having only *Current Zone Status* (Command ID #5) enabled for unsolicited message transmission on a regular basis for *each zone.* The *Current Airflow Status, Current Fault Status* and *Current Display Status* messages are not transmitted unsolicited.

1.2.3. Peer-to-Peer (Unsolicited)

This version of the HLI uses a Peer-to-Peer relationship. Both the HOST and the HLI have the same authority. Both can initiate communication. Data is passed, unsolicited, between the HOST and HLI. Both the HOST and HLI are responsible for supervising the communications link between them. If the link should fail, the HLI can report this failure via the standard VESDA*net* fault reporting mechanism.

Example:

HOST ➔ HLI	Request A	
HOST ➔ HLI	ACK	
HOST ➔ HLI	Reply A	
HOST ➔ HLI	ACK	
HOST ➔ HLI	Reply B	unsolicited
HOST ➔ HLI	ACK	

Operating in this mode requires the use of the ACK and NAK characters to verify that a message has been read by the destination. In the event of the message being corrupted or lost the sender will resend the message.

In Peer-to-Peer mode the host can transmit multiple requests and receive a reply for each request. Each request and reply is either acknowledged or failed with a either single ACK character or NAK character respectively. The order of replies is asynchronous.

If a packet is found to be corrupted a NAK character is sent.

Example:

HOST ➔ HLI	Request A	Corrupt Packet - invalid CRC
HOST ➔ HLI	NAK for A	
HOST ➔ HLI	Request A	
HOST ➔ HLI	ACK for A	

The host can have up to 10 outstanding requests. If additional requests are received the HLI will respond with a NAK character. This is a simple form of flow control.

NOTE: **As this operating mode is a Peer-to-Peer relationship, the Host need not poll the HLI. Data is passed, unsolicited between the Host and HLI. It is recommended that the Host program is able to identify the message format from the HLI.**

Upon power up the Peer-to-Peer Open HLI (VHX-0300), the Host must send Cmd 1 to switch on the parameters embedded in the application software.
The Host then waits for unsolicited Cmd 5.

1.2.4. Master/Slave mode

The Master/Slave mode is discussed in a separate document (10553_xx).

1.3. Message Format

1.3.1. Transmission parameters

The following transmission parameters are fixed for the Open HLI.

Baud Rate:	19200 baud
Parity:	None
Characters:	8 bits
Stop Bits:	1 stop bit

The HLI uses a Texas Instruments TL16C452 DUART that transmits the Least Significant Bit first. The format of data transmitted is big-endian i.e. Most Significant Byte first.

1.3.2. Message Frame Format

The following is the message frame format for Open HLI Protocol.

Byte Order	DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC
No. Bytes	1	1	1	1	1	1	1	[0-128]	1	1	2
Byte Value	10h	2	---	---	---	---	---	---	10h	3	---

The message is transmitted from left to right.
“h” indicates hex-digit. eg. “10h” is equivalent to 16 in decimal value.
See table below for the Predefined characters used.

1.3.2.1. Predefined characters:

Character	Hex	Decimal
STX	2	2
ETX	3	3
DLE	10	16
ACK	6	6
NAK	15	21

1.3.2.2. Zone ID

The Zone ID refers to the VESDA Detector Zone. A special FFh (or 255 decimal) Zone ID is used when addressing the Open HLI itself, eg. when using Command ID #1 (*Set Operation Mode*) to configure the Open HLI.

1.3.2.3. Sector ID

***Note**: This section is only applicable for the LaserPLUS Scanner detectors. For other detectors (eg. LaserPLUS, LaserFOCUS & LaserCOMPACT), the Sector ID should be set to Zero (0). Also see Appendix 5 for scanner specific behaviour.*

The Open protocol is capable of operating with both the LaserPLUS FAS Scanner and the LaserPLUS FD Scanner. Verify that the scanner has its configuration type correctly set, as un-specified behaviour is probable if incorrectly set.

FAS Scanner
The FAS Scanner is capable of indicating the sector in which the smoke was first detected, also known as the First Alarm Sector (FAS). The FAS Scanner reports both Alarm and Smoke Level data on a zone basis only. Hence, for the FAS scanner there are no messages that can be addressed to or received from a specific sector. Even if a sector ID is provided on a request then, as stated in the protocol, a zone wide response will be returned. This return will indicate the First Alarm Sector if appropriate - i.e. if there is valid FAS information.

FD Scanner
The FD Scanner is capable of reporting both the FAS and individual sector alarm status. The FD scanner provides full sector addressing and individual sector responses.

1.3.2.3.1. Sector Addressing Techniques

The Sector ID addressing has two different formats, depending on whether the message is a Host Command message or a HLI Response message.

Transmitted Sector ID (Host → HLI)
In a Host Command message, the Sector ID is used literally. For example, if Sector ID =3, then Sector 3 is addressed.

Received Sector ID (HLI → Host)
The scanner sectors are addressed using the Sector ID in the packet format. The Sector ID byte is divided into two sections. The left four bits are used to represent the sector being addressed and the right four bits are used to represent the first alarm sector (FAS). The FAS bits are not used when addressing a zone and sectors. It is only used to return a LaserPLUS Scanner's present FAS.

Sector Id: **xxxx yyyy**

where
Bits **xxxx** represents sectors 1 to 4. If all four bits are set to 0 then all sectors are being addressed i.e. the entire zone.

Bits **yyyy** will have a maximum of one bit set to high. This indicates the first alarm sector (FAS). If none of the bits are set to high, then no sector has been identified as the first alarm sector.

For example, the following Sector Ids may be received from the Open HLI:

Received Sector ID ("x" denotes digit)	**Denotes "Response from"**
0	Zone – wide (or non-sector specific mode)
8x (hex) or 1000xxxx (binary)	Sector #1
4x (hex) or 0100xxxx (binary)	Sector #2
2x (hex) or 0010xxxx (binary)	Sector #3
1x (hex) or 0001xxxx (binary)	Sector #4

Using this technique an individual sector can be addressed or the entire zone can be addressed.

Sector ID - Summary
The following table summarises the usage of Sector Ids in both Host command messages & Response messages from the HLI.

Sector ID (Host → HLI)	Sector ID (HLI → Host)*	Denotes
1	80h	Sector 1
2	40h	Sector 2
3	20h	Sector 3
4	10h	Sector 4

***** When a First Alarm Sector (FAS) has been identified, the right digit of the received Sector ID will be non-zero to reflect the identified FAS.

1.3.2.4. Data Length
The message length is variable, depending on the number of Data Bytes to be sent.

If there is no Data Bytes to be transmitted, then set the Data Length to zero (0) and omit the Data Length field from the message. However, the Data Length byte (with zero value) must still be included in the transmitted message. This is commonly found in many Host command messages which do not contain any data bytes.

1.3.2.5. CRC Error Correction
The CRC used is CRC-16 (CCiTT). The first CRC byte is the Most Significant Byte obtained from a CRC calculation, which is performed in 16 bits (2 bytes)

The CRC includes everything from the first DLE to the ETX. Any Byte-stuffing character is not included in the CRC calculation.

See Appendix 5: Software Implementations, for a comprehensive treatment of CRC as used in the VESDA communications.

1.3.2.6. DLE Byte Stuffing:
The Open HLI protocol uses DLE characters to signal the start & end a message transmission. Hence any Data characters that correspond to the value of DLE (10 hex or 16 decimal) must be padded with another DLE byte to prevent the receiving device from being confused.

For example, a DLE character is normally followed by either a STX or an ETX character. If a DLE character is found in the data stream then an additional DLE character is inserted to represent that data byte. i.e. Each data byte of 10 hex in the data stream is represented by two DLE characters in the final transmission message.

The receiving device must also strip away the any DLE byte-stuffing characters before interpreting the data.

Byte stuffing is only applied between the DLE STX and the DLE ETX portions of the message.

Note: The Open HLI Protocol does not include the DLE Byte stuffing characters in the CRC calculations.

1.3.2.7. ACK & NAK Messages

In Unsolicited (Peer-to-Peer) mode, the Open HLI will reply to any command messages sent from the Host with a single ACK (06h) or NAK (15h) character.

Similarly the third party software must respond to messages from the Open HLI with ACKs or NAKs. If the HLI does not receive a ACK or NAK, it will retry sending the message three times before discarding it. However, if there are lots of messages coming from VESDAnet side (for example, because of large number of detectors) the HLI buffers will start filling up because the HLI will not be able to get rid of the messages as quickly as they are arriving in the HLI. At this point if the third party software starts communicating with the HLI, it will be observed that HLI starts sending the accumulated messages. In such a situation the HLI will respond to the third party commands only after it has finished sending out old messages.

Note that HLI can keep 128 message buffers in the HLI, which means that HLI can keep a back log of 128 messages only.

It is recommended to clear the buffers of the HLI (refresh the HLI) by sending command 7, if the 3rd party software is ran/connected after the HLI has been running for a while. This action will clear the back log of messages.

1.4. Open HLI Start-up Delay

Important: When the HLI is powered ON the user must wait approximately 10 to 30 seconds before sending any commands to the HLI.

During this time, the HLI starts up its application code and also requests the zone status information from each zone. Depending on the size of the network this process may take 10 to 30 seconds.

Any command sent by a Host during the startup period will be ignored. For example, the Host should wait for the Start-up period to expire before attempting to re-configure the Open HLI using *Set Operation Mode* message (Command ID #1).

1.5. Open HLI Message Processing Limit

The Open HLI is designed to handle a maximum of 128 outstanding poll messages at any given time.

It is possible to overloading the Open HLI by polling too quickly. Adhere to “Host/Open HLI polling rate limitation” given in section 1.12 to keep the number of outstanding HLI replies below the maximum limit of 128 messages.

1.6. Time between unsolicited messages

The time interval between unsolicited messages varies between messages and VESDA installations. The *Current Fault Status* messages will only occur as a result of a fault, rather than on a regular basis.

The other three messages (*Current Zone Status, Current Display Status, Current Airflow Status*) will occur on a regular basis. The *Current Airflow Status* occurs every 30 seconds. This is the airflow reporting period. Both the *Current Display Status* and *Current Zone Status* messages occur on a 45 second interval. Each zone is capable of transmitting an unsolicited message.

The *Current Zone Status* and *Current Airflow Status* are configured to operate in an unsolicited mode on a **network** basis. Individual zones **cannot** be configured to transmit unsolicited messages. On the other hand, the *Current Display Status* message **can** be configured to unsolicited operation on a zone basis.

The *Current Zone Status* and *Current Display Status* are not used simultaneously. If a zone is configured to use *Current Display Status* then no *Current Zone Status* is transmitted.

1.7. Efficient Zone Status updates

In a typical LaserPLUS installation that is correctly commissioned, the presence of faults and alarms is relatively rare. Correspondingly the status of each zone is not likely to change very frequently. This results in the transmission of status information which is not likely to have changed. In the case of a large network this may lead to excessive data transmissions as each zone is reporting largely redundant status information. To reduce the traffic to the absolute minimum, the unsolicited message set can be configured to enable only the *Current Zone Status* messages.

Any unsolicited message sent by the HLI should be acknowledged by the Host with an ACK character (if the CRC is correct). This will prevent unnecessary transmission retries from the HLI.

1.8. Alarm and Fault latching and relays

The HLI uses the present Alarm and Fault latch state when determining if a status change has occurred. Note that the latching state may not reflect the relay configuration. If configurable relays are being used then the Alarm and Fault latching state may not reflect an individual device's relay configuration. In addition the Alarm and Fault status reflects that in use by the detector. Please refer to the LaserPLUS operating manual for further details.

Note: The LaserCOMPACT does not have configurable relays.

1.9. LaserPLUS Fire 2 and Fire confirmation

The Fire2 level is used as a 'Double Knock' trigger. In the two messages that report the alarm levels the bits for Alert, Action, Fire 1 and Fire 2 are **all** set in the event of the Fire 2 state being reached.

The messages involved are

Current Zone Status	5
Display Info	9

Note: The LaserCOMPACT has only two alarm levels: "Pre-Alarm" and "Fire".

If the "Alert" alarm level is configured, then a third alarm level is available (for US-models only).

1.10. Required Equipment

To connect to an Open interface the following is required:

- a Open Protocol HLI unit
- a correctly assembled RS232 cable

The Open HLI connection is via a standard RS232 connection i.e. full duplex. The HLI uses a DB9, female connector. A direct connect cable is used to connect between host and HLI. Presently the pin arrangement is

TX	pin 2
RX	pin 3
Ground	pin 5
RTS	pin 8
CTS	pin 7

Both the OEM host and HLI can communicate simultaneously.

1.11. Primary Reporting

The Open HLI products are NOT intended for use as the primary reporting path. See the following important warning.

IMPORTANT WARNING:

In the case when the OPEN HLI products are use for primary reporting, some form of redundant system (for example, using a second OPEN HLI) is highly recommended. This recommendation is to avoid a potential single point failure as the OPEN HLI is providing the only interface to the HOST system.

1.12. Host/Open HLI polling rate limitation

It is not recommended that the Peer-to-Peer HLI is polled regularly by the Host. If the Host requires to poll the Peer-to-Peer HLI, it is recommended that a message rate of not more than 1 message every 2 seconds is used.

NOTE: Polling is not REQUIRED when using a Peer-to-Peer HLI.

2. Command ID Summary

Command Name	Cmd ID	From → To	Description
Set Operation	1	HOST → HLI HLI → HOST	Set the operating message set. This is recorded in volatile memory.
Get Operation	2	HLI → HOST	Get the operating message set.
Response	3	HOST → HLI HLI → HOST	Universal indicator of success/failure.
Zone Update	4	HOST → HLI	Request for an update of a Zone's status
Current Zone Status✸	5	HLI → HOST	A Zone's present status.
Remote Operation	6	HOST → HLI	Allows a zone to be Reset, Isolated or Silenced
HLI Refresh	7	HOST → HLI	Clear the data stored locally on the High Level Interface
Create Display	8	HOST → HLI	Request the information required to create a virtual Display
Display Info	9	HLI → HOST	The information required to create a virtual display.
Update Display status	10	HOST → HLI	Request for data required to update a virtual Display.
Current Display Status✸	11	HLI → HOST	A Display's status.
Update Fault Status	12	HOST → HLI	Update the fault status of a zone.
Current Fault Status✸	13	HLI → HOST	The current fault status of a zone.
Get Fault String	14	HOST → HLI	Get the fault string used by VESDA by providing the fault number.
Fault String	15	HLI → HOST	The fault string associated with a fault number.
Update Airflow Status	16	HOST → HLI	Update a zone's airflow status
Current Airflow Status✸	17	HLI → HOST	A zone's airflow status.
HLI Enquiry	20	HOST → HLI	Request HLI information
HLI SignOn	21	HLI → HOST	HLI data eg Version number
Get Device Type	22	HOST → HLI	Get a device type
Current Device Type	23	HLI → HOST	Current device type
Network Alarm Status Update Request	64	HOST → HLI	**Not applicable to Peer-to-Peer HLI. If Command 64 is inadvertently sent to a Peer-to-Peer HLI, code "CB" will be received by Host in a Cmd 3 response to indicate "INVALID" command**

✸ The HLI can be configured to send these messages as unsolicited messages to the HOST.

3. Command Messages

3.1. Set HLI Operation Mode (1)

This command (ID 1) is no longer applicable for switching between modes of operation.
Command ID 1 is used after first power up of the Peer-to-Peer HLI by Host to initialise relevant parameters in the Peer-to-Peer application software.

Command ID : 1 (01h)

Description: Sets the Operation Mode of the Open HLI unit.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 1 byte

Data Format:

Operation Type **u 0 v w x y 0 0** 1 byte

where
u = Communication mode between Host and HLI
1 = **Master / Slave** mode (not applicable)
0 = **Unsolicited** mode

Unsolicited Mode:

Bit No.	7	6	5	4	3	2	1	0
Bit Name	u	0	v	w	x	y	0	0
Value	0	0	0/1	0/1	0/1	0/1	0	0

In Unsolicited mode, full broadcasting and multiple requests are allowed. Some messages can be sent unsolicited by the HLI to the Host. The Host can still poll the HLI for data.

The HLI will send a single ACK or NAK character to acknowledge every command message received from the Host.

In Unsolicited mode, four different unsolicited messages can be sent unsolicited by HLI:

Bit	**Description**	**Corresponding Command ID**	
		Dec	Hex
v	Current Zone Status	5	05h
w	Current Display Status	11	0Bh
x	Current Fault Status	13	0Dh
y	Current Airflow Status	17	11h

1 indicates set to unsolicited
0 indicates set to poll only

HLI Response:

Command ID: 3

Data Length: 1

Data Format: Success/Fault Id 1 byte

Success = FF (hex)
Fault ID = Any other value

See Command ID #3 for more details.

Example:
To set the Open HLI to pure Master / Slave mode:

This will disable all unsolicited messages. Also disables the use of ACK character responses from HLI.

Host Sends: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length		DLE	ETX	CRC	
10	02	01	00	FF	00	01	80	10	3	82	60

Byte	Explanation
10	<DLE>
02	<STX>
01	Command ID =1
00	Network No. =0
FF	Zone No. = FFh (Open HLI)
00	Sector No.
01	Data Length =1
80	Data Byte = 80h (1000 0000 binary) Set to Master/Slave mode
10	<DLE>
3	<ETX>
82	CRC Byte #1
60	CRC Byte #2

Open HLI Response: (values in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	03	00	FF	00	01	FF	10	03	43	10

<DLE> <STX> <Command=3> …<Zone ID= FFh> …<Data Length =1> <Data = FFh; “OK”> <DLE> <ETX> <CRC #1= 43h> <CRC #2= 10h>

Example:
To set the Open HLI to full Unsolicited mode:

This will enable all unsolicited messages. Also enables the use of ACK character responses from HLI.

Host Sends: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	01	00	FF	00	01	3E	10	3	18	39

Byte	Explanation
10	<DLE>
02	<STX>
01	Command ID =1
00	Network No. =0
FF	Zone No. = FF (Open HLI)
00	Sector No.
01	Data Length =1
3E	Data Byte = 3Eh (0011 1110 binary) Set to Unsolicited mode & Enable all unsolicited message types
10	<DLE>
3	<ETX>
18	CRC Byte #1
39	CRC Byte #2

Open HLI Response: (values in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	03	00	FF	00	01	FF	10	03	43	10

<DLE> <STX> <Command=3> …<Zone ID= FFh> …<Data Length =1> <Data = FFh; “OK”> <DLE> <ETX> <CRC #1= 43h> <CRC #2= 10h>

Note: The VHX-0310 is not affected by this command, as it is Master/Slave only product.

Important: The Open HLI (VHX-0300) uses the following configuration for its default Operation Type: 0x0010000

The Operation Mode is retained in **volatile** memory. In the event of a power cycle, the HLI unit resets to the factory-default configuration.

Tip: It is preferable for the Open HLI to receive this message as its first command after a power cycle. (for VHX-0300 only)

Warning: The HLI normally takes up to 30 seconds after a power reset before it is ready to respond any command messages from the Host.

Note: This message also serves as a HLI-to-Host response when the HLI receives a Command #2 from the Host. The reported data bits would reflect the current operation mode.

The VHX-0310 would always respond to a Command #2 poll with a Command #1 message containing a data value of 80 hex, signifying Master / Slave mode.

3.2. Get HLI Operation Mode (2)

Command ID : 2 (02h)

Description: Host requests for current HLI Operations Mode.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ---

Note: The VHX-0310 would always respond to this command with a Command #1 message containing a data value of 80 hex, signifying Master / Slave mode.

Example:
To request for the current HLI Operation Mode.

This applies only to the HLI that is directly connected to the Host

Host Sends: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02		02	00	FF	00	00	10	03	91	10

Byte	Explanation
10	<DLE>
02	<STX>
02	Command ID =2
00	Network No. =0
FF	Zone No. = FF (Connected HLI)
00	Sector No.
00	Data Length =0 (Hence omit Data Byte field)
10	<DLE>
3	<ETX>
91	CRC Byte #1
10	CRC Byte #2

A Sample Open HLI Response: (values in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	01	00	FF	00	01	20	10	03	8D	B7

<DLE> <STX> <Command=1> …<Zone ID= FFh> …<Data Length =1> <Data Byte= 20h; Unsolicited Mode, Enabled Current Zone Status Unsolicited messages>
<DLE> <ETX> <CRC #1= 8Dh> <CRC #2= B7h>

See Command ID #1 for more information on Bit values.

3.3. HLI Response (Success / Fault) (3)

Command ID : 3 (03h)

Description: HLI response message to Host requests.

Message Flow: HLI → HOST

Message Type: Polled Response

Data Length: 1

Data Format: Success / Fault Id 1 byte

"OK" or Success = FF (hex)
Fault ID = Any other value

See Appendix #2 for list of other Fault ID values.

Notes: This HLI message is typically generated in response to Host Command Messages with Command Ids 1, 2, 6,7 etc.

However, this HLI message may also be sent in response to other Host messages as an error message.
Example:
Sending a Command ID #4 message from the Host with a non-existent zone will generate a HLI Command ID #3 response with a Fault ID of C8h. (Normally, a Command ID #5 response is expected)

Example:
Below is a sample Open HLI message in response to a Host command to a detector in Zone 10 (0Ah): (values in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	03	00	0A	00	01	FF	10	03	97	34

<DLE> <STX> <Command ID=3> …<Zone ID= 0Ah> …<Data Length =1> <Data Byte= FFh; OK/Success> <DLE> <ETX> <CRC #1= 97h> <CRC #2= 34h>

3.4. Zone Update Request (4)

Command ID : 4 (04h)

Description: Host requests for current Zone update.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ---

HLI Response: See Command ID #5 for more details.

Note: Laser Scanners have four sectors.

Use Command ID #10 can be used to obtain Alarm status & Smoke Levels for individual sectors.

Example:
Request for Current Zone Update from Zone 3.
Note: In this example, Zone 3 can be a LaserPLUS or a LaserCOMPACT.

Host Sends: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	04	00	03	00	00	10	3	21	4B

Byte	Explanation
10	<DLE>
02	<STX>
04	Command ID = 4
00	Network No. =0
03	Zone No. = 03
00	Sector No.
00	Data Length =0 (Hence no data byte field)
10	<DLE>
3	<ETX>
21	CRC Byte #1
4B	CRC Byte #2

Open HLI Response: (values in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data		DLE	ETX	CRC	
10	02	05	00	03	00	02	06	41	10	03	55	CF

<DLE> <STX> <Command=5> …<Zone ID= 03h> …<Data Length =2> <Data Bytes #1 & #2= 06h & 41h; "Urgent Zone Alert"> <DLE> <ETX> <CRC #1= 55h> <CRC #2= CFh>

Interpretation:
Zone 3 is in Urgent Zone Alert. This was simulated by causing an Air Flow fault in Zone 3.

See Command ID #5 for more details.

3.5. Current Zone Status (5)

Command ID : 5 (05h)

Description: HLI reports current Zone Status.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #4)
or Unsolicited Message

Data Length: 2 bytes (16 bits)

Data Format:

Alarm	4 bits
Fault	7 bits
Isolated	1 bit
Normalising	1 bit
Auto-Learning	1 bit
Scanning	1 bit
Other Zone Info	1 bit

First Data Byte:

Bit No.	7	6	5	4	3	2	1	0
Bit Name	Alert	Action	Fire 1	Fire 2	System	Zone	Urgent	Power
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
	Alarms				**Faults**			

Second Data Byte:

Bit No.	7	6	5	4	3	2	1	0
Bit Name	Network	Air Flow	Filter	Isolated	Normalising	Auto Learning	Scanning	Other Zone Info
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
	Faults			**Status**				

1 = True Status (eg. In Alarm or Fault Condition)
0 = False

Note: The LaserCOMPACT has only two alarm levels: Pre-Alarm and Fire.
(For US markets, an additional “Alert” level is configurable)

LaserPLUS Alarm Levels	LaserCOMPACT Alarm Levels
Fire 2	(Not Applicable)
Fire 1	Fire
Action	Pre-Alarm
Alert	Alert (If configured, for US models only)

Table. Corresponding Detector Alarm Levels

Important: Laser Scanners can have up to four sectors. Command ID #5 will only return the Zone-wide information in response to Command ID #4. The Alarm bits reflect the highest sector alarm.

Use Command ID #10 to obtain Sector Alarm status & Sector Smoke Levels.

Important: The "Scanning bit" is active as long as scanning continues.

Important: The "Other Zone Info bit" applies only LaserSCANNER.

Example:
Sample Unsolicited Message from Zone 10 (0Ah):

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data		DLE	ETX	CRC	
10	02	05	00	0A	00	02	08	80	10	03	EA	F2

(values in hex)

<DLE> <STX> <Command=5> …<Zone ID= 0Ah> …<Data Length =2> <Data Bytes #1 & #2= 08h & 80h; "System Fault & Network Fault"> <DLE> <ETX> <CRC #1= EAh> <CRC #2= F2h>

Interpretation:
Zone 10 (0Ah) is reporting a System Fault & a Network Fault. This was caused by plugging a new Programmer into a VESDAnet socket.

NOTE:
In the case of unsolicited messages (ie not requested by a cmd 4 from the host), the sector number will contain the values as per 1.3.2.3.1. Thus sectors 1 through 4 appear as 80h, 40h, 20h and 10h respectively.
In addition the sector number may also contain in the right hand digit a non-zero value to indicate the identified FAS. These may appear as 88h indicating sector 1 data and sector 1 as First alarm sector, or 48h indicating sector 2 with FAS in sector 1.

NOTE:
See appendix 6 for VLS specific behaviours. In particular, the zone information may be different from the sector information. Zone information for VLS may not be valid until a reset has occurred.

3.6. Remote Input (6)

Command ID : 6 (06h)

Description: HOST controls Detector remotely.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 1 byte

Data Format:

Data Byte:

Bit No.	7	6	5	4	3	2	1	0
Bit Name	0	Reset	y	t	z	w	u	v
Value	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1

where

x Reset (all zones allowed)
y Isolate (all zones allowed)
t De-isolate (all zones allowed)
z Silence (all zones allowed)
w Start Test (Detector Test - all zones allowed)
u Start Scanning (for LaserSCANNER only, 1 zone)
v Stop Test (Detector Test – all zones allowed)

1 = Execute Command
0 = No command

Note: Setting a bit to '1' (True) will initiate the appropriate command actions.

The following command bits work in pairs

Isolate / De-isolate:
Set Bit 5 ("y"-bit) to Isolate a zone or all zones. Set Bit 4 ("t"-bit) to De-isolate a zone or all zones.

Detector Test
Set Bit 2 ("w"-bit) to Start the Detector Test for a zone or all zones. The Host must then set Bit 0 ("v"-bit) to Stop the Test.

For Network Isolate / De-isolate broadcasts to all Zones use the Broadcast ID / Zone ID = FFh

For Network Reset broadcasted to all Zones use the Broadcast ID / Zone ID = FFh.
Warning: Network reset will CLEAR all current alarm status.

Warning ***The Detector Test will cause a "Fire" (& Alert & Action) alarm condition on the Detector under test.***

HLI Response:

Command ID: 3

Data Length: 1

Data Format: Success/Fault ID 1 byte

Success = FF (hex)
Fault ID = Any other value

See Command ID #3 and Appendix 2 (Fault Ids) for more details.

Example:
RESET command to a Detector in Zone 10 (0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	06	00	0A	00	01	40	10	03	C0	D0

Explanation:
Data Byte #1 = 40h (Reset command)

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	03	00	0A	00	01	FF	10	03	97	34

Explanation:
Data Byte #1 = FFh (OK / Success)

3.7. HLI Refresh (7)

Command ID : 7 (07h)

Description: HOST commands HLI to refresh.
This will clear all data stored locally in the HLI.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ---

HLI Response:

Command ID: 3

Data Length: 1

Data Format:: Success/Fault ID

Success = FF (hex)
Fault ID = Any other value

Example:
HLI Refresh command

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	07	00	FF	00	00	10	03	61	B3

Explanation:
Zone ID = FFh (Open HLI)

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	03	00	FF	00	01	FF	10	03	43	10

Explanation:
Data Byte #1 = FFh (OK / Success)

NOTES:
After sending a cmd 7 to the Open HLI, all data is cleared from the device list in the HLI.
An immediate request on any zone will result in a invalid zone (hex C8) response.
See Appendix 6: Notes on Open HLI behaviours for cmd 7 behaviour details.

3.8. Create Display (8)

Command ID : 8 (08h)

Description: HOST requests for information to create a zone mimic display.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ----

HLI Response:

Command ID: 9

Data Length: 31 bytes

See Command ID #9 for details

Example:

Request for Zone Display information (from Zone 3)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	08	00	03	00	00	10	03	90	D1

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	09	00	03	00	1F	….(31 data bytes)…	10	03	CRC1	CRC2

Explanation:

Data Length = 31 bytes (1Fh = 31d)

Note:

The 31st byte of the data is not currently used.

3.9. Display Information (HLI Response) (9)

Command ID : 9 (09h)

Description: HLI sends Zone Display Information to Host.
This includes alarm levels and Location Name.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #8)

Data Length: 31 bytes

Data Format:

Byte No.	Description	Comment
1 – 2	Alert	Alert Alarm Level = (Byte 1 & 2) / 1000
3 – 4	Action	Action Alarm Level = (Byte 3 & 4) / 1000
5 – 6	Fire1	Fire1 Alarm Level = (Byte 5 & 6) / 1000
7 – 8	Fire2	Fire2 Alarm Level = (Byte 7 & 8) / 1000
9 – 30	Location Name	ASCII format
31		Not used

Note: Each reported alarm level is multiplied by 1000. Eg 0.050 is returned as 50.

The LaserCOMPACT has only two alarm levels: Pre-Alarm and Fire.
(For US markets, an additional “Alert” level is configurable)

LaserPLUS Alarm Levels	LaserCOMPACT Alarm Levels
Fire 2	(Not Applicable)
Fire 1	Fire
Action	Pre-Alarm
Alert	Alert (if configured, for US models only)

Table. Corresponding Detector Alarm Levels

Example:

Request for Zone Display information (from Zone 10 or 0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	08	00	0A	00	00	10	03	90	D1

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	09	00	0A	00	1F	….(31 data bytes)…	10	03	CRC1	CRC2

Explanation:
Data Length = 31 bytes (1Fh = 31d)

If Data Byte #1 = 0 & Data Byte #2 = 50h, then Alert Alarm Level = 0.080 (where 50h = 80).

If Data Bytes #9 to #30 are, for example:
…. 47 61 74 65 68 6F 75 73 65 20 ….
This corresponds to “Gatehouse….” In ASCII.

Note:
The 31st byte of the data is not currently used.

3.10. Update Display Status (10)

Command ID : 10 (0Ah)

Description: HOST requests for update on display status.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 1 Byte

Data Format: 0 to 4
0 = Sector 0 Status
1 = Sector 1 Status
2 = Sector 2 Status
3 = Sector 3 Status
4 = Sector 4 Status

HLI Response: Command ID: 11

Data Length: 6 bytes

See Command ID #11 for details.

Example 1:

Request for Display Status Update
from Zone 10 or 10h, sector 0

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	0A	00	0A	00	00	10	03	F6	0E

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data						DLE	ETX	CRC	
10	02	0B	00	0A	00	06	00	00	01	00	00	00	10	03	6C	19

Explanation:
Data Length = 6 bytes
Data Byte #1 = 0 & Data Byte #2 = 0, i.e. Smoke Level = 0.000 %/m.
Data Bytes #3 = 1, hence Detector Status = “OK”.

Example 2:

In the event of Fire,
Request for Display Status Update
from Zone 3, sector 2

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	0A	00	03	02	00	10	03	9E	1C

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data						DLE	ETX	CRC	
10	02	0B	00	03	48	06	00	F3	E2	66	00	00	10	03	96	0A

Explanation:
Sector ID = 48 i.e.

- 4 represents sector 2 i.e. reading sector 2
- 8 represents sector 1 i.e. First Alarm Sector (FAS) is sector 1

Data Length = 6 bytes
Data Byte #1 = 0 & Data Byte #2 = F3, i.e. Smoke Level = 0.243 %/m.
Data Byte #3 = E2, i.e. Alarm = Fire1, Isolated, Not OK
Data Byte #4 = 66, i.e. Faults = Zone, Urgent, Airflow, Filter

3.11. Current Display Status (11)

Command ID : 11 (0Bh)

Description: HLI reports the Current Display Status to the Host.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #10)
or Unsolicited Message

Data Length: 6 bytes

Data Format:

Byte No.	Description	Comment
1 – 2	Smoke Level	Smoke Level = (Byte 1 & 2) / 1000 e.g. 0.050 is reported as 50.
3	Alarm LEDs Status	See below.
4	Fault LEDs Status	See below.
5	Alarm Flash Status	*Future Implementation*
6	Fault Flash Status	*Future Implementation*

Byte 3 (Alarm LEDs Status):

Bit No.	7	6	5	4	3	2	1	0
Bit Name	Alert	Action	Fire 1	Fire 2	Major Fault	Minor Fault	Isolated	OK
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Note: The OK bit is not strictly an alarm bit. It actually signifies NO Faults present.

Byte 4 (Fault LEDs Status):

Bit No.	7	6	5	4	3	2	1	0
Bit Name	System	Zone	Urgent	Power	Network	Airflow	Filter	Other
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

1 indicates TRUE (Alarm or Fault Condition)
0 indicates FALSE

Note: Note: The LaserCOMPACT has only two alarm levels: Pre-Alarm and Fire. (For US markets, an additional “Alert” level is configurable)

LaserPLUS Alarm Levels	LaserCOMPACT Alarm Levels
Fire 2	(Not Applicable)
Fire 1	Fire
Action	Pre-Alarm
Alert	Alert (if configured, for US models only)

Table. Corresponding Detector Alarm Levels

Note for LaserSCANNER:

Sector-Specific Information
LaserSCANNER FD detectors support Sector-specific information. Using a non-zero Sector ID (from 1 to 4) will return the Sector Smoke Level, Sector Alarm level for the specified sector.

Using a Sector ID of zero (0) will return the average Zone Smoke Level, the FAS & the highest alarm bits in that zone. The smoke level corresponds to the average smoke level when all pipes are open. i.e. this value is not the smoke level for a particular sector.

Alarm LED Status Bits
The Alarm LED Status is latched in the Open HLI. The Host is expected to refresh the HLI to get the current alarm status.

The Alarm LED Status bits are best viewed as alarm event trigger bits. The HLI will set the bits when it first detects an alarm condition.

Important: When the LaserSCANNER stops scanning (and all pipes are open), the Alarm LED status bits will keep latching unless refreshed. See command 7 for refreshing methods.

The LaserSCANNER will stop scanning when either all alarm conditions have ceased and smoke levels have returned to normal OR in the exceptionally rare real-life situation when the smoke levels have remained constant over a period of time.

Important: See appendix 6 for VLS specific behaviours. In particular, the zone information may be different from the sector information. Zone information for VLS may not be valid until a reset has occurred.

Important: The status information for sectors 1 through sector 4 is NOT valid if there is NO FIRE ALARMs. The information for the sectors only gets updated when the scanner starts scanning. To get LED status when the detector is not in fire, send command 10 with sector number set to zero.

Example:

Request for Display Status Update (from Zone 10 or 0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	0A	00	0A	00	00	10	03	F6	0E

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data						DLE	ETX	CRC	
10	02	0B	00	0A	00	06	00	00	01	00	00	00	10	03	6C	19

Explanation:
Data Length = 6 bytes

Data Byte #1 = 0 & Data Byte #2 = 0, i.e. Smoke Level = 0.000 %/m.

Data Bytes #3 = 1, hence Detector Status = “OK”.

3.12. Get Fault Status (12)

Command ID : 12 (0Ch)

Description: HOST requests for current zone fault status.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ----

HLI Response: Command ID: 13

Data Length: Variable

See Command ID #13 for details.

Example:

Request for Current Zone Fault Status (from Zone 10 or 0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	0C	00	0A	00	00	10	03	AE	C3

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data		DLE	ETX	CRC	
10	02	0D	00	0A	00	02	01	27	10	03	EF	89

Explanation:
Data Length = 2 bytes

Data Byte #1 = 01 i.e. “Number of Faults =1”

Data Byte #2 = 27h (or 39 decimal), i.e. “Zone 10 has “Urgent High Air Flow – Pipe 4” fault

---

3.13. Current Fault Status (13)

Command ID : 13 (0Dh)

Description: HLI reports the Current Fault Status to the Host.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #12)
or Unsolicited Message

Data Length: Variable (up to 22 bytes)

Data Format:

Data Byte No.	Description	Comment
1	No. of Faults	Indicates No. of Faults in Fault List.
2 - 22	Fault List	Fault List (variable length). Each Fault is 1 byte

Note: See Appendix 2 for list of Faults & their corresponding IDs.

Example:

Request for Current Zone Fault Status (from Zone 10 or 0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	0C	00	0A	00	00	10	03	AE	C3

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data		DLE	ETX	CRC	
10	02	0D	00	0A	00	02	01	27	10	03	EF	89

Explanation:
Data Length = 2 bytes

Data Byte #1 = 01 i.e. “Number of Faults =1”

Data Byte #2 = 27h (or 39 decimal), i.e. “Zone 10 has “Urgent High Air Flow – Pipe 4” fault

---

3.14. Get Fault String (14)

Command ID : 14 (0Eh)

Description: HOST requests for fault string used by VESDA by providing the Fault ID number.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 1

Data Format: Fault ID (1 byte)

HLI Response: Command ID: 15

See Command ID #15 for details.

Example:

Request for VESDA Fault String for Fault ID of 23 (= 17h)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	0E	00	FF	00	01	17	10	03	36	AE

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data						DLE	ETX	CRC	
10	02	0F	00	FF	00	16	17	4C	61	73	65	72	10	03	F1	97

Explanation:

Data Length = 16h bytes (or 22 in decimal)

Data Byte #1 = 17h (HLI echoes the given Fault ID)

Data Byte #2 to #6 = 4Ch, …., 72h spells “Laser” etc.

3.15. Current Fault String (15)

Command ID : 15 (0Fh)

Description: HLI returns the Fault String associated with the Fault Number that was provided by the Host.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #15)

Data Length: 36 bytes

Data Format:

Data Byte No.	Description	Comment
1	Fault Number	Fault ID number as sent by HOST
2 – 36	Fault String	Fault String associated with Fault No.

Note: See Appendix 2 for list of Faults & their corresponding IDs.

Example:

Request for VESDA Fault String for Fault ID of 23 (= 17h)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	0E	00	FF	00	01	17	10	03	36	AE

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data						DLE	ETX	CRC	
10	02	0F	00	FF	00	16	17	4C	61	73	65	72	10	03	F1	97

Explanation:

Data Length = 16h bytes (or 22 in decimal)

Data Byte #1 = 17h (HLI echoes the given Fault ID)

Data Byte #2 to #6 = 4Ch, …., 72h spells “Laser” etc.

3.16. Update Airflow Status (16)

Command ID : 16 (10h)

Description: HOST requests for update on Zone Airflow status.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ----

HLI Response:
Command ID: 17

Data Length: 5 bytes

See Command ID #17 for details.

Note: Pipes #2 to #4 are not relevant for LaserCOMPACT Detectors, which have only one pipe.

Example:

Request for Zone Airflow Status from Zone 3

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	10	10	00	03	00	00	10	03	FB	F4

Note: An extra byte of 10h has been added to distinguish the Command ID byte (10h) from the <DLE> character. See section on Byte-Stuffing for details.

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data					DLE	ETX	CRC	
10	02	11	00	03	00	05	08	64	00	00	00	10	03	40	F3

Explanation:
Data Length = 5 bytes

Data Byte #1 = 08h (i.e. only Pipe 1 is in use)

Data Byte #2 = 64h (or 100 in decimal)
(i.e. Airflow = 100%).

3.16.1. Important note on Airflow monitoring

See important note, on the use of command ID 16 and resultant ID 17 response, in the notes after the command ID 17 section.

3.17. Current Airflow Status (17)

Command ID : 17 (11h)

Description: HLI reports the Zone Airflow Status to the Host.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #16)
or Unsolicited Message (only sent when in fault)

Data Length: 5 bytes

Data Format:

Data Byte No.	Description	Comment
1	Pipes in Use	Indicates which pipes are in use. See below for details.
2	Pipe 1 Airflow	Pipe 1 Airflow reading (%)
3	Pipe 2 Airflow	Pipe 2 Airflow reading (%)
4	Pipe 3 Airflow	Pipe 3 Airflow reading (%)
5	Pipe 4 Airflow	Pipe 4 Airflow reading (%)

Each pipe airflow is expressed as a percentage of normalised operating air flow. Eg. 100% is the Normalised Operating Air Flow.

Data Byte 1:

Bit No.	7	6	5	4	3	2	1	0
Bit Name	0	0	0	0	Pipe 1	Pipe 2	Pipe 3	Pipe 4
Value	0	0	0	0	0/1	0/1	0/1	0/1

where
1 = Pipe Open (In Use)
0 = Pipe Closed (Not in use)

Note: Pipes #2 to #4 are not relevant for LaserCOMPACT Detectors, which have only one pipe.

Example:

Request for Zone Airflow Status from a LaserCOMPACT in Zone 3

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	10	10	00	03	00	00	10	03	FB	F4

Note: An extra byte of 10h has been added to distinguish the Command ID byte (10h) from the <DLE> character. See section on Byte-Stuffing for details.

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data					DLE	ETX	CRC	
10	02	11	00	03	00	05	08	64	00	00	00	10	03	40	F3

Explanation:
Data Length = 5 bytes

Data Byte #1 = 08h (i.e. only Pipe 1 is in use)

Data Byte #2 = 64h (or 100 in decimal)
(i.e. Airflow = 100%).

Example:

Request for Zone Airflow Status from a LaserSCANNER in Zone 10 (0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	10	10	00	0A	00	00	10	03	AA	90

Note: An extra byte of 10h has been added to distinguish the Command ID byte (10h) from the <DLE> character. See section on Byte-Stuffing for details.

HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data					DLE	ETX	CRC	
10	02	11	00	0A	00	05	0F	61	5E	60	5E	10	03	C8	A4

Explanation:
Data Length = 5 bytes

Data Byte #1 = 0Fh (i.e. All four pipes are in use)

Data Byte #2 = 61h (or 97 in decimal,)
(i.e. Pipe #1 Airflow = 97%).

Data Byte #3 = 5Eh (or 94 in decimal,)
(i.e. Pipe #2 Airflow = 94%).

Data Byte #4 = 60h (or 96 in decimal,)
(i.e. Pipe #3 Airflow = 96%).

Data Byte #5 = 5Eh (or 94 in decimal,)
(i.e. Pipe #4 Airflow = 94%).

3.17.1. Important note on Airflow Percentage Monitoring

VESDAnet has not been designed for the continuous monitoring of airflow percentage. The airflow status is monitored against the threshold levels and the flow percentage set during the Normalisation process. Fault messages are created when the flow changes outside the Upper and Lower limits.

The flow percentage data, per pipe, is available and updated regularly when monitoring with a VESDA configuration tool such as VConfig Pro (VSW-005) or a hand held programmer (VHH-1000).

A power on or sign-on event by a VESDAnet device such as a detector will transmit the flow percentage rate with other alarm, fault and smoke reading information.

- The VHX-0300 HLI would send this data immediately to the monitoring software.
- The VHX-0310 HLI would only transmit this data when requested via a Command ID 16 request from the monitoring software.
- No other normal event will refresh the flow percentage to any type of open protocol HLI and on-to the monitoring software.

3.17.2. Recommendations on monitoring Airflow

1. Third party software monitoring tools should not attempt to view the actual VESDA detector flow rate data.
2. Command ID 16 from the monitoring software, is a request for the current airflow percentage.
3. The reply to the monitoring software, via a command ID 17, will be the last known airflow stored in the HLI cache memory.

- This data is not the actual current rate, but the last recorded flow rate.
- This rate could have been recorded at the last power on event or the last time a network log-in was provided by a VESDA configuration tool such as Vconfig Pro or a hand hel programmer.
- Therefore, its accuracy to actual flow rates at a given moment may be inaccurate.

4. Do not expect command ID 7 to update the monitoring software for all the VESDA network information.

- Command ID 7 is to refresh the HLI buffer.
- All previous information will be removed and replaced with smoke readings, fault and alarm status information.
- Previous sign-on messages that would have included flow percentages will be deleted.

3.18. HLI Enquiry (20)

Command ID : 20 (14h)

Description: HOST requests for HLI Information.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ---

HLI Response:
Command ID: 21

See Command ID #21 for details.

Example:

Request for HLI Information

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	14	00	FF	00	00	10	03	7C	14

Zone ID = FFh (Direct command to Open HLI)

Sample HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data			DLE	ETX	CRC	
10	02	15	00	FF	00	03	02	00	03	10	03	50	A1

Explanation:
Data Length = 3 bytes

Data Byte #1 to #3 = 02, 00, 03 (i.e. Open HLI Software Version Number 2.0.3)

3.19. HLI SignON (21)

Command ID : 21 (15h)

Description: HLI reports the its Software Version Number to HOST.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #20)
or Unsolicited Message

Data Length: 3 bytes

Data Format:

Data Byte No.	Description	Comment
1 – 3	Version No.	Open HLI Version No.

Example:

Request for HLI Information

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	14	00	FF	00	00	10	03	7C	14

Zone ID = FFh (Direct command to Open HLI)

Sample HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data			DLE	ETX	CRC	
10	02	15	00	FF	00	03	02	00	03	10	03	50	A1

Explanation:
Data Length = 3 bytes

Data Byte #1 to #3 = 02, 00, 03 (i.e. Open HLI Software Version Number 2.0.3)

3.20. Get Detector Type (22)

Command ID : 22 (16h)

Description: HOST requests for current Detector Type.

Message Flow: HOST → HLI

Message Type: Poll Command

Data Length: 0

Data Format: ---

HLI Response:
Command ID: 23 (17h)

Data Length: 1 byte

Returns: Current Detector Type

See Command ID #23 for details.

Note: If a non-existent zone is polled, the HLI will respond with a Command ID #3 message with a fault code. See Command ID #3 for details.

Example:

Request for Current Detector Type from Zone 10 (0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	16	00	0A	00	00	10	03	F2	5D

Sample HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	17	00	0A	00	01	03	10	03	42	FF

Explanation:
Data Length = 1 byte

Data Byte = 03 (i.e. There is a LaserPLUS FD Scanner in this Zone)

3.21. Current Detector Type (23)

Command ID : 23 (17h)

Description: HLI reports the current Detector type to HOST.

Message Flow: HLI → HOST

Message Type: Polled Response (to Command ID #22)

Data Length: 1 byte

Data Format:
Data Byte 1:

Byte Value	Device Type
1	LaserPLUS & LaserFOCUS
2	LaserPLUS FAS Scanner
3	LaserPLUS FD Scanner
4	LaserCOMPACT

Note: If a non-existent zone is polled, the HLI will respond with a Command ID #3 message with a fault code. See Command ID #3 for details.

Example:

Request for Current Detector Type from Zone 10 (0Ah)

Host Command String: (values shown in hex)

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	DLE	ETX	CRC	
10	02	16	00	0A	00	00	10	03	F2	5D

Sample HLI Response:

DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC	
10	02	17	00	0A	00	01	03	10	03	42	FF

Explanation:
Data Length = 1 byte

Data Byte = 03 (i.e. There is a LaserPLUS FD Scanner in this Zone)

Appendix 1: Protocol Summary

Message Format

Byte Order	DLE	STX	Command ID	Network ID	Zone ID	Sector ID	Data Length	Data	DLE	ETX	CRC
No. Bytes	1	1	1	1	1	1	1	[0-128]	1	1	2

Zero Data Length
If the Data Length is zero (0), then the Data Length field is omitted from the message. But the Data Length byte must still be included.

CRC Error Correction
The CRC used is CRC-16 (CCiTT). The first CRC byte is the Most Significant Byte obtained from a CRC calculation, which is performed in 16 bits (2 bytes)

The CRC includes everything from the first DLE to the ETX. Any Byte-stuffing character is not included in the CRC calculation.

See Appendix 3 for a comprehensive treatment of CRC as used in the VESDA communications.

DLE Byte Stuffing:
A DLE character is normally followed by either an STX, ETX or another DLE. If a DLE character is found in the data stream then an additional DLE character is inserted. The byte stuffing is only applied between the DLE STX and the DLE ETX.

Transmission parameters:

Baud Rate:	19200 baud
Parity:	None
Characters:	8 bits
Stop Bits:	1 stop bit.

Predefined characters:

STX	02Hex
ETX	03Hex
ACK	06Hex
NAK	15Hex
DLE	10Hex

ACK & NAK Messages
In Unsolicited (Peer-to-Peer) mode, the Open HLI will reply to any command messages sent from the Host with a single ACK (06h) or NAK (15h) character.

ACK characters are not used in the Master/Slave mode.

The HLI uses a Texas Instruments TL16c452 DUART that transmits the Least Significant Bit first. The format of data transmitted is big-endian ie Most Significant Byte first.

Command ID Summary

Command Name	Cmd ID	From → To	Description
Set Operation	1	HOST → HLI HLI → HOST	Set the operating message set. This is recorded in volatile memory
Get Operation	2	HLI → HOST	Get the operating message set.
Response	3	HOST → HLI HLI → HOST	Universal indicator of success/failure.
Zone Update	4	HOST → HLI	Request for an update of a Zone's status
Current Zone Status✸	5	HLI → HOST	A Zone's present status.
Remote Operation	6	HOST → HLI	Allows a zone to be Reset, Isolated or Silenced
HLI Refresh	7	HOST → HLI	Clear the data stored locally on the High Level Interface
Create Display	8	HOST → HLI	Request the information required to create a virtual Display
Display Info	9	HLI → HOST	The information required to create a virtual display.
Update Display status	10	HOST → HLI	Request for data required to update a virtual Display.
Current Display Status✸	11	HLI → HOST	A Display's status.
Update Fault Status	12	HOST → HLI	Update the fault status of a zone.
Current Fault Status✸	13	HLI → HOST	The current fault status of a zone.
Get Fault String	14	HOST → HLI	Get the fault string used by VESDA by providing the fault number.
Fault String	15	HLI → HOST	The fault string associated with a fault number.
Update Airflow Status	16	HOST → HLI	Update a zone's airflow status
Current Airflow Status✸	17	HLI → HOST	A zone's airflow status.
HLI Enquiry	20	HOST → HLI	Request HLI information
HLI SignOn	21	HLI → HOST	HLI data eg Version number
Get Device Type	22	HOST → HLI	Get a device type
Current Device Type	23	HLI → HOST	Current device type
Network Alarm Status Update Request	64	HOST → HLI	**Not applicable to Peer-to-Peer HLI. If Command 64 is inadvertently sent to a Peer-to-Peer HLI, code "CB" will be received by Host in a Cmd 3 response to indicate "INVALID" command**

✸ The HLI can be configured to send these messages as unsolicited messages to the HOST.

Appendix 2: Fault ID Codes

Fault ID (decimal)	Fault ID (hex)	Fault Description
0	0	Aspirator failed
1	1	Power supply battery failed
2	2	Comms fault on Port A
3	3	Detector PIC failure
4	4	Filter removed
5	5	Reference Detector lost
6	6	Power supply DC output failure
7	7	Software fault found
8	8	Aspirator speed control failure
9	9	Comms fault on Port B
10	A	LED card on display not found
11	B	Filter approaching capacity
12	C	Zone set-up = factory defaults
13	D	More than one Detector in zone
14	E	Flow sensors = factory defaults
15	F	AC mains failure
16	10	Relays not found
17	11	No comms from Detector
18	12	Too many Displays in zone
19	13	Flow sensor failure pipe 4
20	14	Flow sensor failure pipe 3
21	15	Flow sensor failure pipe 2
22	16	Flow sensor failure pipe 1
23	17	Laser signal too low
24	18	Cannot find Display/Relay
25	19	Comms on Port A while open-ended
26	1A	Comms on Port B while open-ended
27	1B	AutoLearn aborted
28	1C	Scanner option misconfigured
29	1D	Manufacturer setup corrupted
30	1E	Relay config = factory defaults
31	1F	Relay state = factory defaults
32	20	Detector clocks not synchronised
33	21	User list = factory defaults
34	22	Detector setup=factory defaults
35	23	Prgmr setup = factory defaults
36	24	Event log corrupt
37	25	Detector cal = factory defaults
38	26	Detector EEPROM failure
39	27	Urgent high airflow pipe 4
40	28	Minor high airflow pipe 4
41	29	Minor low airflow pipe 4
42	2A	Urgent low airflow pipe 4
43	2B	Urgent high airflow pipe 3
44	2C	Minor high airflow pipe 3
45	2D	Minor low airflow pipe 3
46	2E	Urgent low airflow pipe 3
47	2F	Urgent high airflow pipe 2
48	30	Minor high airflow pipe 2
49	31	Minor low airflow pipe 2
50	32	Urgent low airflow pipe 2
51	33	Urgent high airflow pipe 1
52	34	Minor high airflow pipe 1

53	35	Minor low airflow pipe 1
54	36	Urgent low airflow pipe 1
55	37	Power Supply ID No. duplicated
56	38	Clock failed
57	39	Display setup = factory defaults
58	3A	Too many auto scans in one week
59	3B	Fault test
60	3C	Battery Charger failure
61	3D	Power Supply fuse failure
62	3E	Power Supply PIC failure
63	3F	No comms from Power Supply
64	40	Power Supply output relay failed
65	41	Incompatible SW version detected
66	42	Status report period too short
67	43	Network delay too short
68	44	HLI setup = factory defaults
69	45	Ref. Detector has reference
70	46	LC Module reference misconfigured
71	47	Too many LC modules in Zone
72	48	LC Module setup = factory defaults
73	49	Filter clogged
74	4A	Flow too high for Detector
75	4B	Normalisation Failed
76	4C	Filter Replaced (not ACKed)
77	4D	Normalizing
78	4E	Too Many Zones detected by HLI
79	4F	Both numbers failed during a modem dial-out
80	50	Default flow zero-point
81	51	Default variant config
82	52	Urgent Fault Valve Closed - Pipe 1
83	53	Minor Fault Valve Open - Pipe 1
84	54	Urgent Fault Valve Closed - Pipe 2
85	55	Minor Fault Valve Open - Pipe 2
86	56	Urgent Fault Valve Closed - Pipe 3
87	57	Minor Fault Valve Open - Pipe 3
88	58	Urgent Fault Valve Closed - Pipe 4
89	59	Minor Fault Valve Open - Pipe 4

Note: A value of “**FF**” (hex) in the Fault ID field indicates “Success“.
A value of “**C8**” (hex) indicates “Invalid Zone”.
A value of “**C9**” (hex) indicates “Invalid Fault ID”.
A value of “**CB**” (hex) indicates “Invalid Command”.

Appendix 3: VESDA CRC Algorithm

Notation

In this document, unless otherwise noted, all numbers are in decimal format.

In this document, “Bit 0” is the least-significant bit of a byte. “Bit 7” is the most-significant bit of a byte.

	Most-significant bit							Least-significant bit
Bit:	7	6	5	4	3	2	1	0

Bit numbering is similar for multiple-byte values. Bit 15 is the most-significant byte of a two-byte value.

Glossary of Terms

CRC	“Cyclic Redundancy Check”
LSB	“Least-Significant Byte”
MSB	“Most-Significant Byte”
PIC	Microchip family of microcontrollers
UART	“Universal Asynchronous Receiver/Transmitter”

References

[1] "A Painless Guide To CRC Error Detection Algorithms" version 3, by Ross Williams, 19 August 1993. Available at: ftp://ftp.rocksoft.com/papers/crc_v3.txt

Algorithm

The CRC is a 16-bit CRC, having the following attributes:

- The generating polynomial is the CCITT polynomial $x^{16} + x^{12} + x^5 + 1$.
- The CRC register is initialised to zero.
- Each input byte is bit-reflected (so bit 7 becomes bit 0, bit 6 becomes bit 1, etc -- also known as little-endian bit order).
- The final CRC value is bit-reflected (so bit 15 becomes bit 0, bit 14 becomes bit 1, etc).

See reference [1] for a description of CRC concepts and algorithms. With reference to [1], the VESDA CRC algorithm can be specified as follows:

```
Name   : "CRC-16 VESDA"
Width  : 16
Poly   : 1021
Init   : 0000
RefIn  : True
RefOut : True
XorOut : 0000
Check  : 2189
```

Appendix 4: Technical Tips when using HLI in Peer-to-Peer operation mode

- It is not recommended that the Peer-to-Peer HLI is polled by the Host. If the Host requires to poll the Peer-to-Peer HLI, it is recommended that message rate as given in 1.12 Host/Open HLI polling rate limitation.

- It is recommended that at first power up, the Host send a Command ID 1 to the Peer-to-Peer HLI to initialise relevant parameters in the application code. The Host then waits for unsolicited Command ID 5.

- The Host is recommended to send Command ID 10 to obtain detail zone information if necessary. The HLI responses with Command ID 11 as described in this document.

Appendix 5: Software Implementations

CRC Implementation In C

The following C source code provides an implementation of the VESDA CRC algorithm.

```
typedef unsigned short uint16;      /* unsigned 16-bit integer */
typedef unsigned char uint8;        /* unsigned 8-bit integer */

/*-------------------------------------------------------------------
CalculateCRC

'ptr' points to the start of the block of data for which the CRC is
to be calculated.
'length' specifies the data block size in bytes
-------------------------------------------------------------------*/
uint16 CalculateCRC(const uint8 * ptr, const uint8 length)
{
    uint16  crc = 0;
    uint16  q;
    uint8   i;

    for ( i = 0; i < length; i++)
    {

        q = (crc ^ ptr[i]) & 15;

        crc = (crc >> 4) ^ (q * 4225);

        q = (crc ^ (ptr[i] >> 4)) & 15;

        crc = (crc >> 4) ^ (q * 4225);

    }

    return crc;
}
```

Notes for Non C/C++ Readers:

The “^” operator in C/C++ denotes Bitwise Exclusive-OR (XOR)

The “&” operator in C/C++ denotes Bitwise And (AND)

The “>>” symbol in C/C++ denotes Bitwise Shift Right.
For example “CRC >> 4” means Bitwise right shift the value of CRC by 4 bits. Zeroes are placed into the four left-most bits of CRC. This is equivalent to an integer division of CRC by 16 and storing the value back to CRC.

Alternative CRC Implementation In C

The following C source code provides an alternative implementation.

The implementation is very similar to the previous implementation, except that multiplications are replaced by a look-up into a 16-entry table of pre-calculated multiply results. This implementation may be more suited to a processor without a multiplication instruction, such as a PIC microcontroller.

```
typedef unsigned short uint16;      /* unsigned 16-bit integer */
typedef unsigned char uint8;        /* unsigned 8-bit integer */

uint16 CRCLookupTable[16] =         /* 16-entry look-up table (32 bytes) */
{
    4225*0,
    4225*1,
    4225*2,
    4225*3,
    4225*4,
    4225*5,
    4225*6,
    4225*7,
    4225*8,
    4225*9,
    4225*10,
    4225*11,
    4225*12,
    4225*13,
    4225*14,
    4225*15
};

/*---------------------------------------------------------------------
CalcTableCRC

'ptr' points to the start of the block of data for which the CRC is
to be calculated.
'length' specifies the data block size in bytes
---------------------------------------------------------------------*/
uint16 CalcTableCRC(const uint8 * ptr, uint8 length)
{
    uint16  crc = 0;
    uint16  q;
    uint8   i;

    for ( i = 0; i < length; i++)
    {

        q = (crc ^ ptr[i]) & 15;

        crc = (crc >> 4) ^ (CRCLookupTable[q]);

        q = (crc ^ (ptr[i] >> 4)) & 15;

        crc = (crc >> 4) ^ (CRCLookupTable[q]);

    }

    return crc;
}
```

Extracting the CRC Bytes

After completing a CRC calculation, a 16-bit unsigned integer CRC result is obtained. The two CRC bytes can be extracted as follows:

CRC_Most_Significant_Byte = CRC \ 256

CRC_Least_Significant_Byte = CRC MOD 256

The above example is in Visual Basic, where the "\" operator means Integer Division (or "DIV"), where the remainder is discarded. The MOD operator denotes Integer Modulus, which returns the Modulus of an Integer Division.

It may also be necessary to use the LONG type in Visual Basic to ensure that an unsigned integer is used in the CRC calculations. This type may also prevent arithmetic overflow errors.

The two CRC bytes can now be appended into an outgoing message string before transmitted to the Open HLI.

Appendix 6: Notes on Open HLI behaviours

Summary of communicating with the VHX-0300 HLI.

Command 7 behaviour

A cmd 7 clears the entire HLI buffer.
Any command sent immediately after this will respond with C8 indicating a “invalid zone”.
In detail, what actually happens with a cmd 7 in broadcast mode, is that having cleared the HLI buffer we need to wait until each zone has sent its periodic status message which the HLI picks up and re-populates the buffer. The order in which these updates appear is indeterminate i.e. they will appear in any order and thus re-populate the HLI buffer in any order. See next section for an exception in the case of VLS devices.

Two alternatives are available at this point.

- Wait for a period (approximately 3 seconds per device on network) before sending commands to the HLI.
- Repeat the required command for each zone, until the C8 goes away and valid data is returned.

The term “comms lost” should not be used in this context, as we still have communications, but there is no valid data to receive.

In any event the HLI will begin to send updated data to the host as soon as it gets them from devices. The exception being with scanners (see next section).

==========
Example sequence
==========

Send:
10 02 **07** 00 **FF** 00 00 10 03 61 B3
This clears the whole HLI buffer. The zone number should be 00 or FF.
Cmd 7 is clearing **all the data** from the HLI buffer.
Recv:
10 02 03 00 02 00 01 **FF** 10 03 B6 6C
Response to cmd 7 OK
Send:
10 02 **08** 00 **02** 00 00 10 03 9B 95
Send cmd 8 for zone 2
Recv:
10 02 03 00 02 00 01 **C8** 10 03 BC C7
C8 in response says that zone 2 is invalid.
This is because the zone 2 data has not yet
been updated since we cleared it
Send:
10 02 **08** 00 **02** 00 00 10 03 9B 95
Sending another cmd 8 too quickly
Recv:
10 02 03 00 02 00 01 **C8** 10 03 BC C7
This C8 will be received until the HLI buffer data for this zone
becomes valid again.
This in NOT a comms failure. The HLI is correctly reporting a non-existant zone, as the buffer has not yet received any info on this zone.
If the Host PC periodically sends the cmd 8, it will eventually get a cmd 9 response.

OpenHLI behaviour with LaserSCANNER

An exception to the above description is the behaviour of the HLI when there is a scanner device (VLS) on the network being monitored.

VLS (scanner) Message Sequences
The open HLI gets its data from Head Status messages from devices on the VESDAnet. However, once a scanner detects smoke and enters scan mode, head status messages from that scanner cease to arrive. Instead the scanner sends a ScanFirst message followed by ScanData messages (once for each pipe configured).

This will continue until the scanner leaves scan mode. It only does this when the smoke level goes below the threshold previously set. Then regular Head status messages will occur from the scanner. If the smoke level does not change, scanning will also stop and no updated messages will be received. Note that the scanning bit remains 'set' while alarms are active in the detector. Scanning bit is reset to '0' when the HLI is refreshed with command 7. Scanning bit only sets when the scanning a fresh.

Clearing VLS Status in HLI
Once the fault/alarm condition has been cleared, resetting the scanner will get the new state updated. A cmd 7 will also get the new state correctly, but will take longer as the cmd 7 has cleared all the device entries in the HLI. The reset may be accomplished by either the device reset button or from the third party monitoring software.

Status Latching
It is noted in this document that the open HLI does NOT latch alarms for the scanner. However, the faults are latched. Resetting the scanner will clear the faults.

It is recommended that the 3rd party software/infrastructure should latch the Alarms if required.

First Alarm Sector Latching & Clearing
The First Alarm Sector (FAS) value is also latched like the fault bits. It is recommended that when the smoke has decreased below Alert alarm level, the scanner detector is reset so that FAS value is updated along with the faults.

Refreshing the HLI after it has started scanning will clear the first alarm sector. The FAS value will remain cleared unless the scanning restarts. The scanning starts only when the smoke rises from below the alarm threshold and raises above any of the thresholds or when the scanner detector is reset while it is in fire alarm condition.

It is recommended that after a refresh, the scanner is reset using command 6, to get the FAS again.

Updated Data Delay
Note that it requires some time for the refreshed data from a device on the network to be available. This is at least 3 seconds per device, and the order of refreshing is indeterminate.

Retrieving Sector Information
Five sectors are defined in the HLI for the Scanner. Sectors 1, 2, 3 and 4 correspond to "only pipe 1 open", "only pipe 2 open", "only pipe 3 open" and "only pipe 4 open" respectively. Sector 0 corresponds to all pipes open, so it is the overall status of the scanner.

Command 10 is used to fetch sector information by specifying the sector number. However, the sector 1, 2, 3 and 4 information is not valid if scanner is not scanning. Sector 1 through 4 are only updated when the scanner is scanning because of significant changes in smoke.

DO NOT fetch sector 1, 2, 3 and 4 information if scanner is not scanning because the status information is not valid.

Behaviour when Moving Zones

When an existing zone in a VESDAnet network is re-numbered, it is essential that a cmd 7 is sent to the HLI. This will clear the entire HLI buffer which will then acquire the new zone number. Failure to do this will cause the old zone number to be retained in the HLI buffer.