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| NPOL |
| MANAGEMENT PACKET INTERFACE |
| USHUS-2 |
| Version: 1.0 |
| **SCH& CNH** |
| **4 October 2016** |

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# INTRODUCTION

This document describes the Interface between HMI and FE systems in Ushus-2. The Packet structure for control, acknowledgment & health packets of FEP system is retained as in MN 07.

The interface described here shall be applicable to the following subsystems of USHUS-2 (Number of subsystems and a sub-system identifier given alongside)

|  |  |  |
| --- | --- | --- |
| **Subsystem type** | **Number of subsystems in USHUS-2** | **USHUS-2 identifier** |
| Passive receivers FE | 7 Nos. | FE\_PSS-HSU1  FE\_PSS-HSU2  --  --  FE\_PSS-HSU7 |
| Passive SNS (TSS) | 1 No. | FE\_PSS-TSS\_HSU |
| Intercept Band-I SNS (ACTIVE WG)& Band-II SNS (OAS WG) FE | 1 No. | C8\_L3\_INT\_ASNS\_B1B2\_WG\_ACTOAS |
| Intercept Band-III SNS FE | 1 No. | C8\_L3\_DAC1\_B3 |
| OAS SNS FE | 1 No. | C5\_L1\_OAS\_DAC |

Table : FE Subsystems on Management Network in Ushus-2

All FEP subsystems receive control packets from HMIs on Management Network. ( Since HMIs are connected to Display Ethernet Network, the switch in the generator room routes the control packets from Display Network (DISP VLAN) to Management Network (MGMNT VLAN) ). Acknowledgment packets are sent back by these FEP subsystems to HMIs. Health packets communicated by FEP subsystems are received by the Fault Diagnosis Subsystem (FDS) of the Sonar system. All packets are communicated as IP multicast.

# PACKET STRUCTURE

Packet structure is shown below (including Ethernet, IP and UDP headers and FCS).

|  |  |
| --- | --- |
| **Fields** | **Size in bytes** |
| Ethernet Header | 14 |
| IP Header | 20 |
| UDP Header | 8 |
| NPOL Header | 128 |
| Control/ack data | Variable |
| FCS | 4 |

Table : Packet Structure

**MTU** of Ethernet packet (control/ack/health) shall be the **9000 bytes** including the Ethernet header.

# NPOL HEADER STRUCTURE FORMAT

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Field** | **Data Type** | **Description** |
| 1 | Packet Length | Unsigned Long | Length of the packet including header in bytes |
| 2 | Source | Unsigned Long | Project specific. Details given in sections 4.5 and 7.2 |
| 3 | Destination | Unsigned Long | Project specific. Details given in sections 4.5 and 7.2 |
| 4 | Category | Unsigned Long | Broadly identifying the packet category. Project specific. Details given in sections 4.5 and 7.2 |
| 5 | Sub-Category | Unsigned Long | Specific sub category under the broad category above. Project specific. Details given in sections 4.5 and 7.2 |
| 6 | Protocol | Unsigned Long | Indicates the protocol for communication. Options are:UDP = 1 |
| 7 | No of Objects | Unsigned Long | Number of objects of data communicated in this packet. Typically the value is 1 |
| 8 | Total number of fragments | Unsigned Long | Applicable if explicit fragmentation as part of custom middleware is planned. Usually as no explicit fragmentation is used, give value = 1. |
| 9 | Fragment number | Unsigned Long | Fragment number of this packet, if explicit fragmentation was adopted as part of field above, Usually as no explicit fragmentation is used, give value - 1. |
| 10 | Project ID & Flag | Unsigned Long | A fixed value specific to a project. It is obtained by left shifting one bit the project code (e.g., 0XEE for USHUS-2) and adding a flag value (1) to it. The field is more applicable in a multi sonar environment, where multiple project data are communicated. For all subsystems in this project this field would be 0x1DD (which is 0XEE\*2 +1). |
| 11 | Sequence No | Unsigned Long | 1. MAX  Each packet will have a sequence number incremented and will wrap when reaches the max allowed for Unsigned Long Word. Each packet from Src to Dst will have a running sequence number field. Sequence No will be unique for each packet with Category/Sub-category; however retransmitted or duplicate packets can have sequence number repeated. Dst can use this field to identify any packet misses. |
| 12 | Packet Flag | Unsigned Long | 0xAAAA5555  Use this fixed value. A unique identifier in the custom packet |
| 13 | Endianess | Unsigned Long | Endianess of data(1: Little Endian, 2: Big Endian). There is no toggling of endianess during runtime for an interface and is fixed as per interface document. It may be preferred to be Big Endian (2). |
| 14 | TimeStamp: Date | Unsigned Long | Date info packed with Byte 0: Day (1..31); Byte 1: Month (1..12) and  Byte 2,3: Year. |
| 15 | Time Stamp: Time | Unsigned Long | Hours, Min & Sec packed as follows  Byte 0: Sec (0..59)  Byte 1: Min (0..59)  Byte 2,3: Hours (0..23) |
| 16 | Time Stamp: Micro Seconds | Unsigned Long | Micro seconds if considered. (Use full word.) |
| 17 | Time Stamp: Spares | Unsigned Long | Reserved for future expansion. |
| 18 | Reserved field | Unsigned Long | Reserved for other use. Fill with zeroes. |
| 19 | Spare 1 | Unsigned Long | For future expansion |
| 20 | Spare 2 | Unsigned Long | For future expansion |
| 21 | Spare 3 | Unsigned Long | For future expansion |
| 22 | Spare 4 | Unsigned Long | For future expansion |
| 23 | Spare 5 | Unsigned Long | For future expansion |
| 24 | Spare 6 | Unsigned Long | For future expansion |
| 25 | Spare 7 | Unsigned Long | For future expansion |
| 26 | Spare 8 | Unsigned Long | For future expansion |
| 27 | Spare 9 | Unsigned Long | For future expansion |
| 28 | Spare 10 | Unsigned Long | For future expansion |
| 29 | Spare 11 | Unsigned Long | For future expansion |
| 30 | Spare 12 | Unsigned Long | For future expansion |
| 31 | Spare 13 | Unsigned Long | For future expansion |
| 32 | Checksum | Unsigned Long | This is a Computed value.  It is actually, 32-bit XOR of all 31 fields above in header. Checksum is only an overall check of the header (which may not find error if more than one bit error has occurred in the header). The individual fields have to be necessarily checked (even if checksum is correct) for their ranges and validity. Please note that as some of the fields of the header – sequence no, date, time etc, change in every packet, the checksum will be different in each packet. At present, the Checksum is an added validation mechanism and is not necessarily the only validation required for the packet. |

Table : NPOL Header

In Time stamp -Date field, Byte0 will hold Day, Byte 1 will hold Month, Byte 2 will hold LSB of YEAR and Byte 3 will hold MSB of the YEAR. For example 01 Mar 2011 will be stored as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Byte 3  (MSB of Year) | Byte 2  (LSB of Year) | Byte 1  (Month) | Byte 0  (Day) |
| 0x07 | 0xDB | 0x03 | 0x01 |

Table : Example Date Stamp representation

In Time stamp-Time field, Byte0 will hold Seconds, Byte 1 will hold minutes, Byte 2 will hold LSB of HOUR and Byte 3 will hold MSB of the HOUR. For example 10:20:30 will be stored as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Byte 3  (MSB of Hour) | Byte 2  (LSB of Hour) | Byte 1  (Minutes) | Byte 0  (Seconds) |
| 0x00 | 0x0A | 0x14 | 0x1E |

Table : Example Time Stamp representation

# Packing of Control, Acknowledgment and Health Data

This section describes the packing of data as objects, object identifiers and packing of objects in various control/acknowledgment packets.

## Object Header and Trailer

Each data communicated shall be packed as an ‘Object’. Data shall be prefixed by and Object Header (consisting of three fields) and suffixed by an Object Trailer (consisting of one field), as shown below:

|  |  |  |  |
| --- | --- | --- | --- |
| **SL NO** | **Fields** | **Size in bytes/Types** | **Description** |
| 1 | Object ID | 4/Unsigned long | Identifier of control/ack object |
| 2 | Object Length | 4/Unsigned long | Length of control/ack/health objects in bytes. |
| 3 | Object validity | 4/Unsigned long | In case of control packets, 1 indicates object is valid and 0 indicates object is invalid.  In case of ACK objects, if object is valid, this field should contain sequence number of control packet received for which the ACK is send. 0 indicates that ACK object is invalid. |
| 4 | Control/Ack data | Depends on control parameter group | Length of control packet selected |
| 5 | Object trailer | 4/Unsigned long | 32-bit XOR of objects header and control/ack data. |

Table : Object Header/Trailer

Object ID has the following general format

First byte: FE Control (0x20)

Second byte: Control (0x01), Ack (0x51)

Third byte: 0x01 – All, 0x02 – PSS, 0x03 – IB2, 0x04 – IB3, 0x05 – OAS, 0x06 – ACT, 0x07 – UCS

Fourth byte: running number

Object IDs for specific control and acknowledgments are explained below*.*

## Subsystem IDs

Subsystem IDs of HMIs and FDS are given below

|  |  |
| --- | --- |
| **Subsystem** | **ID (in Hex)** |
| HMI\_1\_C10 | 0x06 |
| HMI\_2\_C10 | 0x010 |
| HMI\_3\_C11 | 0x20 |
| HMI\_4\_C11 | 0x24 |
| SYS\_PC | 0x40 |
| REMOTE\_DISPLAY1 | 0x44 |
| FDS | 0x17 |

Table : U2 Subsytem IDS for HMIs & FDS

Subsystem ID and IP address (of Management port) of all FE systems are given below. The subsystem ID forms the last byte of the IP address (Netmask is 255.255.255.0).

|  |  |  |
| --- | --- | --- |
| **Subsystem** | **ID (in Hex)** | **IP address (Management port)** |
| FE\_PSS-HSU1 | 0xA0 | 192.238.2.160 |
| FE\_PSS-HSU2 | 0xA1 | 192.238.2.161 |
| FE\_PSS-HSU3 | 0xA2 | 192.238.2.162 |
| FE\_PSS-HSU4 | 0xA3 | 192.238.2.163 |
| FE\_PSS-HSU5 | 0xA4 | 192.238.2.164 |
| FE\_PSS-HSU6 | 0xA5 | 192.238.2.165 |
| FE\_PSS-HSU7 | 0xA6 | 192.238.2.166 |
| FE\_PSS\_TSS\_HSU | 0xA7 | 192.238.2.167 |
| C8\_L3\_DAC1\_B3 | 0x86 | 192.238.2.134 |
| C8\_L3\_INT\_ASNS\_B1B2\_WG\_ACTOAS | 0x87 | 192.238.2.135 |
| C5\_L1\_OAS\_DAC | 0x66 | 192.238.2.102 |

## Control Object ID

|  |  |
| --- | --- |
| **Object (Short object name in brackets)** | **Object ID** |
| System parameters (SYS) | 0x20010101 |
| Gain parameters for PSS (GAIN-PSS) | 0x20010201 |
| OAS transmission parameters (OAS-TX) | 0x20010502 |
| Active transmission parameters (ACT-TX) | 0x20010601 |

Table : ObjectIDs for Control messages

## \*Object IDs shown in red color are not used in Ushus-2 as of now.

## AcknowledgementObjectID

|  |  |
| --- | --- |
| Object (Short object name in brackets) | Object ID |
| System parameter ack (SYS-ACK) | 0x20510101 |
| Gain parameters for PSS ack (GAIN-PSS-ACK) | 0x20510201 |
| OAS transmission parameters (OAS-TX-ACK) | 0x20510502 |
| Active transmission parameters (ACT-TX-ACK) | 0x20510601 |

## Control and Acknowledgement data packets

**Control packets**

Each control packet consists of a control object and is multicast to the specified address and port. Front-end subsystems interested in receiving the control shall join the multicast address/port.

Control packets are transmitted by any of the Ushus-2 HMIs.

Details of fields in different control packets are shown below:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Fields in packet header  (Project specific fields) | | | | | | |
| Destination | Objects packed | Multicast group address/  Unicast address | Port number | Src | Dest | Cat | Sub-cat |
| All subsystems | SYS | 239.238.2.1 | 52501 | Ref.  Table | 0x201 | 0x20 | 0x01 |
| FE\_PSS\_HSU1 to FE\_PSS\_HSU7 | GAIN-PSS | 239.238.2.3 | 52503 | Ref.  Table | 0x203 | 0x20 | 0x02 |
| C8\_L3\_DAC2\_B2\_OASWG | OAS-TX | 239.238.2.5 | 52505 | 0x18 | 0x205 | 0x20 | 0x06 |
| FE\_PSS\_HSU1,  FE\_PSS\_HSU2,  --  --  FE\_PSS\_HSU7,  C8\_L3\_DAC2\_B2\_OASWG | ACT-TX | 239. 238.2.7 | 52507 | 0x18 | 0x207 | 0x20 | 0x07 |

**Acknowledgement packets**

All FE subsystems receiving a control packet shall transmit back the acknowledgement packet to the specified multicast address/port. FCI shall check the acknowledgement received; if the acknowledgement is negative or if acknowledgement is not received within a timeout period, the FCI shall re-transmit the control packet with the same sequence number in the header.

All acknowledgement packets are received by the FCI. ID of FCI is 0x18. “Src” field of the acknowledgement packet shall be filled with respective subsystem IDs.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Fields in packet header  (Project specific fields) | | | | | | |
| Source | Objects packed | Multicast group address | Port number | Src | Dest | Cat | Sub-cat |
| All subsystems | SYS-ACK | 239.238.2.2 | 52502 | 0xA0 to 0XA7;  0x86 0x87 0x66 | 0x202 | 0x20 | 0x51 |
| FE\_PSS\_HSU1 to FE\_PSS\_HSU7 | GAIN-PSS-ACK | 239.238.2.4 | 52504 | 0xA0 to 0XA7; | 0x204 | 0x20 | 0x52 |
| C8\_L3\_DAC2\_B2\_OASWG | OAS-TX-ACK | 239.238.2.6 | 52506 | 0x86 | 0x206 | 0x20 | 0x56 |
| FE\_PSS\_HSU1,  FE\_PSS\_HSU2,  --  --  FE\_PSS\_HSU7,  C8\_L3\_DAC2\_B2\_OASWG | ACT-TX-ACK | 239.238.2.8 | 52508 | 0x87 | 0x208 | 0x20 | 0x57 |

# CONTROL PARAMETERS GROUP STRUCTURE DETAILS

**Note:** The Front End units may at times receive a duplicate control packet (with the same sequence number in header) due to the retransmissions from the FCI as well as the reconfiguration of network paths. Front End unit should accept only unique control packets. It shall reject duplicate control packets.

## System parameters

Structure size: 16 words (64 bytes)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Values & meaning** | **Remarks** |
| 1 | Mode of operation | 4/Unsigned long | System = 0x01  Analog SNS = 0x02  Analog test mode = 0x03  Digital SNS = 0x04  Replay = 0x05  Training Simulator Mode =0x06  Beam Pattern Check Mode= 0x07 | Same for PSS,IS,OAS& SNS systems.  For PSS, IS, OAS receivers:  Sent data in modes 0x01, 0x02, 0x03 and 0x07 only; Stop data in modes 0x04, 0x05 and 0x06. |
| 2 | Test pattern selection | 4/Unsigned long | Zero pattern = 0x01  Increment = 0x02  Sine wave = 0x03 | Same for PSS,IS,OAS& SNS systems.  Valid for 0x03 Mode of operation |
| 3 | Spare[14] | 56/Array of 14 Unsigned longs |  |  |
|  |  |  |  |  |

## Gain Parameters (same for PSS, IS,OAS receiver systems)

Structure size: 16 words (64 bytes)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Values & meaning** | **Remarks** |
| 1 | Gain mode selection | 4/Unsigned long | Common AGC(Int) = 0x01  Individual AGC(Int) = 0x03  MGC = 0x06 | Default mode :0x01  Same for PSS,IS,OAS Receiver systems |
| 2 | Gain word | 4/Unsigned long | Receives 2 bytes of gain word (Hex) common for all channels | Same for PSS –RX,IS BII-RX,IS BIII-RX (4 channels ),OAS - RX  Receiver systems  Valid for gain mode 0x06  Corresponding gain in dB may be displayed at HMI.  dB to Hex conversion formula  Ref:Appendix’B’  If gain mode selection is 0x01 or 0x03, this field is 0x00 |
| 3 | AGC ref level | 4/Unsigned long | 0.125 Vrms = 0x01  0.25 Vrms = 0x02(default)  0.5 Vrms = 0x03 | If gain mode selection is 0x06, this field is 0x00 |
| 4 | Spare[13] | 52/Array of 13 Unsigned longs | Spare field |  |

***Note:*** *Gain control packet to IB3-RX will have* ***three gain objects*** *corresponding to BIII, B1-AFT and B2-AFT. The data contained in each of these objects will have the structure mentioned above. The object IDs are specified in* 4.3 *().*

## Active Transmission Parameters

Structure size: 16 words (64 bytes)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Values & meaning** | **Remarks** |
| 1 | Ping | 4/Unsigned long | Off – 0x01  On – 0x02 | Transmit On/Off. Transmit on to be taken only once at reception of control packet. |
| 2 | Pulse Width | 4/Unsigned long | 0x01-Low  0x02-Medium  0x03-High | 128 ms  256 ms  512 ms |
| 3 | Pulse Type | 4/Unsigned long | CW-0x01  LFMUP-0x02  LFMDN-0x03 | 3.5 Khz  3.25 – 3.75 KHz  3.75 – 3.25 KHz |
| 4 | Source Level | 4/Unsigned long | 0x01-Low  0x02-Medium  0x03-High  0x04 – Very High  0x05 - Max | -12 db  -9  -6  -3  0 |
| 5 | Transmit mode | 4/Unsigned long | 0x01-Normal  0x02-TEST – Auto  0x03- Test- Manual | Test mode : 2 options. Auto / manual  Auto: 5ms cw without shading. 1/4th of src level. PRI: 10sec. To be stopped when going to Normal or test manual.  Manual: 20 ms pulse same at set src level. On Transmit from HMI. |
| 6 | Override PA Disable | 4/Unsigned long | 0x00-OFF  0x01-ON | Override the ‘PA Disabled’ condition which occurs due to Overload or Over Temperature, and transmit.  ( Battle shot ) |
| 7 | Spare[10] | 40/Array of 10 Unsigned longs |  |  |

## OAS Transmission Parameters

Structure size: 16 words (64 bytes)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Values & meaning** | **Remarks** |
| 1 | OAS mode | 4/Unsigned long | 0x01 – NORMAL  0x02 – TEST | Test: Analog sns .  TxC is idle during Test Mode. |
| 2 | Transmission mode | 4/Unsigned long | 0x01-SCAN-  0x02-PORT-  0x03-AHEAD-  0x04-STBD | Current sector is updated to Receiver on start of each transmission. |
|  | Range scale | 4/Unsigned long | 0x01-1 Kilometer  0x02-2 Kilometer  0x03-4 Kilometer |  |
| 4 | Pulse type | 4/Unsigned long | 0x01-CW  0x02-LFM - UP | CW: 37 Khz  LFM: 36 – 38 Khz. In 72 steps. |
| 5 | Pulse\_width | 4/Unsigned long | 0x01-LOW  0x02-HIGH | LOW: 10 ms  HIG: 20 ms |
| 6 | Source level | 4/Unsigned long | 0x01-LOW  0x02-MED  0x03-HIGH | -6 dB  -3 dB  0 dB |
| 7 | Transmission | 4/Unsigned long | 0x01-OFF (Stop)  0x02-ON (Start) |  |
| 8 | Test beam | 4/Unsigned long | 0x0000abcd  Where nibbles ‘cd’ indicate the horizontal beam number (1 to 49) and nibbles ‘ab’ indicate the vertical beam selection (1 to 3). Values are:  0x0101 to 0x0131,  0x0201 to 0x0231,  0x0301 to 0x0331 | Not used in U2  To be used in TEST mode only. |
| 9 | Waveform mode | 4/Unsigned long | 0x01 – Pulsed  0x02 – Continuous | Not in U2 |
| 10 | Transmit shading | 4/Unsigned long | 0x01 – OFF  0x02 – ON | Default OFF |
| 11 | Spare[6] | 24/Array of 6 unsigned longs | Spare field |  |

# ACKNOWLEDGE PACKET FROM FEP CONTROLLER

Incase if host sends the not supported or pending options, the following error value will be returned from FEP system

Error value = 0x000000EE indicates the sent command is **Not supported** in current version

Error value = 0x000000DD indicates the sent command **implementation is pending**

Error value 0x000000FF indicates card write error

Error value 0x000000CC indicates Out of range Field From FCI

**ABBREVIATIONS**

ack = acknowledgement

csv = current set value

## System parameters acknowledgement

Structure size: 32 words (128 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Remarks** |
| 1 | Status[16] | 4/Unsigned long | Value 0x00000000 : success  Value 0x000000FF : indicates card write error  Value 0x000000CC : Out of range Field  Value 0x000000EE : **Not supported** in current version  Value 0x000000DD : **implementation is pending** |
| 2 | Mode of operation csv | 4/Unsigned long | Returns current set value. |
| 3 | Test pattern selection csv | 4/Unsigned long | Returns current set value. |
| 4 | Spare[14] | 56/Array of 14 Unsigned long | Value 0x00000000 |

## Gain parameter acknowledgement

Structure size: 32 words (128 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Remarks** |
| 1 | Status[16] | 4/Unsigned long | Value 0x00000000 : success  Value 0x000000FF : indicates card write error  Value 0x000000CC : Out of range Field From FCI  Value 0x000000EE : **Not supported** in current version  Value 0x000000DD : **implementation is pending** |
| 2 | Gain mode selection csv | 4/Unsigned long | Returns current set value. |
| 3 | Gain word csv | 4/Unsigned long | Returns current set value. |
| 4 | AGC ref lvlcsv | 4/Unsigned long | Returns current set value. |
| 5 | Spare[13] | 52/Array of 13 Unsigned long | Value 0x00000000 |

***Note:*** *Gain acknowledgment packet from IB3-RX will have* ***three gain acknowledgment objects*** *corresponding to BIII, B1-AFT and B2-AFT. The data contained in each of these objects will have the structure mentioned above. The object IDs are specified in* 4.4 *(*AcknowledgementObjectID*).*

## Active transmission parameters acknowledgement

Structure size: 32 words (128 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Remarks** |
| 1 | Status[16] | 4/Unsigned long | Value 0x00000000 : success  Value 0x000000FF : indicates card write error  Value 0x000000CC : Out of range Field From FCI  Value 0x000000EE : **Not supported** in current version  Value 0x000000DD : **implementation is pending** |
| 2 | Ping | 4/Unsigned long | Returns current set value. |
| 3 | Pulse Width | 4/Unsigned long | Returns current set value. |
| 4 | Pulse Type | 4/Unsigned long | Returns current set value. |
| 5 | Source Level | 4/Unsigned long | Returns current set value. |
| 6 | Transmit mode | 4/Unsigned long | Returns current set value. |
| 7 | Override PA Disable | 4/Unsigned long | Returns current set value. |
| 9 | Spare[10] | 40/Array of 10Unsigned longs | Value 0x00000000 |

## 

## OAS transmission parameters acknowledgement

|  |  |  |  |
| --- | --- | --- | --- |
| **SL NO** | **Field name** | **Size in bytes/Types** | **Remarks** |
| 1 | Status[16] | 4/Unsigned long | Value 0x00000000 : success  Value 0x000000FF : indicates card write error  Value 0x000000CC : Out of range Field From FCI  Value 0x000000EE : **Not supported** in current version  Value 0x000000DD : **implementation is pending** |
| 2 | OAS mode | 4/Unsigned long | Returns current set value. |
| 3 | Transmission mode | 4/Unsigned long | Returns current set value. |
| 4 | Range scale | 4/Unsigned long | Returns current set value. |
| 5 | Pulse type | 4/Unsigned long | Returns current set value. |
| 6 | Pulse width | 4/Unsigned long | Returns current set value. |
| 7 | Source level | 4/Unsigned long | Returns current set value. |
| 8 | Transmission | 4/Unsigned long | Returns current set value. |
| 9 | Test beam | 4/Unsigned long | Returns current set value. |
| 10 | Waveform mode | 4/Unsigned long | Returns current set value. |
| 11 | Transmit shading | 4/Unsigned long | Returns current set value. |
| 12 | Spare[6] | 24/Array of 6 unsigned longs | Value 0x00000000 |

# Health Data Packets from FEP Controllers

*First byte: Health data (0xF0)*

*Second byte: FE health (0x10)*

*Third byte: 0x01 – Type I PCB, 0x02 – Type II PCB, …*

*Fourth byte: running number*

Type I PCBs are:

PSS RX (7), PSS-SNS (1), IB3-SNS(1), OAS-SNS (1), CTRL (IB1-SNS , ACT\_WFG) (IB2-SNS , OAS\_WFG)

## Health Data

All receivers and analog SNS subsystems shall provide the health data objects given below. For the case of Health data these shall be designated as Type-I subsystems. The subsystems are (number of units given in brackets): PSS RX (7), PSS-SNS (1), IB2-SNS (1), IB3-SNS (1) and OAS-SNS (1).

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl.No.** | **Type of health** | **Short ID** | **Object ID** |
| 1 | FEP Identification | FEP-ID | 0xF0100101 |
| 2 | System health status | SYS-STAT | 0xF0100102 |
| 3 | Card temperatures | CARD-TEMP | 0xF0100103 |
| 4 | Card voltages | CARD-VOLT | 0xF0100104 |
| 5 | Channel health | CHNL-HLTH | 0xF0100105 |
| 6 | Network health | NW-HLTH | 0xF0100106 |
| 7 | Gain health | GAIN-HLTH | 0xF0100107 |

All TXC subsystems shall provide the health data objects given below. For the case of Health data these shall be designated as Type-II subsystems. The subsystems are (number of units given in brackets): OAS-TXC (1), ACT-TXC (1)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl.No.** | **Type of health** | **Short ID** | **Object ID** |
| 1 | FEP Identification | FEP-ID | 0xF0100201 |
| 2 | System health status | SYS-STAT | 0xF0100202 |
| 3 | Card temperatures | CARD-TEMP | 0xF0100203 |
| 4 | Card voltages | CARD-VOLT | 0xF0100204 |
| *Channel health not given by this PCB* | | | |
| 5 | Network health | NW-HLTH | 0xF0100206 |
| *Gain health not given by this PCB* | | | |
| 6 | Power Amplifier status | PW-STAT | 0xF0100208 |

Health data objects shall be packed with Object header and trailer as described in section 4.1 (). Each FEP subsystem shall pack all its health data objects in a single packet addressed to a multicast group.

Health objects provided by various subsystems are indicated in the table below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl.No.** | **Health objects** | Type I Subsystems | | | | |
|  |  | PSS-RX | PSS-SNS, | IB3-SNS | OAS-SNS | CTRL,  IB1-SNS/ ACT-WFG,  B2-SNS/OAS-WFG |
| 1 | FEP Identification | √ | √ | √ | √ | √ |
| 2 | System health status | √ | √ | √ | √ | √ |
| 3 | Card temperatures | √ | √ | √ | √ | √ |
| 4 | Card voltages | √ | √ | √ | √ | √ |
| 5 | Channel health | √ | N/A | N/A | N/A | N/A |
| 6 | Network health | √ | √ | √ | √ | √ |
| 7 | Gain health | √ | N/A | N/A | N/A | N/A |
| 8 | Power amplifier status | N/A | N/A | N/A | N/A | √ |

## Health Data Packets

Health data packets shall be transmitted to the specified multicast address every **10 seconds**. “Src” field of the acknowledgement packet shall be filled with respective subsystem IDs.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Fields in packet header  (Project specific fields) | | | | | | |
| Source | Objects packed | Multicast group address | Port number | Src | Dest | Cat | Sub-cat |
| PSS-RX (7 Nos.) | All health objects | 239.238.2.48 | 52548 | 0xA0 to 0xA6 | 0x230 | 0xF0 | 0x10 |
| PSS-SNS | All health objects | 239.238.2.48 | 52548 | 0xA7 | 0x230 | 0xF0 | 0x10 |
| FE\_ISB1B2\_SNS\_ACT\_OAS\_WFG | All health objects | 239.238.2.48 | 52548 | 0xA8 | 0x230 | 0xF0 | 0x10 |
| IB3-SNS | All health objects | 239.238.2.48 | 52548 | 0xA9 | 0x230 | 0xF0 | 0x10 |
| OAS-SNS | All health objects | 239.238.2.48 | 52548 | 0xAA | 0x230 | 0xF0 | 0x10 |

**Health Objects for Type-I PCBs**

## FEP Identification - Type I PCB

|  |  |  |  |
| --- | --- | --- | --- |
| SL NO | Field name | Size in bytes/Types | Remarks |
| 1 | FPGA software version | 4/unsigned long | Format to be specified |
| 2 | Syscon board revision | 4/unsigned long | Format to be specified |
| 3 | PPC software version | 4/unsigned long | Format to be specified |
| 4 | PTP software version | 4/unsigned long | Format to be specified |
| 5 | ADC/DAC card version[8] | 32/Array of 8 unsigned longs | Format to be specified |
| 6 | ADC /DAC card revision[8] | 32/Array of 8 unsigned longs | Format to be specified |
| 7 | Cage ID | 4/unsigned long | Format to be specified  HSU1 – 0x01  HSU2 – 0x02  HSU3 – 0x03  HSU4 – 0x04  HSU5 – 0x05  HSU6 – 0x06  HSU7 – 0x07  TSS\_SNS HSU – 0x08  FE\_ISB1B2\_SNS\_ACT\_OAS\_WFG – 0x09  FE\_IB3\_SNS - 0x0A  OAS\_SNS - 0x0B |
| 8 | Spare[11] | 44/Array of 11 unsigned longs |  |

## System health status - Type I PCB

PSS Receiver : Health status of 3 PRE AMP, 3 ADC, 1 controller card.

PSSSNS FE : Health status of 3 DAC card, 1 controller card

FE\_ISB1B2\_SNS\_ACT\_OAS\_WFG : Health status of 1 controller card, 2 DAC(B1+ACT\_WFG & B2+OAS\_WFG)

IS BAND III SNS FE : Health status of 1 controller card

OAS-SNS : Health status of 8 DAC card, 1 controller card

Structure size: 32 words (128 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| SL No | Field name | Size in bytes/Type | Remarks |
| 1 | Sysconcard status | 4/unsigned long | Detailed status in Appendix ‘A’ included in this document |
| 2 | ADC/DAC card status[8] | 32/Array of 8 unsigned longs | Detailed status in Appendix’ A’ included in this document |
| 3 | Preamp card status[8] | 32/Array of 8 unsigned longs | Detailed status in Appendix ‘A’ included in this document |
| 4 | Master/Slave | 4/unsigned long | PSS:  Master :0x01  Slave:0x00  IS BII:0x01  IS BIII:0x01  OAS:0x01 |
| 5 | Sync/Out of sync | 4/unsigned long | PSS: 0x01  IS BII:0x01  IS BIII:0x01  OAS:0x01 |
| 6 | Sys Mode Echo | 4/unsigned long | Detailed status in Sec 5.1 Sl. No.1 |
| 7 | Spares[12] | 48/Array of 12 unsigned longs |  |

## Temperature health object structure - Type I PCB

PSS Receiver : Health status of 3 PRE AMP, 3 ADC, 1 controller card.

PSSSNS FE : Health status of 3 DAC card, 1 controller card

FE\_ISB1B2\_SNS\_ACT\_OAS\_WFG : Health status of 1 controller card, 2 DAC(B1+ACT\_WFG & B2+OAS\_WFG)

IS BAND III SNS FE : Health status of 1 controller card

OAS-SNS : Health status of 8 DAC card, 1 controller card

### Temperature health

Structure size: 8 words (32 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | Field name | Size in bytes/Type | Remarks |
| 1 | Card ID | 4/unsigned long | Card Identifier |
| 2 | Validity flag | 4/unsigned long | Intended for indicating data validity. If flag is 1 data is valid, if flag is 0 data is invalid |
| 3 | Temp1 | 4/signed long | External top edge temperature |
| 4 | Temp2 | 4/signed long | External bottom edge temperature |
| 5 | Temp3 | 4/signed long | External middle edge temperature |
| 6 | Spare[3] | 12/Array of 3 unsigned longs | Spare fields |

Note: Temperature health packet has a hex value in the respective field. The corresponding decimal value/100 gives the temp in degC.Eg:HeX value 0X0E70.Corresponding temp value=dec(e70)/100=36.96degC

Warning may be indicated beyond 70 degC

### Temperature health object

Object size varies depending on the subsystem to which the controls are sent. Validity flag will indicate the validity of data given by the system. If card is not present then the particular card structure will be filled with dummy value of zero.

Structure size: 160 words (640 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | Field name | Size in bytes/Type | Remarks |
| 1 | Number of ADC/DAC cards | 4/unsigned long | Actual number of cards present in system |
| 2 | Temperature health record for ADC/DAC card 1 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 3 | Temperature health record for ADC/DAC card 2 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 4 | … | … | … |
| 5 | Temperature health record for ADC/DAC card 8 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 6 | Number of Pre-amp cards | 4/unsigned long | Actual number of cards present in system |
| 7 | Temperature health record for Pre-amp card 1 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 8 | Temperature health record for Pre-amp card 2 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 9 | … | … | … |
| 10 | Temperature health record for Pre-amp card 8 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 11 | Number of Controller cards | 4/unsigned long | Actual number of cards present in system. |
| 12 | Temperature health record for Controller card 1 | Structure “Temperature Health” | If card is not present give Card ID as 0xCD |
| 13 | Spares[21] | 84/Array of 21 unsigned longs | Spare field |

## Power supply health object structure - Type I PCB

PSS Receiver : Health status of 3 PRE AMP, 3 ADC, 1 controller card.

PSSSNS FE : Health status of 3 DAC card, 1 controller card

FE\_ISB1B2\_SNS\_ACT\_OAS\_WFG : Health status of 1 controller card, 2 DAC(B1+ACT\_WFG & B2+OAS\_WFG)

IS BAND III SNS FE : Health status of 1 controller card

OAS-SNS : Health status of 8 DAC card, 1 controller card

### Power supply health for ADC/DAC card

Structure size: 16 words (64 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | Field name | Size in bytes/Type | Remarks |
| 1 | Card ID | 4/unsigned long | Card Identifier |
| 2 | Validity flag | 4/unsigned long | Intended for indicating data validity. If flag is 1 data is valid, if flag is 0 data is invalid |
| 3 | Power supply 3.3 V ADC/DAC card | 4/signed | Main digital power supply  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 4 | Power supply 2.5 V ADC/DAC card | 4/signed | FPGA power supply  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 5 | Power supply 1.0 V ADC/DAC card | 4/signed | FPGA internal power supply  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 6 | Power supply 5.0 V ADC/DAC card | 4/signed | Analog power supply  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 7 | Power supply -5.0 V ADC/DAC card | 4/signed | Analog power supply  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 8 | Power supply 1.8 V ADC/DAC card | 4/signed | ADC power supply  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 9 | Power supply 1.2 V ADC/DACcard | 4/signed | Analog power supply for GTP transmitters and receivers  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 10 | Power supply 1.2 V PLL ADC/DAC card | 4/signed | Analog power supply for GTP PLL  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 11 | Power supply 1.0 V GTP ADC/DAC card | 4/signed | Analog power supply for GTP  If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 12 | Spare[5] | 20/Array of 5 unsigned longs | Spare fields |

Note: Power supply value = power supply value in hex converted to dec/100

### Power supply health for controller card

Structure size: 8 words (32 bytes)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sl. No. | Field name | Size in bytes/Type | Remarks |  |
| 1 | Card ID | 4/unsigned long | Card Identifier |  |
| 2 | Validity flag | 4/unsigned long | If flag is 1, then card is present and data to be used; if 0, then card is not present |  |
| 3 | Power supply 3.3 V controller card | 4/signed | Main power supply | If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 4 | Power supply 2.5 V controller card | 4/signed | FPGA, DDR,PHY,PPC power supply | If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 5 | Power supply 1.0 V controller card | 4/signed | PHY and FPGA internal power supply | If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 6 | Reserved | 4/unsigned long | Reserved | Reserved field |
| 7 | Power supply 1.5 V controller card | 4/signed | PPC power supply | If the supply voltage is not relevant to the particular subsystem , fill the value as 0xBBBBBBBB |
| 8 | Spare | 4/unsigned long | Spare |  |

The operational values of various power supplies are as follows.

3.3 V – between 3.19V and 3.4V (both inclusive)

2.5V – between 2.37V and 2.65V (both inclusive)

1.0V – between 0.95V and 1.05V (both inclusive)

+5.0V – between 4.75V and 5.2V (both inclusive)

-5.0V – between -4.75V and -5.2V (both inclusive)

1.8V – between 1.65V and 1.95V (both inclusive)

1.2V – between 1.14V and 1.26V (both inclusive)

1.2V – between 1.14V and 1.26V (both inclusive)

1.0V – between 0.95V and 1.05V (both inclusive)

1.5V – between 1.35 V and 1.65 V (both inclusive)

Voltage values outside these limits shall be treated as faulty.

### Power supply health object

Object size varies depending on the subsystem to which the controls are sent. Validity flag will indicate the presence of a card in a system.

Structure size: 160 words (640 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | Field name | Size in bytes/Type | Remarks |
| 1 | Number of ADC/DAC cards | 4/unsigned long | Actual number of cards present in system |
| 2 | Power supply health record for ADC/DAC card 1 | Structure “Power supply health for ADC/DAC card” | If card is not present give Card ID as 0xCD |
| 3 | Power supply health record for ADC/DAC card 2 | Structure “Power supply health for ADC/DAC card” | If card is not present give Card ID as 0xCD |
| 4 | … | … | … |
| 5 | Power supplyhealth record for ADC/DAC card 8 | Structure “Power supply health for ADC/DAC card” | If card is not present give Card ID as 0xCD |
| 6 | Number of Controller cards | 4/unsigned long | Actual number of cards present in system. |
| 7 | Power supply health record for Controller card | Structure “Power supply health for Controller card” | If card is not present give Card ID as 0xCD |
| 8 | Spares[22] | 132/Array of 33unsigned longs |  |

## Channel health - Type I PCB

PSS Receiver : 128 channels

IS Band II Receiver : 64 channels

IS Band II Receiver : 8 channels

OAS Receiver : 256 channels

Structure size: 258 words (1032 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| SL NO | Field name | Size in bytes/Types | Remarks |
| 1 | ADC capture mode | 4/unsigned long | It contains the ADC capture is in system/Analog SNS mode. If this field contains Value 1 means FE hardware is in system or Analog SNS mode and it should provide data output. If this filed contains value 0 means FE hardware is in other modes and hence data output is not provided. |
| 2 | No of channels | 4/unsigned long | It can be 32/64/128/256 |
| 3 | RMSChannelHealth[256] | 1024/Array of 256 unsigned longs | If above mode is not “System”, “Analog SNS”or“Beam Pattern Check”mode then channel health value contains all zero’s. If it is in start mode then it contains each channels average Value as channel health status.  If card is not present then the respective channel health field shall have 0X000000CD ( Card not preset) (and the corresponding channels may be ignored as mentioned in sec health pkt 7.2) |

Note: The channel may be reported as faulty if the signal level lies above 0.75 Vrms (0x00266666) and below 0.1Vrms (0X00051EB8).

## Network health status - Type I PCB

Structure size: 8 words (32 bytes)

|  |  |  |  |
| --- | --- | --- | --- |
| SL NO | Field name | Size in bytes/Types | Remarks |
| 1 | UDP data port 1 transmit packet sequence number | 4/unsigned long | It contains number of packet transmitted in UDP data port. This is valid for FE receiver units which transmit the data. |
| 2 | UDP data port 1 receive packet sequence number | 4/unsigned long | It contains number of packet received in UDP data port. This is valid for FE SNS units which receive data via Ethernet. |
| 3 | UDP data port 2 transmit packet sequence number | 4/unsigned long | It contains sequence number of packet transmitted in UDP data port. This is valid for FE receiver units which transmit the data. |
| 4 | UDP data port 2 receive packet sequence number | 4/unsigned long | It contains sequence number of packet received in UDP data port. This is valid for FE SNS units which receive data via Ethernet. |
| 5 | UDP data port 1 receive packet missed count | 4/unsigned long | It contains the number of sequence number missed in receive section. This is valid for FE SNS units which receive data via Ethernet. |
| 6 | UDP data port 2 receive packet missed count | 4/unsigned long | It contains the number of sequence number missed in receive section. This is valid for FE SNS units which receive data via Ethernet. |
| 7 | UDP data port 1 link status | 4/unsigned long | It contains UDP port 1 link status. Value 0 is no link, 1 is link. |
| 8 | UDP data port 2 link status | 4/unsigned long | It contains UDP port 2 link status. Value 0 is no link, 1 is link. |

## Gain health - Type I PCB

Structure size: 8 words (32 bytes)

Gain mode field shall have the following values:

Common AGC(Int) = 0x01

Individual AGC(Int) = 0x03

MGC = 0x06

|  |  |  |  |
| --- | --- | --- | --- |
| SL NO | Field name | Size in bytes/Types | Remarks |
| 1 | Gain mode | 4/unsigned long | IB3-RX |
| 2 | Gain word | 4/unsigned long | PSS-RX, IB2-RX, OAS Rx and IB3-RX  Hex to dB conversion  Ref: Appendix ‘B’ |
| 3 | Gain mode | 4/unsigned long | Band I AFT only in health data from IB3-Rx |
| 4 | Gain word | 4/unsigned long | Band I AFT only in health data from IB3-Rx  Hex to dB conversion  Ref: Appendix ‘B’ |
| 5 | Gain mode | 4/unsigned long | Band II AFT only in health data from IB3-Rx |
| 6 | Gain word | 4/unsigned long | Band II AFT only in health data from IB3-Rx  Hex to dB conversion  Ref: Appendix ‘B’ |
| 7 | Spares[2] | 8/Array of 2 unsigned longs |  |

**Appendix ‘A’**

Error Codes assigned for Status Field

|  |  |  |  |
| --- | --- | --- | --- |
| Sl. No. | PCB | Status field (32-bit word) (values in hexadecimal – bit which is to be set is indicated alongside) | Description |
|  | Pre amplifier card | 0x00000000 | Card ok |
| 0x00000001 (bit 0) | Power supply fault |
| 0x00000002 (bit 1) | Temperature fault |
| 0x80000000 (bit 31) | Card not present |
|  | ADC/DAC card | 0x00000000 | Card ok |
| 0x00000001 (bit 0) | Power supply fault |
| 0x00000002 (bit 1) | Temperature fault |
| 0x00000004 (bit 2) | ADC/DAC clock fault |
| 0x00000008 (bit 3) | ADC/DAC sync fault |
| 0x00000080 (bit 7) | ADC/DAC link fault |
| 0x80000000 (bit 31) | Card not present |
|  | Controller card | 0x00000000 | Card ok |
| 0x00000001 (bit 0) | Power supply fault |
| 0x00000002 (bit 1) | Temperature fault |
| 0x00000004 (bit 2) | Clock status faulty |
| 0x00000008 (bit 3) | Sync status faulty |
| 0x00000010 (bit 4) | Card ok data port 1/cable faulty, data port 2 ok (indicate partially healthy) |
| 0x00000020 (bit 5) | Card ok data port 2/cable faulty, data port 1 ok(indicate partially healthy) |
|  |  | 0x00000040 (bit 6) | Card not ok due to problems in data port 1 and 2 / cable |
|  |  | 0x00000180 (bits 7 and 8) | ADC/DAC 1 link fault |
|  |  | 0x00000280 (bits 7 and 9) | ADC/DAC 2 link fault |
|  |  | 0x00000480 (bits 7 and 10) | ADC/DAC 3 link fault |
|  |  | 0x00000880 (bits 7 and 11) | ADC/DAC 4 link fault |
|  |  | 0x00001080 (bits 7 and 12) | ADC/DAC 5 link fault |
|  |  | 0x00002080 (bits 7 and 13) | ADC/DAC 6 link fault |
|  |  | 0x00004080 (bits 7 and 14) | ADC/DAC 7 link fault |
|  |  | 0x00008080 (bits 7 and 15) | ADC/DAC 8 link fault |
|  |  | 0x80000000 (bit 31) | Card not present |

**Appendix ‘B’**

* The channel may be reported as faulty if the signal level lies above 0.75 Vrms (0x00266666) and below 0.1Vrms (0X00051EB8)
* *MGC selection*

*MGC selection from HMI is preferred in the range -20 - +60 dB (G). When MGC is selected from HMI in this range, the corresponding decimal value calculated (x) may be sent to the controller card in 16 bit format .eg.for -20 dB dec value from eqnis 62 hence 6262 (i.e hex 3E3E) may be sent to the card.*

*Hex to dB conversion formula*

G=40\*log ((60+78.125x)/ (20530-78.125x)), where G is the gain in dB, x is the decimal value of the first eight bits of the corresponding hex word received from HMI.

*Gain word from HSU is 16 bit.Inorder to represent gain in dB this conversion formula is to be used and this can be used to derive the sea state .From the 16 bit first 8 bit to be taken(other 8 bit is the duplication of this 8 bit+/- 1 lsb) as X and convert this into decimal(x) and to be used in that formula.*

*dB to hex conversion formula*

X=((10 (G/40)\*20530)-60)/(78.125(1+10 (G/40))) , where G is the gain in dB, x is the decimal value of the first eight bits of the corresponding hex word sent in the gain health (sec 7.7) of health packet.