# Packet API

# netX Dual-Port Memory

## Packet-based services (netX 90/4000/4100)

**Hilscher Gesellschaft für Systemautomation mbH**

**www.hilscher.com**

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# 1 Introduction

## 1.1 About this document

The *netX Dual-Port Memory Interface Manual* describes the physical dual-port memory (DPM) layout, content and the general handling procedures and includes the usage of a mailbox system to exchange non-cyclic packet-based data with the firmware and the general definition of packets, packet structures and the handling of command packets and confirmation packets.

This manual

- is an extension to the *netX Dual-Port Memory Interface Manual*,
- defines and describes the non-cyclic packet-based services available in most firmware, and
- focus on the available system services, their functionality and definitions.

This manual is valid for firmware based on netX 90/4000/4100.

For firmware based on netX 10/50/51/52/100/500, use the manual "Packet API, netX Dual-Port Memory, Packet-based services (netX 10/50/51/52/100/500), DOC161001APIxxEN".

## 1.2 List of revisions

| Rev | Date | Name | Revisions |
|---|---|---|---|
| 3 | 2019-08-21 | HHE, ALM | Table 11 updated. |
| | | | Section *Rename a File*: Added Application channels 0, 1 to table. |
| | | | Section *Read Physical Memory service:* Added note about locked-up state. |
| | | | Section *Exception handler:* Added more details about exception handler. |
| 4 | 2020-05-04 | ALM, RMA | Section *Firmware / System Reset*: Update description for remanent data deletion. |
| | | | Section *Identifying Channel Firmware*: Values 4 and 5 for ulChannelID added. |
| | | | Section *Files and folders*: Describe precedence of paths and ulChannelNo. Example for path names added. Application channels 0 … 1 added. ulId and fragmentation handling described. Subsections *General information*, *Use cases A/B/C*, and *List Directories and Files from File System* added. |
| | | | Section *Format the Default Partition*: Description about quick format and full format added. |
| | | | Section *Memory usage information* added. |
| | | | Section *General packet fragmentation*: Description for packet fragmentation and ulId usage reviewed and changed. |
| | | | Section *Device Data Provider*: Description for Device Data Provider state handling added. |
| | | | Application channels added to firmware identify, common control block, common status block, extended status block, and COMFLAG requests. |
| 5 | 2020-06-04 | ALM, HHE | Section *List Directories and Files from File System*: Added note about emulation of default directories |
| | | | Section *Read Extended Status Block*: Fragmentation is not supported for this service. |

*Table 1: List of revisions*

## 1.3 Terms, abbreviations and definitions

| Term | Description |
|---|---|
| DPM | Dual-port memory |
| FW | Firmware |
| RTC | Real-time clock |

*Table 2: Terms, abbreviations and definitions*

## 1.4 References to documents

[1] Hilscher Gesellschaft für Systemautomation mbH:
netX Dual-Port Memory Interface Manual, Revision 15, English.

[2] Hilscher Gesellschaft für Systemautomation mbH:
Application note, Fragmentation of packets, Revision 1, English.

[3] Hilscher Gesellschaft für Systemautomation mbH:
netX 90 - Production guide, Revision 3, English.

*Table 3: References to documents*

## 1.5 Information and data security

Please take all the usual measures for information and data security, in particular for devices with Ethernet technology. Hilscher explicitly points out that a device with access to a public network (Internet) must be installed behind a firewall or only be accessible via a secure connection such as an encrypted VPN connection. Otherwise, the integrity of the device, its data, the application or system section is not safeguarded.

Hilscher can assume no warranty and no liability for damages due to neglected security measures or incorrect installation.

# 2 Packet-based services

The **Non-cyclic data transfer via mailboxes using packets** is the basis for packet-based services. For an explanation and description, see reference [1] that also includes the general packet structure, the packet elements, and the packet exchange with the netX-based firmware.

### Structures and definitions

The following C-header files provide structures and definitions used in this document.

| | |
|---|---|
| HIL_Packet.h | Provides the “Packet” structure |
| HIL_SystemCmd.h | Provides the system commands and structures |
| HIL_ApplicationCmd.h | Provides the commands and structures for the application task |
| HIL_DualPortMemory.h | Provides the netX dual-port memory layout |

For using protocol-specific functions, you need further header files provided by the protocol stack: Protocol-specific header files are coming with the firmware implementation and using additional header files.

**Note:** Due to further development and standardization, header files and names are reworked and the Prefix *RCX_* is replaced by *HIL_*.

Example of header file and definition name changes:

`rcx_Public.h` replaced by `HIL_Packet.h`, `HIL_SystemCmd.h, HIL_ApplicationCmd.h`

`rcx_User.h` replaced by `HIL_DualPortMemory.h`.

# 2.1 General packet structure

The structure HIL_PACKET_T is the general structure of a packet. The description is a short extract from the information in the *netX Dual-Port Memory Interface Manual* (reference [1]).

| Area | Variable / Element | Type | Value / Range | Description |
|---|---|---|---|---|
| Header (tHead) | ulDest | uint32_t | 0 ... 0xFFFFFFFF | Destination Address / Handle |
| | ulSrc | uint32_t | 0 ... 0xFFFFFFFF | Source Address / Handle |
| | ulDestId | uint32_t | 0 ... 0xFFFFFFFF | Destination Identifier |
| | ulSrcId | uint32_t | 0 ... 0xFFFFFFFF | Source Identifier |
| | ulLen | uint32_t | 0 ... max. packet data size | Packet Data Length (in byte) |
| | ulId | uint32_t | 0 ... 0xFFFFFFFF | Packet Identifier |
| | ulSta | uint32_t | 0 ... 0xFFFFFFFF | Packet State / Error |
| | ulCmd | uint32_t | 0 ... 0xFFFFFFFF | Packet Command / Confirmation |
| | ulExt | uint32_t | 0 or extension bit mask | Packet Extension |
| | ulRout | uint32_t | 0 ... 0xFFFFFFFF | Reserved (routing information) |
| Packet Data (abData) | abData | … | 0 … 0xFF | Packet Data (packet-specific data) |

*Table 4: General packet structure: HIL_PACKET_T*

**Note:** In this document, only the elements which have to be set or changed to create a specific packet are outlined, unchanged elements of the packet are not described.

| Variable / Element | Brief description |
|---|---|
| ulDest<br>ulDestId<br>ulSrc<br>ulSrcId | **Destination Address / Handle**<br>**Destination Identifier**<br>**Source Address / Handle**<br>**Source Identifier**<br>These elements are used to address the receiver and sender of a packet. |
| ulLen | **Packet Data Length**<br>ulLen defines how many data follow the packet header. The length is counted **in bytes**. The packet header length is not included in ulLen and has a fixed length of 40 bytes (see HIL_PACKET_HEADER_T) |
| ulId | **Packet Identifier**<br>ulId is intended be used as a unique packet number to destingush between multiple packets of the same type (e.g. multiple packet of the same ulCmd). It is set by the packet creator. |
| ulSta | **Packet State / Error**<br>ulSta is used to signal packet errors in an answer (response/confirmation) packet. The value is always zero for command packets (request/indication), because commands with an error are not meaningful.<br>In answer packets used to signal any problem with the packet header or packet data content (e.g. ERR_HIL_UNKNOWN_COMMAND, ERR_HIL_INVALID_PACKET_LEN, ERR_HIL_PARAMETER_ERROR etc.*)* |

| | |
|---|---|
| ulCmd | **Packet Command / Packet Answer**<br>ulCmd is a predefined code which marks the packet as a command or answer packet. Command codes are defined as even numbers while answers are defined as odd numbers.<br>Example: Reading the hardware identification of a netX-based device<br>▪ HIL_HW_IDENTIFY_REQ (0x00001EB8)<br>Command to read general hardware information like device number / serial number etc.<br>▪ HIL_HW_IDENTIFY_CNF (0x00001EB9) Answer to the HIL_HW_IDENTIFY_REQ command. |
| ulExt | **Packet Extension**<br>ulExt is used to mark packets as packets of a sequence, in case a transfer consists of multiple packets (e.g. file download). |
| ulRout | **Reserved (Routing Information)**<br>This is reserved for further use (shall not be changed by the receiver of a packet). |
| abData | **Packet Data**<br>abData defines the start of the user data area (payload) of the packet. The data content depends on the command or answer given in ulCmd. Each command and answer has a defined user data content while ulLen defines the number of user data bytes contained in the packet. |

*Table 5: Brief description of the elements/variables of a packet*

## 2.2 Recommended packet handling

- Only one process should handle a mailbox, because multiple processes, accessing the same mailbox, are able to steal packets from each other.
- Receive packet handling should be done before the send packet handling, helping to prevent buffer underruns inside the netX firmware (packet buffers in the firmware are limited).
- A command packet buffer should be initialized with 0 before filled with data.
- `ulId` of each command packet should be unique allowing to follow up the packet execution.
- The receive packet buffer should have the maximum packet size to be able to store a packet with the maximum size. Packet execution on the netX firmware is not serialized and therefore it is unpredictable which packet will be received next if multiple packets are active.
- An answer packet should always be checked against the command packet to be sure to received the requested information. The order of receive packets is not guaranteed when multiple send command are activated. The following elements should be compared.

| Send Packet | | Receive Packet |
|---|---|---|
| `ulCmd` | `<->` | `ulCmd & HIL_MSK_PACKET_ANSWER` |
| `ulId` | `<->` | `ulId` |
| `ulSrc` | `<->` | `ulSrc` |
| `ulSrcId` | `<->` | `ulSrcId` |

- **Note:** The answer code is defined as "command code +1" therefore the lowest bit must be masked out if compared.
- Always check `ulSta` of the answer packet to be 0 before evaluating the packet data, `ulSta` unequal to 0 signals a packet error.

## 2.3 Additional Packet Data Information

Packet data always depends on the command / answer code given in `ulCmd`.

Some of the packet data structures are containing elements where the element length has to be defined / obtained from another element in the structure.

**Example: MD5 request with a null terminated file name in the structure**

```
typedef __HIL_PACKED_PRE struct HIL_FILE_GET_MD5_REQ_DATA_Ttag
{
  uint32_t                              ulChannelNo;            /* 0 = Channel 0, ..., 3
= Channel 3, 0xFFFFFFFF = System, see HIL_FILE_xxxx */
  uint16_t                              usFileNameLength;       /* length of NUL-
terminated file name that will follow */
  /* a NUL-terminated file name will follow here */
} __HIL_PACKED_POST HIL_FILE_GET_MD5_REQ_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_FILE_GET_MD5_REQ_Ttag
{
  HIL_PACKET_HEADER_T                     tHead;                  /* packet header */
  HIL_FILE_GET_MD5_REQ_DATA_T             tData;                  /* packet data */
} __HIL_PACKED_POST HIL_FILE_GET_MD5_REQ_T;
```

The structure does not contain an element `szFileName`. The comment inside the structure explains this behavior, and the length of the filename is given in `usFileNameLength`.

If such an element should be filled out, the filename in this case has to be placed right behind the length parameter `ulFileNameLength`.

```
HIL_PACKET                    tPacket;
HIL_FILE_GET_MD5_REQ_DATA_T* ptMD5Data  = (HIL_FILE_GET_MD5_REQ_DATA_T*)tPacket.abData;
uint8_t*                       szFileName = “config.nxd”

memset(&tPacket, 0, sizeof(tPacket));
```

Initialize the packet structure elements:

```
/* set the “normal” fields */
ptMD5Data->ulChannelNo      = 0;
ptMD5Data->usFileNameLength = strlen(szFilename)+1;
```

Append the subsequent information (e.g. file name):

```
/* append the file name*/
strcpy((uint8_t*)(ptMD5Data + 1), szFileName);
```

Packet data is also available as lists of elements. Depending to the command, such lists are either defined by a starting data element given the number of elements in the subsequent packet data area or must be calculated by using the packet data length `ulLen`.

# 3 System services

The netX operating system of the device and the middleware components of the firmware offer **system services**. Most of the functions are common to all netX-based devices. Differences are possible if a device does not offer all common hardware components, e.g. Ethernet interface, file system, etc.

## 3.1 Function overview

| System services | Command definition | Page |
|---|---|---|
| **Reset** | | |
| Firmware and system reset | HIL_FIRMWARE_RESET_REQ | 13 |
| **Identification and information** | | |
| Read the general hardware identification information | HIL_HW_IDENTIFY_REQ | 15 |
| Read the device-specific hardware information | HIL_HW_HARDWARE_INFO_REQ | 19 |
| Read the name and version or firmware, operating system or protocol stack running on a communication channel | HIL_FIRMWARE_IDENTIFY_REQ | 21 |
| **System Channel Information Blocks** | | |
| Read the system channel: *System Information Block* | HIL_SYSTEM_INFORMATION_BLOCK_REQ | 26 |
| Read the system channel: *Channel Information Block* | HIL_CHANNEL_INFORMATION_BLOCK_REQ | 27 |
| Read the system channel: *System Control Block* | HIL_SYSTEM_CONTROL_BLOCK_REQ | 30 |
| Read the system channel: *System Status Block* | HIL_SYSTEM_STATUS_BLOCK_REQ | 31 |
| **Files and folders** | | |
| List directories and files from the file system | HIL_DIR_LIST_REQ | 36 |
| Download a file (start, send file data, abort) | HIL_FILE_DOWNLOAD_REQ | 40 |
| | HIL_FILE_DOWNLOAD_DATA_REQ | 43 |
| | HIL_FILE_DOWNLOAD_ABORT_REQ | 45 |
| File Upload (start, read file data, abort) | HIL_FILE_UPLOAD_REQ | 47 |
| | HIL_FILE_UPLOAD_DATA_REQ | 49 |
| | HIL_FILE_UPLOAD_ABORT_REQ | 51 |
| File Delete | HIL_FILE_DELETE_REQ | 52 |
| File Rename | HIL_FILE_RENAME_REQ | 54 |
| Create a CRC32 checksum | (example code) | 56 |
| Calculate the MD5 checksum for a given file | HIL_FILE_GET_MD5_REQ | 57 |
| Read the MD5 checksum from the file header of a given file | HIL_FILE_GET_HEADER_MD5_REQ | 59 |
| Format the default partition containing the file system | HIL_FORMAT_REQ | 60 |

| | | |
|---|---|---|
| **License Information** | | |
| Read the license information stored on the netX hardware | HIL_HW_LICENSE_INFO_REQ | 69 |
| **Determining the DPM Layout** | | |
| Read and evaluate the DPM Layout of the system / communication channels | HIL_DPM_GET_BLOCK_INFO_REQ | 62 |
| **Device information** | | |
| Read device information | HIL_DDP_SERVICE_GET_REQ | 81 |
| Change device information (temporarily) | HIL_DDP_SERVICE_SET_REQ | 83 |
| **Error log information** | | |
| Read startup error log information | HIL_SYSTEM_ERRORLOG_REQ_T | 70 |
| **Exception Handler (only)** | | |
| Get exception context from crashed firmware | HIL_EXCEPTION_INFO_REQ | 85 |
| Read physical memory from crashed firmware | HIL_PHYSMEM_READ_REQ | 88 |

*Table 6: System services (function overview)*

# 3.2 Firmware / System Reset

A **Firmware / System Reset** resets the entire netX target.

### Firmware Reset request

The application uses the following packet in order to reset the netX chip. The application has to send this packet through the system mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| `ulLen` | uint32_t | 8 | Packet data length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001E00 | HIL_FIRMWARE_RESET_REQ |
| Data | | | |
| `ulTimeToReset` | uint32_t | 0 | Time delay until reset is executed in milliseconds [ms]<br>Fix: 500 ms (not changeable) |
| `ulResetMode` | uint32_t | 0 | Reset Mode & Parameter<br>Specify the kind of reset to execute (see table below). |

*Table 7: HIL_FIRMWARE_RESET_REQ_T – Firmware Reset request*

| **Variable:** *`ulResetMode`* | |
|---|---|
| **Bit No.** | **Definition / Description** |
| 31..9 | reserved |
| 8 | Delete complete remanent data area after reset.<br>1 = Remanent data area will be deleted.<br>0 = Remanent data area will not be deleted.<br>This option is only available for the modes BOOTSTART and UPDATESTART.<br>In mode BOOTSTART, the remanent area is deleted when the maintenance firmware starts up.<br>In mode UPDATESTART, the remanent area is only deleted after a successful firmware installation. |
| 7..4 | Reset Parameter<br>Arguments that will be evaluated upon system reset.<br>For mode `HIL_RESET_MODE_UPDATESTART`<br>`0x0 … 0xF =` This value specifies the firmware that will be installed.<br>For mode `HIL_RESET_MODE_CONSOLESTART`<br>`0x0 =` Start/Enable Ethernet interface<br>`0x1 =` Start/Enable UART interface<br>`0x2 =` Start/Enable USB interface<br>The interface is hardware-specific. Start/enable the specific interface only if the interface is available on the used hardware! |
| 3..0 | Reset Mode |
| | `0 = HIL_RESET_MODE_COLDSTART`<br>The cold start will perform a reset of the device and starts the installed firmware again. |
| | `1 = HIL_RESET_MODE_WARMSTART`<br>Unused. |
| | `2 = HIL_RESET_MODE_BOOTSTART`<br>The boot start will perform a reset of the device and starts the maintenance firmware. The boot start can be used to start the maintenance firmware without starting an update process (idle mode). |

| | |
|---|---|
| | 3 = HIL_RESET_MODE_UPDATESTART<br>The update start will perform a reset of the device and start the maintenance firmware.<br>If a valid update file is available, it will be automatically processed and installed.<br>If no update file is available or if the update file is not valid, the maintenance firmware will change into error mode , changes the SYS LED (to yellow on) and sets an error code (e.g. ERR_HIL_NOT_AVAILABLE, 0xC0001152). |
| | 4 = HIL_RESET_MODE_CONSOLESTART<br>The console start will perform a reset of the device and start the specified ROM loader in console mode (see Reset Parameter above). The firmware will not start up again, all communication takes place with the ROM loader now. |
| Other values are reserved | |

### Packet structure reference

```
/* CHANNEL RESET REQUEST */
#define HIL_FIRMWARE_RESET_REQ              0x00001E00

typedef struct HIL_FIRMWARE_RESET_REQ_DATA_Ttag
{
  uint32_t ulTimeToReset;  /* time to reset in ms   */
  uint32_t ulResetMode;    /* reset mode parameter  */
} HIL_FIRMWARE_RESET_REQ_DATA_T;

typedef struct HIL_FIRMWARE_RESET_REQtag
{
  HIL_PACKET_HEADER             tHead;  /* packet header */
  HIL_FIRMWARE_RESET_REQ_DATA_T  tData;  /* packet data   */
} HIL_FIRMWARE_RESET_REQ_T;
```

### Firmware Reset confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / error code, see Section 6. |
| ulCmd | uint32_t | 0x00001E01 | HIL_CHANNEL_RESET_CNF |

*Table 8: HIL_FIRMWARE_RESET_CNF_T – Firmware Reset confirmation*

### Packet structure reference

```
/* CHANNEL RESET CONFIRMATION */
#define HIL_CHANNEL_RESET_CNF               HIL_CHANNEL_RESET_REQ+1

typedef struct HIL_FIRMWARE_RESET_CNF_Ttag
{
  HIL_PACKET_HEADER    tHead;  /* packet header                          */
} HIL_FIRMWARE_RESET_CNF_T;
```

# 3.3 Identifying netX Hardware

Hilscher netX-based products uses a **Flash Device Label** to store certain hardware and product-related information that helps to identify the hardware.

The firmware reads the information during a power-up reset and copies certain entries into the *System Information Block* of the system channel located in the dual-port memory.

A configuration tool like SYCON.net evaluates the information and use them to decide whether a firmware file can be downloaded or not. If the information in the firmware file does not match the information read from the dual-port memory, the attempt to download will be rejected.

The following fields are relevant to identify netX hardware.

- Device Number, Device Identification
- Serial Number
- Manufacturer
- Device Class
- Hardware Assembly Options
- Production Date
- License Code

### Dual-Port Memory Default Values

In case Flash Device Label is not present or provides inconsistent data, the firmware initializes the system information block with the following default data:

- Device Number, Device Identification — Set to zero
- Serial Number — Set to zero
- Manufacturer — Set to UNDEFINED
- Device Class — Set to UNDEFINED
- Hardware Assembly Options — Set to NOT AVAILABLE
- Production Date — Set to zero for both, production year and week
- License Code — Set to zero

### 3.3.1 Read Hardware Identification Data

The command returns the device number, hardware assembly options, serial number and revision information of the netX hardware. The request packet is passed through the system mailbox only.

#### Hardware Identify request

The application uses the following packet in order to read netX hardware information.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001EB8 | HIL_HW_IDENTIFY_REQ |

*Table 9: HIL_HW_IDENTIFY_REQ_T – Hardware Identify request*

#### Packet structure reference

```
/* IDENTIFY FIRMWARE REQUEST */
#define HIL_HW_IDENTIFY_REQ                  0x00001EB8

typedef struct HIL_HW_IDENTIFY_REQ_Ttag
{
  HIL_PACKET_HEADER     tHead;             /* packet header                */
} HIL_HW_IDENTIFY_REQ_T;
```

### Hardware Identify confirmation

The channel firmware returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>36<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EB9 | HIL_HW_IDENTIFY_CNF |
| Data | | | |
| ulDeviceNumber | uint32_t | 0 … 0xFFFFFFFF | Device Number |
| ulSerialNumber | uint32_t | 0 … 0xFFFFFFFF | Serial Number |
| ausHwOptions[4] | uint16_t | 0 … 0xFFFF | Hardware Assembly Option |
| usDeviceClass | uint16_t | 0 … 0xFFFF | netX Device Class |
| bHwRevision | uint8_t | 0 … 0xFF | Hardware Revision Index |
| bHwCompatibility | uint8_t | 0 … 0xFF | Hardware Compatibility Index |
| ulBootType | uint32_t | 0 … 8 | Hardware Boot Type |
| ulChipType | uint32_t | 0 … n | Chip Type (see tables below) |
| ulChipStep | uint32_t | 0 … 0x000000FF | Chip Step |
| ulRomcodeRevision | uint32_t | 0 … 0x00000FFF | ROM Code Revision |

*Table 10: HIL_HW_IDENTIFY_CNF_T – Hardware Identify confirmation*

### Packet structure reference

```
/* HARDWARE IDENTIFY CONFIRMATION */
#define HIL_HW_IDENTIFY_CNF                  HIL_HW_IDENTIFY_REQ+1

typedef struct HIL_HW_IDENTIFY_CNF_DATA_Ttag
{
  uint32_t ulDeviceNumber;              /* device number / identification */
  uint32_t ulSerialNumber;              /* serial number                  */
  uint16_t ausHwOptions[4];             /* hardware options               */
  uint16_t usDeviceClass;               /* device class                   */
  uint8_t  bHwRevision;                 /* hardware revision              */
  uint8_t  bHwCompatibility;            /* hardware compatibility         */
  uint32_t ulBootType;                  /* boot type                      */
  uint32_t ulChipTyp;                   /* chip type                      */
  uint32_t ulChipStep;                  /* chip step                      */
  uint32_t ulRomcodeRevision;           /* rom code revision              */
} HIL_HW_IDENTIFY_CNF_DATA_T;

typedef struct HIL_HW_IDENTIFY_CNF_Ttag
{
  HIL_PACKET_HEADER           tHead;    /* packet header                  */
  HIL_HW_IDENTIFY_CNF_DATA_T  tData;    /* packet data                    */
} HIL_HW_IDENTIFY_CNF_T;
```

### Boot Type

This field indicates how the netX operating system was started.

| Value | Definition / Description |
|---|---|
| 0x00000000 | ROM Loader: PARALLEL FLASH (SRAM Bus) |
| 0x00000001 | ROM Loader: PARALLEL FLASH (Extension Bus) |
| 0x00000002 | ROM Loader: DUAL-PORT MEMORY |
| 0x00000003 | ROM Loader: PCI INTERFACE |
| 0x00000004 | ROM Loader: MULTIMEDIA CARD |
| 0x00000005 | ROM Loader: I2C BUS |
| 0x00000006 | ROM Loader: SERIAL FLASH |
| 0x00000007 | Second Stage Boot Loader: SERIAL FLASH |
| 0x00000008 | Second Stage Boot Loader: RAM |
| 0x00000009 | ROM Loader: Internal Flash |
| Other values are reserved | |

*Table 11: Boot Type*

### Chip Type

This field indicates the type of chip that is used.

| Value | Definition / Description |
|---|---|
| 0x00000000 | Unknown |
| 0x00000001 | netX 500 |
| 0x00000002 | netX 100 |
| 0x00000003 | netX 50 |
| 0x00000004 | netX 10 |
| 0x00000005 | netX 51 |
| 0x00000006 | netX 52 |
| 0x00000007 | netX 4000 |
| 0x00000008 | netX 4100 |
| 0x00000009 | netX 90 |
| Other values are reserved | |

*Table 12: Chip Type*

# 3.4 Read Hardware Information

### Hardware Info request

Obtain information about the netX hardware. The packet is send through the system mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001EF6 | HIL_HW_HARDWARE_INFO_REQ |

*Table 13: HIL_HW_HARDWARE_INFO_REQ_T – Hardware Info request*

### Packet structure reference

```
/* READ HARDWARE INFORMATION REQUEST */
#define HIL_HW_HARDWARE_INFO_REQ             0x00001EF6

typedef struct HIL_HW_HARDWARE_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER     tHead;             /* packet header               */
} HIL_HW_HARDWARE_INFO_REQ_T;
```

### Hardware Info confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 56<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EF7 | HIL_HW_HARDWARE_INFO_CNF |
| Data | | | |
| ulDeviceNumber | uint32_t | 0 … 0xFFFFFFFF | Device Number / Identification |
| ulSerialNumber | uint32_t | 0 … 0xFFFFFFFF | Serial Number |
| ausHwOptions[4] | Array of uint16_t | 0 … 0xFFFF | Hardware Assembly Option |
| usManufacturer | uint16_t | 0 … 0xFFFF | Manufacturer Code |
| usProductionDate | uint16_t | 0 … 0xFFFF | Production Date |
| ulLicenseFlags1 | uint32_t | 0 … 0xFFFFFFFF | License Flags 1 |
| ulLicenseFlags2 | uint32_t | 0 … 0xFFFFFFFF | License Flags 2 |
| usNetxLicenseID | uint16_t | 0 … 0xFFFF | netX License Identification |
| usNetxLicenseFlags | uint16_t | 0 … 0xFFFF | netX License Flags |
| usDeviceClass | uint16_t | 0 … 0xFFFF | netX Device Class |
| bHwRevision | uint8_t | 0 …0xFFFF | Hardware Revision Index |
| bHwCompatibility | uint8_t | 0 | Hardware Compatibility Index |
| ulHardware Features1 | uint32_t | 0 | Hardware Features 1 (not used, set to 0) |
| ulHardware Features2 | uint32_t | 0 | Hardware Features 2 (not used, set to 0) |
| bBootOption | uint8_t | 0 | Boot Option (not used, set to 0) |
| bReserved[11] | uint8_t | 0 | Reserved, set to 0 |

*Table 14: HIL_HW_HARDWARE_INFO_CNF_T – Hardware Info confirmation*

### Packet structure reference

```
/* READ HARDWARE INFORMATION CONFIRMATION */
#define HIL_HW_HARDWARE_INFO_CNF            HIL_HW_HARDWARE_INFO_REQ+1

typedef struct HIL_HW_HARDWARE_INFO_CNF_DATA_Ttag
{
  uint32_t ulDeviceNumber;         /* device number              */
  uint32_t ulSerialNumber;         /* serial number              */
  uint16_t ausHwOptions[4];        /* hardware assembly options  */
  uint16_t usManufacturer;         /* device manufacturer        */
  uint16_t usProductionDate;       /* production date            */
  uint32_t ulLicenseFlags1;        /* license flags 1            */
  uint32_t ulLicenseFlags2;        /* license flags 2            */
  uint16_t usNetxLicenseID;        /* license ID                 */
  uint16_t usNetxLicenseFlags;     /* license flags              */
  uint16_t usDeviceClass;          /* device class               */
  uint8_t  bHwRevision;            /* hardware revision          */
  uint8_t  bHwCompatibility;       /* hardware compatibility     */
  uint32_t ulHardwareFeatures1;    /* not used, set to 0         */
  uint32_t ulHardwareFeatures2;    /* not used, set to 0         */
  uint8_t  bBootOption;            /* not used, set to 0         */
  uint8_t  bReserved[11];          /* reserved, set to 0         */
} HIL_HW_HARDWARE_INFO_CNF_DATA_T;

typedef struct HIL_HW_HARDWARE_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;  /* packet header     */
  HIL_HW_HARDWARE_INFO_CNF_DATA_T  tData;  /* packet data       */
} HIL_HW_HARDWARE_INFO_CNF_T;
```

# 3.5 Identifying Channel Firmware

This request returns the name, version and date of the operating system, firmware or protocol stack running on the netX chip. The information depends on the kind of executed firmware (maintenance firmware or protocol firmware).

The destination address *ulDest* and the *ulChannelID* parameter within the packet are used to define the returned information.

Delivered versions information according to *ulDest* and *ulChannelID*:

| **Firmware: *System or Communication Channel Mailbox*** | | |
|---|---|---|
| **ulDest** | **ulChannelID** | **Returned Information** |
| HIL_PACKET_DEST_SYSTEM | 0xFFFFFFFF | Version of the operating system |
| | 0 ... 3 | Protocol stack name of the communication channel given by *ulChannelID* |
| | 4 … 5 | Name of application channel given by *ulChannelID* |
| HIL_PACKET_DEST_DEFAULT_CHANNEL | 0xFFFFFFFF | Firmware name (see note below) |
| | 0 ... 3 | Protocol stack name of the communication channel given by *ulChannelID* |
| | 4 … 5 | Name of application channel given by *ulChannelID* |
| **Maintenance Firmware: *System Channel Mailbox*** | | |
| **ulDest** | **ulChannelID** | **Returned Information** |
| HIL_PACKET_DEST_SYSTEM | 0xFFFFFFFF | Version of the operating system |
| HIL_PACKET_DEST_DEFAULT_CHANNEL | 0xFFFFFFFF | Maintenance firmware version |

**Note:** Usually ***Firmware Name*** and ***Protocol Stack Name*** of communication channel 0 are equal

### Firmware Identify request

Depending on the requirements, the packet is passed through the system mailbox to obtain operating system information, or it is passed through the channel mailbox to obtain protocol stack related information.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000<br>0x00000020 | HIL_PACKET_DEST_SYSTEM<br>HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001EB6 | HIL_FIRMWARE_IDENTIFY_REQ |
| Data | | | |
| ulChannelId | uint32_t | see definition above | Channel Identification |

*Table 15: HIL_FIRMWARE_IDENTIFY_REQ_T – Firmware Identify request*

### Packet structure reference

```
/* IDENTIFY FIRMWARE REQUEST */
#define HIL_FIRMWARE_IDENTIFY_REQ           0x00001EB6

typedef struct HIL_FIRMWARE_IDENTIFY_REQ_DATA_Ttag
{
  uint32_t   ulChannelId;                   /* channel ID                */
} HIL_FIRMWARE_IDENTIFY_REQ_DATA_T;

typedef struct HIL_FIRMWARE_IDENTIFY_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header             */
  HIL_FIRMWARE_IDENTIFY_REQ_DATA_T tData;   /* packet data               */
} HIL_FIRMWARE_IDENTIFY_REQ_T;
```

### Firmware Identify confirmation

The channel firmware returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>76<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EB7 | HIL_FIRMWARE_IDENTIFY_CNF |
| Data | | | |
| tFwVersion | Structure | see below | Firmware Version |
| tFwName | Structure | see below | Firmware Name |
| tFwDate | Structure | see below | Firmware Date |

*Table 16: HIL_FIRMWARE_IDENTIFY_CNF_T – Firmware Identify confirmation*

### Packet structure reference

```
/* IDENTIFY FIRMWARE CONFIRMATION */
#define HIL_FIRMWARE_IDENTIFY_CNF           HIL_FIRMWARE_IDENTIFY_REQ+1

typedef struct HIL_FW_IDENTIFICATION_Ttag
{
  HIL_FW_VERSION_T  tFwVersion;           /* firmware version            */
  HIL_FW_NAME_T     tFwName;              /* firmware name               */
  HIL_FW_DATE_T     tFwDate;              /* firmware date               */
} HIL_FW_IDENTIFICATION_T;

typedef struct HIL_FIRMWARE_IDENTIFY_CNF_DATA_Ttag
{
  HIL_FW_IDENTIFICATION_T   tFirmwareIdentification;    /* firmware ID    */
} HIL_FIRMWARE_IDENTIFY_CNF_DATA_T;

typedef struct HIL_FIRMWARE_IDENTIFY_CNF_Ttag
{
  HIL_PACKET_HEADER                 tHead;  /* packet header             */
  HIL_FIRMWARE_IDENTIFY_CNF_DATA_T  tData;  /* packet data               */
} HIL_FIRMWARE_IDENTIFY_CNF_T;
```

### Version *tFwVersion*

The version information field consist of four parts separated into a *Major*, *Minor*, *Build* and *Revision* section.

- *Major* number, given in hexadecimal format [0..0xFFFF].
  The number is increased for significant enhancements in functionality (backward compatibility cannot be assumed)
- *Minor* number, given in hexadecimal format [0..0xFFFF].
  The number is incremented when new features or enhancements have been added (backward compatibility is intended).
- *Build* number, given in hexadecimal format [0..0xFFFF].
  The number denotes bug fixes or a new firmware build
- R*evision* number, given in hexadecimal format [0..0xFFFF].
  It is used to signal hotfixes for existing versions. It is set to zero for new *Major* / *Minor* / *Build* updates.

Version Structure

```
typedef struct HIL_FW_VERSION_Ttag
{
  uint16_t              usMajor;            /* major version number */
  uint16_t              usMinor;            /* minor version number */
  uint16_t              usBuild;            /* build number         */
  uint16_t              usRevision;         /* revision number      */
} HIL_FW_VERSION_T;
```

**Name** *tFwName*

This field holds the name of the firmware comprised of ASCII characters.

- *bNameLength* holds the length of valid bytes in the *abName[63]* array.
- *abName[63]* contains the firmware name as ASCII characters, limited to 63 characters

Firmware Name Structure:

```
typedef struct HIL_FW_NAME_Ttag
{
  uint8_t              bNameLength;        /* length of firmware name    */
  uint8_t              abName[63];         /* firmware name              */
} HIL_FW_NAME_T;
```

**Date** *tFwDate*

The ***tFwDate*** field holds the date of the firmware release.

- *usYear* year is given in hexadecimal format in the range [0..0xFFFF]
- *bMonth* month is given in hexadecimal format in the range [0x01..0x0C]
- *bDay* day is given in hexadecimal format in the range [0x01..0x1F].

Firmware Date Structure:

```
typedef struct HIL_FW_DATE_Ttag
{
  uint16_t             usYear;             /* firmware creation year    */
  uint8_t              bMonth;             /* firmware creation month   */
  uint8_t              bDay;               /* firmware creation day     */
} HIL_FW_DATE_T;
```

## 3.6 System Channel Information Blocks

The following packets are defined to make system data blocks available for read access through the mailbox channel. These packets are used by configuration tools, like SYCON.net, if they are connected via a serial interface and need to read this information from the netX hardware.

If the requested data block exceeds the maximum mailbox size, the block is transferred in a sequenced or fragmented manner (see *netX Dual-Port Memory Interface Manual* for details about fragmented packet transfer).

Available Blocks:

| Block Name | DPM Structure | Description |
|---|---|---|
| System Information Block | HIL_DPMSYSTEM_INFO_BLOCK_T | Contains general information of the hardware (device) like the cookie, device number, serial number etc. |
| Channel Information Block | HIL_DPM_CHANNEL_INFO_BLOCK_T | Contains information about the available channels in a firmware |
| System Control Block | HIL_DPM_SYSTEM_CONTROL_BLOCK_T | Contains available control registers and flags to control the hardware |
| System Status Block | HIL_DPM_SYSTEM_STATUS_BLOCK_T | Contains state information about the hardware (e.g. Boot Error, System Error, CPU Load information etc.) |

### 3.6.1 Read System Information Block

The packet outlined in this section is used to request the *System Information Block*. Therefore it is passed through the system mailbox.

#### System Information Block request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001E32 | HIL_SYSTEM_INFORMATION_BLOCK_REQ |

*Table 17: HIL_READ_SYS_INFO_BLOCK_REQ_T – System Information Block request*

#### Packet structure reference

```
/* READ SYSTEM INFORMATION BLOCK REQUEST */
#define HIL_SYSTEM_INFORMATION_BLOCK_REQ    0x00001E32

typedef struct HIL_READ_SYS_INFO_BLOCK_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_READ_SYS_INFO_BLOCK_REQ_T;
```

#### System Information Block confirmation

The following packet is returned.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 48<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E33 | HIL_SYSTEM_INFORMATION_BLOCK_CNF |
| Data | | | |
| tSystemInfo | Structure | | System Information Block<br>See *netX Dual-Port Memory Interface Manual* for more details. |

*Table 18: HIL_READ_SYS_INFO_BLOCK_CNF_T – System Information Block confirmation*

#### Packet structure reference

```
/* READ SYSTEM INFORMATION BLOCK CONFIRMATION */
#define HIL_SYSTEM_INFORMATION_BLOCK_CNF    HIL_SYSTEM_INFORMATION_BLOCK_REQ+1

typedef struct HIL_READ_SYS_INFO_BLOCK_CNF_DATA_Ttag
{
  HIL_DPM_SYSTEM_INFO_BLOCK_T          tSystemInfo; /* packet data       */
} HIL_READ_SYS_INFO_BLOCK_CNF_DATA_T;

typedef struct HIL_READ_SYS_INFO_BLOCK_CNF_Ttag
{
  HIL_PACKET_HEADER                  tHead;   /* packet header          */
  HIL_READ_SYS_INFO_BLOCK_CNF_DATA_T tData;   /* packet data            */
} HIL_READ_SYS_INFO_BLOCK_CNF_T;
```

## 3.6.2 Read Channel Information Block

The packet outlined in this section is used to request the *Channel Information Block*. Therefore it is passed through the system mailbox. There is one packet for each of the channels. The channels are identified by their channel ID or port number. The total number of blocks is part of the structure of the Channel Information Block of the system channel.

### Channel Information Block request

This packet is used to request the *Channel Information Block* (*HIL_DPM_CHANNEL_INFO_BLOCK_T*) of a channel specified by *ulChannelId*.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E34 | HIL_CHANNEL_INFORMATION_BLOCK_REQ |
| Data | | | |
| ulChannelId | uint32_t | 0 … 7 | Channel Identifier<br>Port Number, Channel Number |

*Table 19: HIL_READ_CHNL_INFO_BLOCK_REQ_T – Channel Information Block request*

### Packet structure reference

```
/* READ CHANNEL INFORMATION BLOCK REQUEST */
#define HIL_CHANNEL_INFORMATION_BLOCK_REQ    0x00001E34

typedef struct HIL_READ_CHNL_INFO_BLOCK_REQ_DATA_Ttag
  uint32_t ulChannelId;                       /* channel id              */
} HIL_READ_CHNL_INFO_BLOCK_REQ_DATA_T;

typedef struct HIL_READ_CHNL_INFO_BLOCK_REQ_Ttag
{
  HIL_PACKET_HEADER                   tHead;  /* packet header           */
  HIL_READ_CHNL_INFO_BLOCK_REQ_DATA_T tData;  /* packet data             */
} HIL_READ_CHNL_INFO_BLOCK_REQ_T;
```

### Channel Information Block confirmation

The confirmation packet contains the *tChannelInfo* data structure which is defined as a union of multiple structures. To be able to us the data, the first element of any union structure defines the channel type. This type must be evaluated before the corresponding structure can be used to evaluate the content of the structure.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulLen` | uint32_t | <br>16<br>0 | Packet Data Length (in Bytes)<br>If `ulSta` = `SUCCESS_HIL_OK`<br>Otherwise |
| `ulSta` | uint32_t | See Below | Status / Error Code, see Section 6 |
| `ulCmd` | uint32_t | 0x00001E35 | HIL_CHANNEL_INFORMATION_BLOCK_CNF |
| Data | | | |
| `tChannelInfo` | Structure | | Channel Information Block<br>See *netX Dual-Port Memory Interface Manual* for more details. |

*Table 20: HIL_READ_CHNL_INFO_BLOCK_CNF_T – Channel Information Block confirmation*

### Packet structure reference

```
/* READ CHANNEL INFORMATION BLOCK CONFIRMATION */
#define HIL_CHANNEL_INFORMATION_BLOCK_CNF    HIL_CHANNEL_INFORMATION_BLOCK_REQ+1

typedef union HIL_DPM_CHANNEL_INFO_BLOCKtag
{
  HIL_DPM_SYSTEM_CHANNEL_INFO_T          tSystem;
  HIL_DPM _HANDSHAKE_CHANNEL_INFO_T      tHandshake;
  HIL_DPM _COMMUNICATION_CHANNEL_INFO_T  tCom;
  HIL_DPM _APPLICATION_CHANNEL_INFO_T    tApp;
} HIL_DPM_CHANNEL_INFO_BLOCK_T;

typedef struct HIL_READ_CHNL_INFO_BLOCK_CNF_DATA_Ttag
{
  HIL_DPM_CHANNEL_INFO_BLOCK_T     tChannelInfo;  /* channel info block   */
} HIL_READ_CHNL_INFO_BLOCK_CNF_DATA_T;

typedef struct HIL_READ_CHNL_INFO_BLOCK_CNF_Ttag
{
  HIL_PACKET_HEADER                     tHead;     /* packet header        */
  HIL_READ_CHNL_INFO_BLOCK_CNF_DATA_T   tData;     /* packet data          */
} HIL_READ_CHNL_INFO_BLOCK_CNF_T;
```

### Example how to evaluate the structure

```
uint32_t                      ulBlockID
HIL_DPM_CHANNEL_INFO_BLOCK_T* ptChannel;

/* Iterate over all block definitions, start with channel 0 information */
ptChannel = &tChannelInfo

/*------------------------------------------------------------*/
/* Evaluate the channel information blockt                    */
/*------------------------------------------------------------*/
for(ulBlockID = 0 ulBlockID < HIL_DPM_MAX_SUPPORTED_CHANNELS; ++ulBlockID)
{
  /* Check Block types */
  switch(ptChannel->tSystem.bChannelType))
  {
    case HIL_CHANNEL_TYPE_COMMUNICATION:
    {
      /* This is a communication channel, read an information */
      uint16_t usActualProtocolClass;
      usActualProtocolClass = ChannelInfo->tCom.usProtocolClass;
    }
    break;

    case HIL_CHANNEL_TYPE_APPLICATION:
      /* This is an application channel */
    break;

    case HIL_CHANNEL_TYPE_HANDSHAKE:
      /* This is the handshake channel containing the handshake registers */
      break;

    case HIL_CHANNEL_TYPE_SYSTEM:
      /* This is the system channel */
      break;

    case HIL_CHANNEL_TYPE_UNDEFINED:
    case HIL_CHANNEL_TYPE_RESERVED:
   default:
      /* Do not process these types */
    break;

  } /* end switch */
  ++ptChannel; /* address next infromation from the channel info block */

} /* end for loop */
```

## 3.6.3 Read System Control Block

### System Control Block request

This packet is used to request the *System Control Block* (*HIL_DPM_SYSTEM_CONTROL_BLOCK_T*).

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001E36 | HIL_SYSTEM_CONTROL_BLOCK_REQ |

*Table 21: HIL_READ_SYS_CNTRL_BLOCK_REQ_T – System Control Block request*

### Packet structure reference

```
/* READ SYSTEM CONTROL BLOCK REQUEST */
#define HIL_SYSTEM_CONTROL_BLOCK_REQ        0x00001E36

typedef struct HIL_READ_SYS_CNTRL_BLOCK_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_READ_SYS_CNTRL_BLOCK_REQ_T;
```

### System Control Block confirmation

The following packet is returned by the firmware.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 8<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E37 | HIL_SYSTEM_CONTROL_BLOCK_CNF |
| Data | | | |
| tSystem Control | Structure | | System Control Block<br>See *netX Dual-Port Memory Interface Manual* for more details. |

*Table 22: HIL_READ_SYS_CNTRL_BLOCK_CNF_T – System Control Block confirmation*

### Packet structure reference

```
/* READ SYSTEM CONTROL BLOCK CONFIRMATION */
#define HIL_SYSTEM_CONTROL_BLOCK_CNF        HIL_SYSTEM_CONTROL_BLOCK_REQ+1

typedef struct HIL_READ_SYS_CNTRL_BLOCK_CNF_DATA_Ttag
{
  HIL_DPM_SYSTEM_CONTROL_BLOCK_T   tSystemControl;
} HIL_READ_SYS_CNTRL_BLOCK_CNF_DATA_T;

typedef struct HIL_READ_SYS_CNTRL_BLOCK_CNF_Ttag
{
  HIL_PACKET_HEADER                    tHead;    /* packet header        */
  HIL_READ_SYS_CNTRL_BLOCK_CNF_DATA_T  tData;    /* packet data          */
} HIL_READ_SYS_CNTRL_BLOCK_CNF_T;
```

## 3.6.4 Read System Status Block

### System Status Block request

This packet is used to request the *System Status Block* (*HIL_DPM_SYSTEM_STATUS_BLOCK_T*)

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001E38 | HIL_SYSTEM_STATUS_BLOCK_REQ |

*Table 23: HIL_READ_SYS_STATUS_BLOCK_REQ_T – System Status Block request*

### Packet structure reference

```
/* READ SYSTEM STATUS BLOCK REQUEST */
#define HIL_SYSTEM_STATUS_BLOCK_REQ          0x00001E38

typedef struct HIL_READ_SYS_STATUS_BLOCK_REQ_Ttag
{
  HIL_PACKET_HEADER                 tHead;   /* packet header             */
} HIL_READ_SYS_STATUS_BLOCK_REQ_T;
```

### System Status Block confirmation

The following packet is returned by the firmware.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 64<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E39 | HIL_SYSTEM_STATUS_BLOCK_CNF |
| Data | | | |
| tSystemState | Structure | | System Status Block<br>See *netX Dual-Port Memory Interface Manual* for more details. |

*Table 24: HIL_READ_SYS_STATUS_BLOCK_CNF_T – System Status Block confirmation*

### Packet structure reference

```
/* READ SYSTEM STATUS BLOCK CONFIRMATION */
#define HIL_SYSTEM_STATUS_BLOCK_CNF          HIL_SYSTEM_STATUS_BLOCK_REQ+1

typedef struct HIL_READ_SYS_STATUS_BLOCK_CNF_DATA_Ttag
{
  HIL_DPM_SYSTEM_STATUS_BLOCK_T        tSystemState;
} HIL_READ_SYS_STATUS_BLOCK_CNF_DATA_T;

typedef struct HIL_READ_SYS_STATUS_BLOCK_CNF_Ttag
{
  HIL_PACKET_HEADER                    tHead;    /* packet header        */
  HIL_READ_SYS_STATUS_BLOCK_CNF_DATA_T tData;    /* packet data          */
} HIL_READ_SYS_STATUS_BLOCK_CNF_T;
```

# 3.7 Files and folders

A standard netX 90 / netX 4000-based system either contains

- a Flash-based file system or
- a Flash-based storage mechanism

to store firmware, configuration and user files.

The following section describes the services offered by a netX firmware to access files and folders.

## 3.7.1 General information

The following points containing information, helping to understand files and folders functionalities.

**Note:** A detailed description of netX system behavior, layout and "**uses cases"** can be found in the *netX90 Production Guide* (reference [3]).

**Note:** Some of the services support a Channel number field `ulChannelNo` and a directory path or file name. If both information are provided, the path will have precedence over the `ulChannelNo` field and the `ulChannelNo` is ignored.
E.g. for the directory list request, if `ulChannelNo` is "3" but the provided path is "PORT_0", then the command will be executed on "PORT_0".

## 3.7.2 Use cases A/B/C

Depending on the system and the system hardware layout, Flash memory can be chip internal (e.g. netX 90), external Flash memory (e.g. netX 4000) or a combination of internal and external Flash memory (e.g. netX 90 with external Flash memory).

As long as only internal Flash is available, downloaded files are stored in plain Flash segments. If external Flash is available, it is also possible file storage is done via a Flash-based file system, using several folders.

These different possibilities of storing files are described as "**use cases**". Currently three of use cases are defined "**Use case A/B/C**".

**Note:** A detailed description of netX system behavior, layout and "**Uses cases**" can be found in the ***netX90 Production Guide***

**Use cases definition**

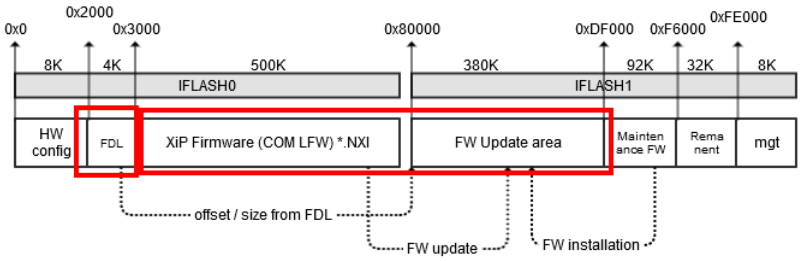
| Use case | Description | File storage |
|---|---|---|
| A | netX 90 system<br>with internal Flash only | **Plain Flash areas**<br>-> in the internal netX Flash |
| B | netX 90 system<br>with internal and external Flash | **Plain Flash areas**<br>-> in the internal netX Flash<br>-> and an external connected Flash chip |
| C | netX 90 and netX 4000 system<br>with external Flash | **Flash-file system**<br>-> in the external Flash<br>using a predefined folder structure |

"Use cases" are also influencing system services like file upload / file download and directory list functions. Because in one case a plain Flash area is used, not offering file names or sub-directory entries and in the other case, a complete file system is used.

### 3.7.2.1 Plain Flash area

In **use case A/B**, where files are stored in plain Flash areas, the Flash layout definition takes place in the system FDL (Flash Device Label).

**Example Flash layout**

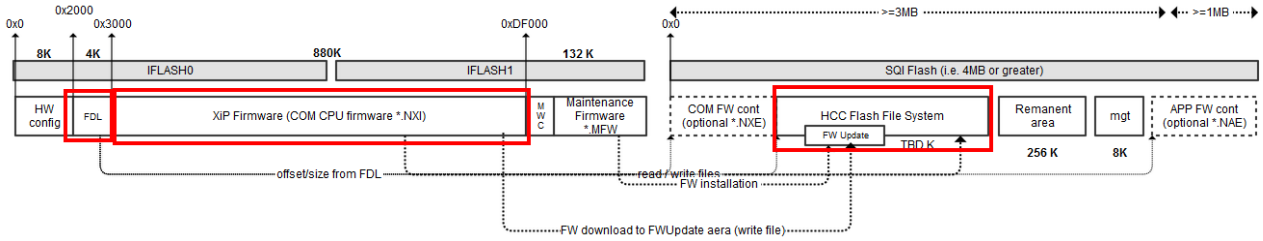



### 3.7.2.2 Flash file system

If a file system is available (see “**Use case C**”), the file system is always a “Safe FAT” system and has a pre-defined folder structure (see below).

| **Note** | The file system which is used in the netX firmware is FAT based and supports only file names in the "8.3" format. |
|---|---|

**Example Flash layout**




**File system - Folder layout**

| Volume | Directory | Description |
|---|---|---|
| root | System | unused / internal use |
| | PORT_0 | Communication Channel 0 |
| | PORT_1 | Communication Channel 1 |
| | PORT_2 | Communication Channel 2 |
| | PORT_3 | Communication Channel 3 |
| | PORT_4 | Application Channel 0 |
| | PORT_5 | Application Channel 1 |

| **Note:** | The installed firmware will always be shown in the subdirectory *Port_0.* |
|---|---|

### 3.7.2.3 File names

File names of system files, like firmware or configuration files, are also pre-defined.

All netX system files are equiped with a file type specific header information in the files and a specific file extension, indicating the file type.

**Example of system files and names**

| File name | Extension | Description |
|---|---|---|
| <firmware> | .NXI | Firmware file for the communication CPU, stored in the internal FLASH |
| <firmware> | .NXE | Firmware file for the communication CPU, stored in the external FLASH |
| <firmware> | .NAI | Firmware file for the application CPU, stored in the internal FLASH |
| <firmware> | .NAE | Firmware file for the application CPU, stored in the external FLASH |
| FWUPDATE | .ZIP | File container to update multiple system files at once |

Supported characters for file services are: a-z, A-Z, 0-9, ‘.’, ‘:’, ‘/’, ‘\’, ‘_’.

Wildcard characters, like “*” and others, are not supported.

Unless otherwise stated, provided paths are zero terminated strings. An example string and its internal representation shows the following table.

| Input string | Internal |
|---|---|
| PORT_0/example.txt | SYSVOLUME:/PORT_0/example.txt |

File services enable the usage of a channel number and/or a path/name in form of a zero-terminated string.

**Note:** If a file name is provided that includes a path information, the path information will take precedence over the channel number and the channel number is ignored.

### 3.7.3 List Directories and Files from File System

Directories and files in the file system of netX can be listed by the command outlined below. Section *Flash file system* (page 34) shown the default file system layout.

**Note:** The installed firmware will always be shown in the subdirectory of *Port 0.*

Depending on the use case, this function behave slightly different.

**Use Case A/B (without a file system)**

A special handling is done for the firmware files (.NXI or .NAI) or firmware update file (FWUPDATE.ZIP). In these use cases, such files are stored in an update area and there is no file name or folder information available and they are not necessarily active or installed after a download.

Without a file system, no information about files and folders exists (file name, directory content). Therfore, HIL_DIR_LIST_REQ is not able to list previously downloaded files. The only listed files are “installed” and active firmware files. Because of this and the missing folder and file name information, HIL_DIR_LIST_REQ will always return “default” names for such files inside the default folder PORT_0.

Default names are:

- “FIRMWARE.NXI” or “FIRMWARE.NXE” if requested from a running firmware

  and additionally,

- “FIRMWARE.NAI” or “FIRMWARE.NAE” if requested from a running Maintenance firmware

Example:

PORT_0: “FIRMWARE.<extension>“

It is also not possible to rename or delete such files by using the HIL_FILE_DELETE_REQ or HIL_FILE_RENAME_REQ services.

For use case A/B, the default file system entries are (partly) emulated. So querying the root, SYSTEM, PORT_0-PORT_1 directories will return successfully with ulSta = 0x00000000, ulLen = 0 and ulExt = 0x40. Querying PORT_0 returns the installed firmware files as described above. Unknown directories will return the ulSta: ERR_HIL_FS_NOT_AVAILABLE.

### Directory List request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 6 + n | sizeof(HIL_DIR_LIST_REQ_DATA_T) + strlen("DirName")+1<br>Remark: 0 can be used for the second, third, etc. packet. |
| ulCmd | uint32_t | 0x00001E70 | HIL_DIR_LIST_REQ |
| ulExt | uint32_t | 0x00,<br>0xC0 | 0x00: for the first packet.<br>0xC0: for the next packets. |
| Data | | | |
| ulChannelNo | uint32_t | <br>0 … 3<br>4 … 5<br>0xFFFFFFFF | Channel number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if the file name contains a path information |
| usDirName Length | uint16_t | <br>n | Name length<br>Length of the Directory Name (in Bytes)<br>strlen("DirName")+1 |
| | uint8_t | <br>ASCII | Directory Name<br>ASCII string, zero terminated |

*Table 25: HIL_DIR_LIST_REQ_T – Directory List request*

### Packet structure reference

```
/* DIRECTORY LIST REQUEST */
#define HIL_DIR_LIST_REQ                    0x00001E70

/* Channel Number */
#define HIL_FILE_CHANNEL_0 (0)
#define HIL_FILE_CHANNEL_1 (1)
#define HIL_FILE_CHANNEL_2 (2)
#define HIL_FILE_CHANNEL_3 (3)
#define HIL_FILE_CHANNEL_4 (4)
#define HIL_FILE_CHANNEL_5 (5)
#define HIL_FILE_SYSTEM    (0xFFFFFFFF)
```

```
typedef struct HIL_DIR_LIST_REQ_DATA_Ttag
{
  uint32_t ulChannelNo;    /* 0 = channel 0 ... 5 = channel 5   */
           /* 0xFFFFFFFF = system, see HIL_FILE_xxxx */
  uint16_t usDirNameLength;     /* length of NULL terminated string  */
  /* a NULL-terminated name string will follow here */
} HIL_DIR_LIST_REQ_DATA_T;

typedef struct HIL_DIR_LIST_REQ_Ttag
{
  HIL_PACKET_HEADER  tHead;     /* packet header     */
  HIL_DIR_LIST_REQ_DATA_T tData;     /* packet data  */
} HIL_DIR_LIST_REQ_T;
```

### Directory List confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>24<br>0<br><br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>If ulSta = SUCCESS_HIL_OK and ulExt = 0x40 (last packet)<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E71 | HIL_DIR_LIST_CNF |
| ulExt | uint32_t | 0x80,<br>0xC0,<br>0x40 | 0x80 for the first packet.<br>0xC0 for the following packets.<br>0x40 for the last packet. |
| Data | | | |
| szName[16] | uint8_t | | File Name |
| ulFileSize | uint32_t | m | File Size in Bytes |
| bFileType | uint8_t | <br>0x00000001<br>0x00000002 | File Type<br>HIL_DIR_LIST_CNF_FILE_TYPE_DIRECTORY<br>HIL_DIR_LIST_CNF_FILE_TYPE_FILE |
| bReserved | uint8_t | 0 | Reserved, unused |
| usReserved2 | uint16_t | 0 | Reserved, unused |

*Table 26: HIL_DIR_LIST_CBF_T – Directory List confirmation*

### Packet structure reference

```
/* DIRECTORY LIST CONFIRMATION */
#define HIL_DIR_LIST_CNF                    HIL_DIR_LIST_REQ+1

/* TYPE: DIRECTORY */
#define HIL_DIR_LIST_CNF_FILE_TYPE_DIRECTORY 0x00000001

/* TYPE: FILE */
#define HIL_DIR_LIST_CNF_FILE_TYPE_FILE     0x00000002

typedef struct HIL_DIR_LIST_CNF_DATA_Ttag
{
  uint8_t                szName[16];    /* file name                    */
  uint32_t               ulFileSize;    /* file size                    */
  uint8_t                bFileType;     /* file type                    */
  uint8_t                bReserved;     /* reserved, set to 0           */
  uint16_t               bReserved2     /* reserved, set to 0           */
} HIL_DIR_LIST_CNF_DATA_T;

typedef struct HIL_DIR_LIST_CNF_Ttag
{
  HIL_PACKET_HEADER       tHead;        /* packet header                */
  HIL_DIR_LIST_CNF_DATA_T tData;        /* packet data                  */
} HIL_DIR_LIST_CNF_T;
```

### 3.7.4 Downloading / Uploading Files

Any download / upload of files to/from the netX firmware is handled via netX packets as described below.

**Note:** File download / upload can be done via the “System” or “Channel” mailbox. In both cases, the destination identifier has to be *ulDest* = HIL_SYSTEM_CHANNEL. The difference of a “System” and a “Channel” mailbox is just the size of the transferable packet length.

To download a file, the user application has to split the file into smaller pieces that fit into the packet data area and send them to the netX. Similar handling is necessary for a file upload, where a file is requested in pieces and have to be assembled by the user application.

For file uploads / downloads (e.g. firmware or configuration files) where the data does not fit into a single packet, the packet header field *ulExt* in conjunction with the packet identifier *ulId* has to be used to control packet sequence handling, indicating the first, last and sequenced packets.

**Note:** The user application must send/request files in the order of its original sequence. The *ulId* field in the packet holds a sequence number and is incremented by one for each new packet. Sequence numbers shall not be skipped or used twice. Because, a netX firmware **cannot** re-assemble file data received out of order.

**Note:** The HIL_FILE_DOWNLOAD_REQ and HIL_FILE_DOWNLOAD_DATA_REQ are independent commands. Therefore, it is allowed, to either increment *ulId* for both commands (shown in the table below) or increment it independently of each other.

Example:

| **Single Packet Upload/Download** | | | **Two Packet Upload/Download** | | |
|---|---|---|---|---|---|
| **Definition** | **ulId** | **ulExt** | **Definition** | **ulId** | **ulExt** |
| HIL_FILE_DOWNLOAD_REQ | n | HIL_PACKET_SEQ_NONE | HIL_FILE_DOWNLOAD_REQ | n | HIL_PACKET_SEQ_NONE |
| HIL_FILE_DOWNLOAD_DATA_REQ | n+1 | HIL_PACKET_SEQ_NONE | HIL_FILE_DOWNLOAD_DATA_REQ | n+1 | HIL_PACKET_SEQ_FIRST |
| | | | HIL_FILE_DOWNLOAD_DATA_REQ | n+2 | HIL_PACKET_SEQ_LAST |

| **Multi Packet Upload/Download** | | |
|---|---|---|
| **Definition** | **ulId** | **ulExt** |
| HIL_FILE_DOWNLOAD_REQ | n | HIL_PACKET_SEQ_NONE |
| HIL_FILE_DOWNLOAD_DATA_REQ | n+1 | HIL_PACKET_SEQ_FIRST |
| ..... | ..... | ..... |
| HIL_FILE_DOWNLOAD_DATA_REQ | n +1 | HIL_PACKET_SEQ_MIDDLE |
| HIL_FILE_DOWNLOAD_DATA_REQ | n +1 | HIL_PACKET_SEQ_MIDDLE |
| ..... | ..... | ..... |
| HIL_FILE_DOWNLOAD_DATA_REQ | n +1 | HIL_PACKET_SEQ_LAST |

### 3.7.4.1 File Download

The download procedure consist of two commands. The first one is a *File Download Request* packet, providing at least the file name and the file length. The system responds with the maximum possible packet data size if the file is accepted.

The second command is a *File Download Data Request*, used to send the file data down to the system. The maximum packet size from the first command defines how many data can be sent by each data packet. The data packet itself must be sent as many times until the whole file is transferred to the system.

Each packet will be confirmed by the firmware. The download is finished with the last packet.

**Flowchart**

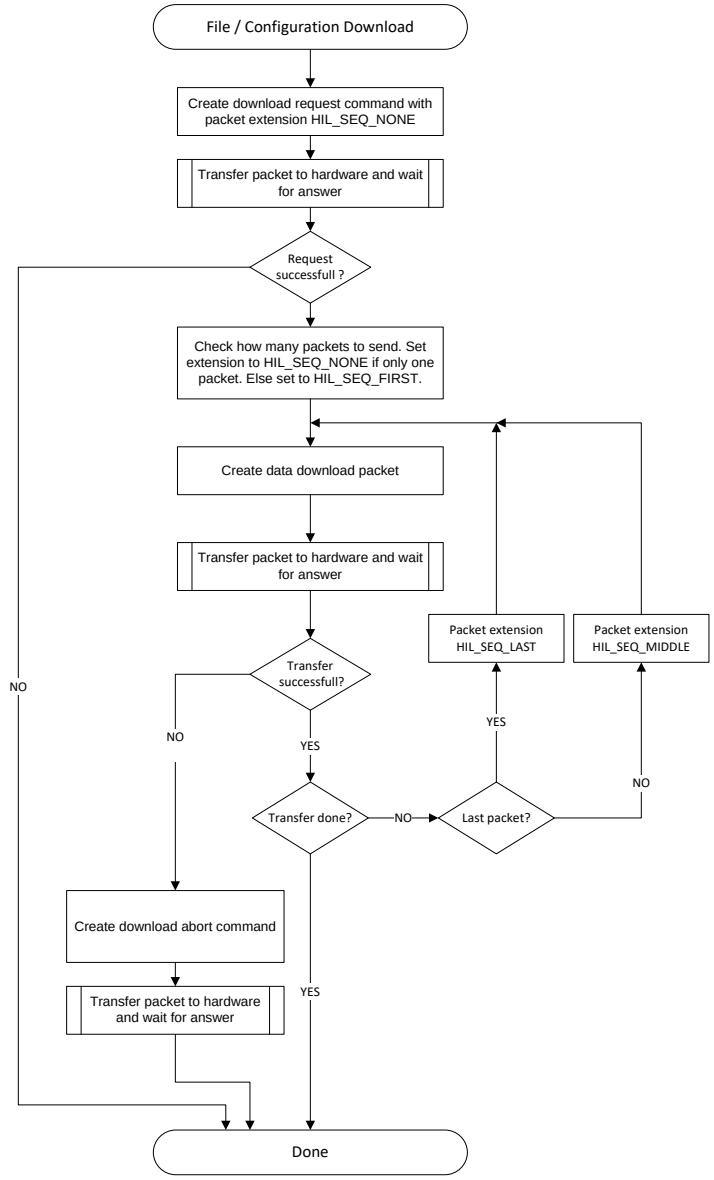



*Figure 1: Flowchart File Download*

**Note:** If an error occurs during the download, the process must be canceled by sending a *File Download Abort* command.

### File Download request

The packet below is the first request sent to the netX firmware, to start a file download. The application provides the length of the file and its name in the request packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_SYSTEM_CHANNEL |
| ulLen | uint32_t | 18 + n | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E62 | HIL_FILE_DOWNLOAD_REQ |
| ulId | uint32_t | Any | Packet Identifer |
| ulExt | uint32_t | 0x00000000 | Extension<br>HIL_PACKET_SEQ_NONE |
| Data | | | |
| ulXferType | uint32_t | 0x00000001 | Download Transfer Type<br>HIL_FILE_XFER_FILE |
| ulMaxBlockSize | uint32_t | 1 … m | Max Block Size<br>Maximum Size of Block per Packet |
| ulFileLength | uint32_t | n | File size to be downloaded in bytes |
| ulChannelNo | uint32_t | 0 … 3<br>4 … 5<br>0xFFFFFFFF | Destination Channel Number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if file name contains a path information |
| usFileNameLength | uint16_t | n | Length of Name<br>Length of the following file name (in Bytes) |
| (file name) | uint8_t | ASCII | File Name<br>ASCII string, zero terminated |

*Table 27: HIL_FILE_DOWNLOAD_REQ_T – File Download request*

### Packet structure reference

```
/* FILE DOWNLOAD REQUEST */
#define HIL_FILE_DOWNLOAD_REQ               0x00001E62

/* TRANSFER FILE */
#define HIL_FILE_XFER_FILE                  0x00000001

/* TRANSFER INTO FILE SYSTEM */
#define HIL_FILE_XFER_FILESYSTEM            0x00000001

/* TRANSFER MODULE */
#define HIL_FILE_XFER_MODULE                0x00000002

/* Channel Number */
#define HIL_FILE_CHANNEL_0                  (0)
#define HIL_FILE_CHANNEL_1                  (1)
#define HIL_FILE_CHANNEL_2                  (2)
#define HIL_FILE_CHANNEL_3                  (3)
#define HIL_FILE_CHANNEL_4                  (4)
#define HIL_FILE_CHANNEL_5                  (5)
#define HIL_FILE_SYSTEM                     (0xFFFFFFFF)

typedef struct HIL_FILE_DOWNLOAD_REQ_DATA_Ttag
{
  uint32_t ulXferType;
  uint32_t ulMaxBlockSize;
  uint32_t ulFileLength;
  uint32_t ulChannelNo;
  uint16_t usFileNameLength;
  /* a NULL-terminated file name follows here                    */
  /* uint8_t   abFileName[ ];                                    */
} HIL_FILE_DOWNLOAD_REQ_DATA_T;
```

```
typedef struct HIL_FILE_DOWNLOAD_REQ_Ttag
{
  HIL_PACKET_HEADER  tHead;     /* packet header     */
  HIL_FILE_DOWNLOAD_REQ_DATA_T  tData;     /* packet data  */
} HIL_FILE_DOWNLOAD_REQ_T;
```

### File Download confirmation

The netX firmware acknowledges the request with the following confirmation packet. It contains the size of the data block transferable in one packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>4<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E63 | HIL_FILE_DOWNLOAD_CNF |
| ulId | uint32_t | From Request | Packet Identifer |
| Data | | | |
| ulMaxBlockSize | uint32_t | <br>1 … n | Max Block Size<br>Maximum Size of Block per Packet |

*Table 28: HIL_FILE_DOWNLOAD_CNF_T – File Download confirmation*

### Packet structure reference

```
/* FILE DOWNLOAD CONFIRMATION */
#define HIL_FILE_DOWNLOAD_CNF                HIL_FILE_DOWNLOAD_REQ+1

typedef struct HIL_FILE_DOWNLOAD_CNF_DATA_Ttag
{
  uint32_t ulMaxBlockSize;
} HIL_FILE_DOWNLOAD_CNF_DATA_T;

typedef struct HIL_FILE_DOWNLOAD_CNF_Ttag
{
  HIL_PACKET_HEADER              tHead;     /* packet header              */
  HIL_FILE_DOWNLOAD_CNF_DATA_T   tData;     /* packet data                */
} HIL_FILE_DOWNLOAD_CNF_T;
```

### 3.7.4.2 File Download Data

This packet is used to transfer a block of data to the netX operating system to be stored in the file system. The term *data block* is used to describe a portion of a file. The data block in the packet is identified by a block or sequence number and is secured through a continuous CRC32 checksum.

**Note:** If the download fails, the operating system returns an error code in *ulSta*. The user application then has to send an *Abort File Download Request* packet (see page 45) and start over.

The block or sequence number *ulBlockNo* starts with zero for the first data packet and is incremented by one for each following packet. The checksum in *ulChksum* is calculated as a CRC32 polynomial. It is calculated continuously over all data packets that were sent already. A sample on how to calculate the checksum is included in this manual.

#### File Download Data request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_SYSTEM_CHANNEL |
| ulLen | uint32_t | 8 + n | Packet Data Length (in Bytes) |
| ulId | uint32_t | id | Packet Identifier<br>**Note:** Should be incremented for each request:<br>ulId (this request) = ulId (previous request) + 1 |
| ulCmd | uint32_t | 0x00001E64 | HIL_FILE_DOWNLOAD_DATA_REQ |
| ulExt | uint32_t | 0x00000000<br>0x00000080<br>0x000000C0<br>0x00000040 | Extension<br>HIL_PACKET_SEQ_NONE (if data fits into one packet)<br>HIL_PACKET_SEQ_FIRST<br>HIL_PACKET_SEQ_MIDDLE<br>HIL_PACKET_SEQ_LAST |
| Data | | | |
| ulBlockNo | uint32_t | 0 ... m | Block Number<br>Block or Sequence Number |
| ulChksum | uint32_t | S | Checksum<br>CRC32 Polynomial |
| | uint8_t | 0 … 0xFF | File Data Block (length given in *ulLen*) |

*Table 29: HIL_FILE_DOWNLOAD_DATA_REQ_T – File Download Data request*

#### Packet structure reference

```
/* FILE DOWNLOAD DATA REQUEST*/
#define HIL_FILE_DOWNLOAD_DATA_REQ          0x00001E64

/* PACKET SEQUENCE */
#define HIL_PACKET_SEQ_NONE                 0x00000000
#define HIL_PACKET_SEQ_FIRST                0x00000080
#define HIL_PACKET_SEQ_MIDDLE               0x000000C0
#define HIL_PACKET_SEQ_LAST                 0x00000040

typedef struct HIL_FILE_DOWNLOAD_DATA_REQ_DATA_Ttag
{
  uint32_t ulBlockNo;               /* block number                      */
  uint32_t ulChksum;                /* cumulative CRC-32 checksum        */
  /* data block follows here                                             */
  /* uint8_t   abData[ ];                                                */
} HIL_FILE_DOWNLOAD_DATA_REQ_DATA_T;
```

```
typedef struct HIL_FILE_DOWNLOAD_DATA_REQ_Ttag
{
  HIL_PACKET_HEADER                  tHead;     /* packet header          */
  HIL_FILE_DOWNLOAD_DATA_REQ_DATA_T  tData;     /* packet data            */
} HIL_FILE_DOWNLOAD_DATA_REQ_T;
```

### File Download Data confirmation

The following confirmation packet is returned. It contains the expected CRC32 checksum of the data block. If the ulSta field is not SUCCESS_HIL_OK, the expected checksum can be compared to the one sent.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>0<br>4 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>If ulSta != SUCCESS_HIL_OK |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E65 | HIL_FILE_DOWNLOAD_DATA_CNF |
| ulId | uint32_t | From Request | Packet Identifer |
| Data | | | |
| ulExpectedCrc32 | uint32_t | <br>S | Checksum<br>Expected CRC32 polynomial |

*Table 30: HIL_FILE_DOWNLOAD_DATA_CNF_T – File Download Data confirmation*

### Packet structure reference

```
/* FILE DOWNLOAD DATA CONFIRMATION */
#define HIL_FILE_DOWNLOAD_DATA_CNF          HIL_FILE_DOWNLOAD_DATA_REQ+1

/* PACKET SEQUENCE */
#define HIL_PACKET_SEQ_NONE                 0x00000000

typedef struct HIL_FILE_DOWNLOAD_DATA_CNF_DATA_Ttag
{
  uint32_t ulExpectedCrc32;          /* expected CRC-32 checksum          */
} HIL_FILE_DOWNLOAD_DATA_CNF_DATA_T;

typedef struct HIL_FILE_DOWNLOAD_DATA_CNF_Ttag
{
  HIL_PACKET_HEADER                  tHead;     /* packet header          */
  HIL_FILE_DOWNLOAD_DATA_CNF_DATA_T  tData;     /* packet data            */
} HIL_FILE_DOWNLOAD_DATA_CNF_T;
```

### 3.7.4.3 File Download Abort

If an error occurs during the download of a file (*ulSta* not equal to SUCCESS_HIL_OK), the user application has to abort the download procedure by sending the *File Download Abort* command.

This command can also be used by an application to abort the download procedure at any time.

#### File Download Abort request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_SYSTEM_CHANNEL |
| ulCmd | uint32_t | 0x00001E66 | HIL_FILE_DOWNLOAD_ABORT_REQ |
| ulId | uint32_t | Any | Packet Identifer as Unique Number |

*Table 31: HIL_FILE_DOWNLOAD_ABORT_REQ_T – File Download Abort request*

#### Packet structure reference

```
/* ABORT DOWNLOAD REQUEST */
#define HIL_FILE_DOWNLOAD_ABORT_REQ          0x00001E66

typedef struct HIL_FILE_DOWNLOAD_ABORT_REQ_Ttag
{
  HIL_PACKET_HEADER     tHead;             /* packet header                */
} HIL_FILE_DOWNLOAD_ABORT_REQ_T;
```

#### File Download Abort confirmation

The netX operating system returns the following confirmation packet, indicating that the download was aborted.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E67 | HIL_FILE_DOWNLOAD_ABORT_CNF |

*Table 32: HIL_FILE_DOWNLOAD_ABORT_CNF_T – File Download Abort confirmation*

#### Packet structure reference

```
/* ABORT DOWNLOAD REQUEST */
#define HIL_FILE_DOWNLOAD_ABORT_CNF          HIL_FILE_DOWNLOAD_ABORT_REQ+1

typedef struct HIL_FILE_DOWNLOAD_ABORT_CNF_Ttag
{
  HIL_PACKET_HEADER     tHead;             /* packet header                */
} HIL_FILE_DOWNLOAD_ABORT_CNF_T;
```

### 3.7.5 Uploading Files from netX

Just as the download process, the upload process is handled via packets. The file to be uploaded is selected by the file name. During the *File Upload* request, the file name is transferred to the netX operating system. If the requested file exists, the netX operating system returns all necessary file information in the response.

The host application creates *File Upload Data* request packets, which will be acknowledged by the netX operating system with the corresponding confirmation packets holding portions of the file data. The application has to continue sending *File Upload Data* request packets until the entire file is transferred. Receiving the last confirmation packet finishes the upload process.

**Flowchart**

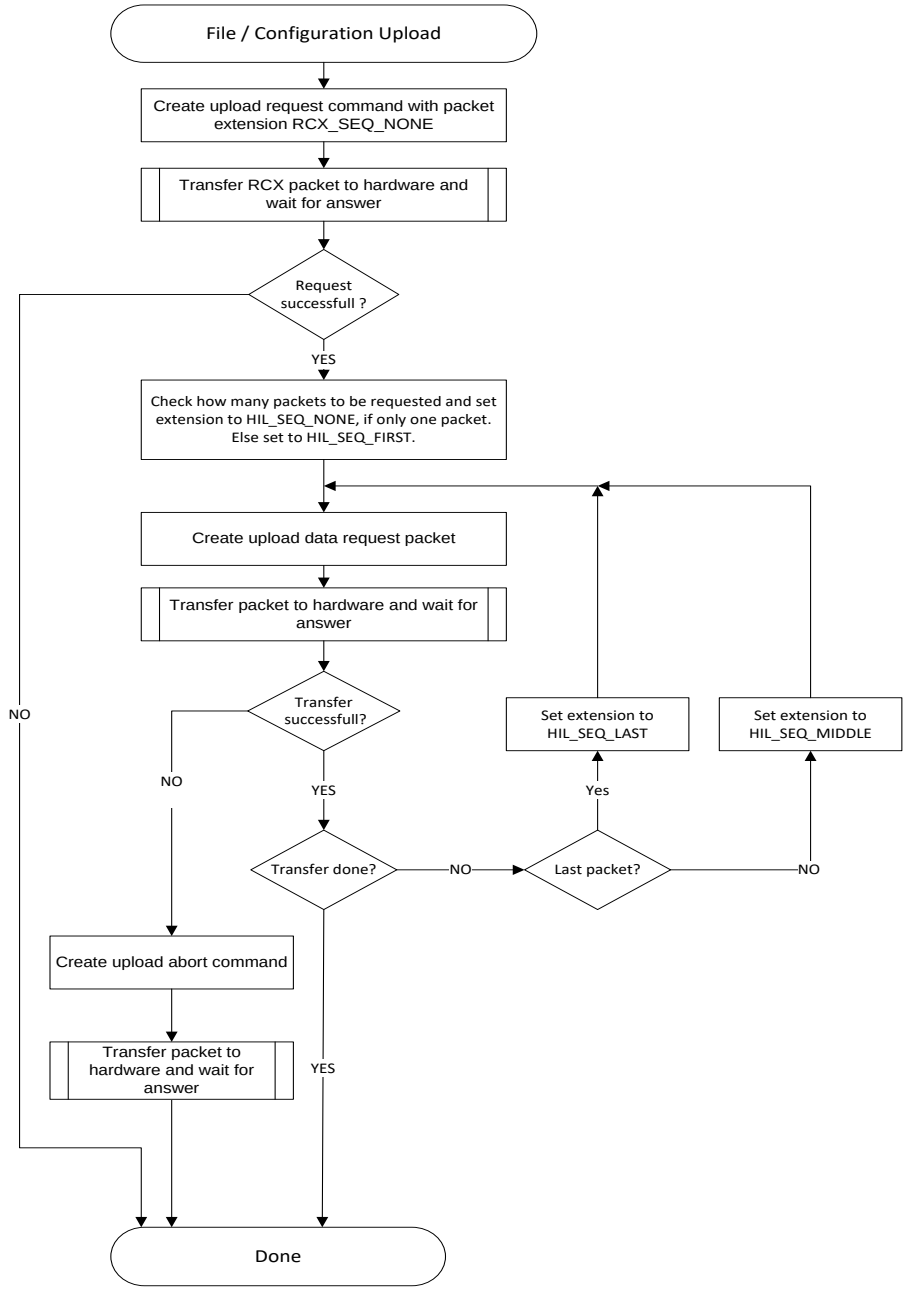



*Figure 2: Flowchart File Upload*

### 3.7.5.1 File Upload

**Note:** If an error occurs during a file upload, the process **must** be canceled by sending a *File Upload Abort* command.

#### File Upload request

The file upload request is the first request to be sent to the system. The application provides the length of the file and its name in the request packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 14 + n | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E60 | HIL_FILE_UPLOAD_REQ |
| ulId | uint32_t | Any | Packet Identifier |
| ulExt | uint32_t | 0x00000000 | Extension<br>HIL_PACKET_SEQ_NONE |
| Data | | | |
| ulXferType | uint32_t | 0x00000001 | Transfer Type:<br>HIL_FILE_XFER_FILE |
| ulMaxBlockSize | uint32_t | 1 … m | Max Block Size<br>Maximum Size of Block per Packet |
| ulChannelNo | uint32_t | 0 … 3<br>4 … 5<br>0xFFFFFFFF | Channel Number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if file name contains a path information |
| usFileNameLength | uint16_t | n | Length of Name<br>Length of Following File Name (in Bytes) |
| | uint8_t | ASCII | File Name<br>ASCII string, zero terminated |

*Table 33: HIL_FILE_UPLOAD_REQ_T – File Upload request*

#### Packet structure reference

```
/* FILE UPLOAD COMMAND */
#define HIL_FILE_UPLOAD_REQ                0x00001E60

/* PACKET SEQUENCE */
#define HIL_PACKET_SEQ_NONE                0x00000000

/* TRANSFER TYPE */
#define HIL_FILE_XFER_FILE                 0x00000001

/* CHANNEL Number */
#define HIL_FILE_CHANNEL_0                 (0)
#define HIL_FILE_CHANNEL_1                 (1)
#define HIL_FILE_CHANNEL_2                 (2)
#define HIL_FILE_CHANNEL_3                 (3)
#define HIL_FILE_CHANNEL_4                 (4)
#define HIL_FILE_CHANNEL_5                 (5)
#define HIL_FILE_SYSTEM                    (0xFFFFFFFF)
```

```
typedef struct HIL_FILE_UPLOAD_REQ_DATA_Ttag
{
  uint32_t ulXferType;                    /* transfer type               */
  uint32_t ulMaxBlockSize;                /* block size                  */
  uint32_t ulChannelNo;                   /* channel number              */
  uint16_t usFileNameLength;              /* length of file name         */
  /* a NULL-terminated file name follows here                           */
  /* uint8_t   abFileName[ ];                file name                  */
} HIL_FILE_UPLOAD_REQ_DATA_T;

typedef struct HIL_FILE_UPLOAD_REQ_Ttag
{
  HIL_PACKET_HEADER           tHead;      /* packet header               */
  HIL_FILE_UPLOAD_REQ_DATA_T  tData;      /* packet data                 */
} HIL_FILE_UPLOAD_REQ_T;
```

### File Upload confirmation

The netX system acknowledges the request with the following confirmation packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>8<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E61 | HIL_FILE_UPLOAD_CNF_T |
| ulId | uint32_t | From Request | Packet Identifier |
| Data | | | |
| ulMaxBlockSize | uint32_t | n | Max Block Size<br>Maximum Size of Block per Packet |
| ulFileLength | uint32_t | n | File Length<br>Total File Length (in Bytes) |

*Table 34: HIL_FILE_UPLOAD_CNF_T – File Upload confirmation*

### Packet structure reference

```
/* FILE UPLOAD CONFIRMATION */
#define HIL_FILE_UPLOAD_CNF                 HIL_FILE_UPLOAD_REQ+1

/* PACKET SEQUENCE */
#define HIL_PACKET_SEQ_NONE                 0x00000000

typedef struct HIL_FILE_UPLOAD_CNF_DATA_Ttag
{
  uint32_t ulMaxBlockSize;            /* maximum block size possible     */
  uint32_t ulFileLength;              /* file size to transfer           */
} HIL_FILE_UPLOAD_CNF_DATA_T;

typedef struct HIL_FILE_UPLOAD_CNF_Ttag
{
  HIL_PACKET_HEADER           tHead;  /* packet header                   */
  HIL_FILE_UPLOAD_CNF_DATA_T  tData;  /* packet data                     */
} HIL_FILE_UPLOAD_CNF_T;
```

### 3.7.5.2 File Upload Data

This packet is used to transfer a block of data from the netX system to the user application. The term *data block* is used to describe a portion of a file. The data block in the packet is identified by a block or sequence number and is secured through a continuous CRC32 checksum.

#### File Upload Data request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001E6E | HIL_FILE_UPLOAD_DATA_REQ |
| ulId | uint32_t | ulId+1 | Packet Identifer<br>**Note:** Should be incremented for each request |
| ulExt | uint32_t | 0x00000000<br>0x00000080<br>0x000000C0<br>0x00000040 | Extension<br>HIL_PACKET_SEQ_NONE (if data fits into one packet)<br>HIL_PACKET_SEQ_FIRST<br>HIL_PACKET_SEQ_MIDDLE<br>HIL_PACKET_SEQ_LAST |

*Table 35: HIL_FILE_UPLOAD_DATA_REQ_T – File Upload Data request*

#### Packet structure reference

```
/* FILE UPLOAD DATA REQUEST */
#define HIL_FILE_UPLOAD_DATA_REQ            0x00001E6E

/* PACKET SEQUENCE */
#define HIL_PACKET_SEQ_NONE                 0x00000000
#define HIL_PACKET_SEQ_FIRST                0x00000080
#define HIL_PACKET_SEQ_MIDDLE               0x000000C0
#define HIL_PACKET_SEQ_LAST                 0x00000040

typedef struct HIL_FILE_UPLOAD_DATA_REQ_Ttag
{
  PACKET_HEADER    tHead;               /* packet header              */
} HIL_FILE_UPLOAD_DATA_REQ_T;
```

### File Upload Data confirmation

The confirmation contains the block number and the expected CRC32 checksum of the data block.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulLen` | uint32_t | 8 + n<br>0 | Packet Data Length (in Bytes)<br>If `ulSta` = `SUCCESS_HIL_OK`<br>Otherwise |
| `ulSta` | uint32_t | See Below | Status / Error Code, see Section 6 |
| `ulCmd` | uint32_t | 0x00001E6F | HIL_FILE_UPLOAD_DATA_CNF |
| `ulId` | uint32_t | Any | Packet Identifier |
| Data | | | |
| `ulBlockNo` | uint32_t | 0 … m | Block Number<br>Block or Sequence Number |
| `ulChksum` | uint32_t | S | Checksum<br>CRC32 Polynomial |
| | uint8_t | | File Data Block (Size is n given in *`ulLen`*) |

*Table 36: HIL_FILE_UPLOAD_DATA_CNF_T – File Upload Data confirmation*

### Packet structure reference

```
/* FILE DATA UPLOAD CONFIRMATION */
#define HIL_FILE_UPLOAD_DATA_CNF            HIL_FILE_UPLOAD_DATA_REQ +1

/* PACKET SEQUENCE */
#define HIL_PACKET_SEQ_NONE                 0x00000000

typedef struct HIL_FILE_UPLOAD_DATA_CNF_DATA_Ttag
{
  uint32_t ulBlockNo;                     /* block number starting from 0 */
  uint32_t ulChksum;                      /* cumulative CRC-32 checksum   */
  /* data block follows here                                              */
  /* uint8_t   abData[ ];                                                 */
} HIL_FILE_UPLOAD_DATA_CNF_DATA_T;

typedef struct HIL_FILE_UPLOAD_DATA_CNF_Ttag
{
  HIL_PACKET_HEADER               tHead;   /* packet header             */
  HIL_FILE_UPLOAD_DATA_CNF_DATA_T tData;   /* packet data               */
} HIL_FILE_UPLOAD_DATA_CNF_T;
```

### Block Number *`ulBlockNo`*

The block number *ulBlockNo* starts with zero for the first data packet and is incremented by one for every following packet. The netX operating system sends the file in the order of its original sequence. Sequence numbers are not skipped or used twice.

### Checksum *`ulChksum`*

The checksum *ulChksum* is calculated as a CRC32 polynomial. It is calculated continuously over all data packets that were sent already. A sample to calculate the checksum is included in the toolkit for netX based products.

### 3.7.5.3 File Upload Abort

In case of an error (*ulSta* not equal to SUCCESS_HIL_OK) during an upload, the application has to cancel the upload procedure by sending the abort command.

If necessary, the application can use the command abort an upload procedure at any time.

#### File Upload Abort request

| **Structure Information:** *HIL_FILE_UPLOAD_ABORT_REQ_T* | | | |
|---|---|---|---|
| **Variable** | **Type** | **Value / Range** | **Description** |
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001E5E | HIL_FILE_UPLOAD_ABORT_REQ |
| ulId | uint32_t | Any | Packet Identifer as Unique Number |

*Table 37: HIL_FILE_UPLOAD_ABORT_REQ_T – File Upload Abort request*

#### Packet structure reference

```
/* FILE ABORT UPLOAD REQUEST */
#define HIL_FILE_UPLOAD_ABORT_REQ           0x00001E5E

typedef struct HIL_FILE_UPLOAD_ABORT_REQ_Ttag
{
  HIL_PACKET_HEADER     tHead;            /* packet header               */
} HIL_FILE_UPLOAD_ABORT_REQ_T;
```

#### File Upload Abort confirmation

The system acknowledges an abort command with the following confirmation packet.

| **Structure Information:** *HIL_FILE_UPLOAD_ABORT_CNF_T* | | | |
|---|---|---|---|
| **Variable** | **Type** | **Value / Range** | **Description** |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E5F | HIL_FILE_UPLOAD_ABORT_CNF |

*Table 38: HIL_FILE_UPLOAD_ABORT_CNF_T – File Upload Abort confirmation*

#### Packet structure reference

```
/* FILE ABORT UPLOAD CONFIRMATION */
#define HIL_FILE_UPLOAD_ABORT_CNF           HIL_FILE_UPLOAD_ABORT_REQ+1

typedef struct HIL_FILE_UPLOAD_ABORT_CNF_Ttag
{
  HIL_PACKET_HEADER     tHead;            /* packet header               */
} HIL_FILE_UPLOAD_ABORT_CNF_T;
```

### 3.7.6 Delete a File

If the target hardware supports a FLASH/RAM based file system, all downloaded files like firmware (FLASH only), configuration and user files are stored in the file system.

**Note:** Installed firmware files of PORT_0 cannot be deleted as these are not stored in the file system.

The following service can be used to delete files from the target files system.

#### File Delete request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 6 + n | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E6A | HIL_FILE_DELETE_REQ |
| Data | | | |
| ulChannelNo | uint32_t | 0 … 3<br>4 … 5<br>0xFFFFFFFF | Channel Number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if file name contains a path information |
| usFileName Length | uint16_t | n | Length of Name<br>Length of the Following File Name (in Bytes) |
| | uint8_t | ASCII | File Name<br>ASCII string, zero terminated |

*Table 39: HIL_FILE_DELETE_REQ_T – File Delete request*

#### Packet structure reference

```
/* FILE DELETE REQUEST */
#define HIL_FILE_DELETE_REQ                 0x00001E6A

/* Channel Number */
#define HIL_FILE_CHANNEL_0                  (0)
#define HIL_FILE_CHANNEL_1                  (1)
#define HIL_FILE_CHANNEL_2                  (2)
#define HIL_FILE_CHANNEL_3                  (3)
#define HIL_FILE_CHANNEL_4                  (4)
#define HIL_FILE_CHANNEL_5                  (5)
#define HIL_FILE_SYSTEM                     (0xFFFFFFFF)

typedef struct HIL_FILE_DELETE_REQ_DATA_Ttag
{
  uint32_t    ulChannelNo;          /* 0 = channel 0 ... 5 = channel 5        */
                                    /* 0xFFFFFFFF = system, see HIL_FILE_xxxx */
  uint16_t    usFileNameLength;     /* length of NULL-terminated file name    */
  /* a NULL-terminated file name will follow here */
} HIL_FILE_DELETE_REQ_DATA_T;

typedef struct HIL_FILE_DELETE_REQ_Ttag
{
  HIL_PACKET_HEADER            tHead;          /* packet header               */
  HIL_FILE_DELETE_REQ_DATA_T   tData;          /* packet data                 */
} HIL_FILE_DELETE_REQ_T;
```

### File Delete confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E6B | HIL_FILE_DELETE_CNF |

*Table 40: HIL_FILE_DELETE_CNF_T – File Delete confirmation*

### Packet structure reference

```
/* FILE DELETE REQUEST */
#define HIL_FILE_DELETE_CNF                  HIL_FILE_DELETE_REQ+1

typedef struct HIL_FILE_DELETE_CNF_Ttag
{
  HIL_PACKET_HEADER       tHead;                /* packet header       */
} HIL_FILE_DELETE_CNF_T;
```

### 3.7.7 Rename a File

This service can be used to rename files in the target file system.

**Note:** Installed firmware files of `PORT_0` cannot be renamed as these are not stored in the file system.

#### File Rename request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| `ulLen` | uint32_t | 8+m+n | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001E7C | HIL_FILE_RENAME_REQ |
| Data | | | |
| `ulChannelNo` | uint32_t | 0 … 3<br>4 … 5<br>0xFFFFFFFF | Channel Number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if file name contains a path information |
| `usOldNameLength` | uint16_t | m | Length of Old File Name<br>Length of following NULL terminated old File Name (in Bytes) |
| `usNewNameLength` | uint16_t | n | Length of New File Name<br>Length of following NULL terminated new File Name (in Bytes) |
| | uint8_t | ASCII | Old File Name<br>ASCII string, zero terminated |
| | uint8_t | ASCII | New File Name<br>ASCII string, zero terminated |

*Table 41: HIL_FILE_RENAME_REQ_T – File Rename request*

#### Packet structure reference

```
/* FILE RENAME REQUEST */
#define HIL_FILE_RENAME_REQ                0x00001E7C

#define HIL_FILE_CHANNEL_0                   (0)
#define HIL_FILE_CHANNEL_1                   (1)
#define HIL_FILE_CHANNEL_2                   (2)
#define HIL_FILE_CHANNEL_3                   (3)
#define HIL_FILE_CHANNEL_4                   (4)
#define HIL_FILE_CHANNEL_5                   (5)
#define HIL_FILE_SYSTEM                      (0xFFFFFFFF)

typedef struct HIL_FILE_RENAME_REQ_DATA_Ttag
{
  uint32_t  ulChannelNo;     /* 0..5 = Channel 0..5, 0xFFFFFFFF = System */
  uint16_t  usOldNameLength; /* length of NUL-terminated old file name
                                that will follow */
  uint16_t  usNewNameLength; /* length of NUL-terminated new file name
                                that will follow */

  /* old NUL-terminated file name will follow here */
  /* new NUL-terminated file name will follow here */
} HIL_FILE_RENAME_REQ_DATA_T;

typedef struct HIL_FILE_RENAME_REQ_Ttag
{
  HIL_PACKET_HEADER          tHead;        /* packet header */
  HIL_FILE_RENAME_REQ_DATA_T tData;        /* packet data */
} HIL_FILE_RENAME_REQ_T;
```

### File Rename confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E7D | HIL_FILE_RENAME_CNF |

*Table 42: HIL_FILE_RENAME_CNF_T – File Rename confirmation*

### Packet structure reference

```
/* FILE RENAME CONFIRMATION */
#define HIL_FILE_RENAME_CNF                HIL_FILE_RENAME_REQ+1

typedef struct HIL_FILE_RENAME_CNF_Ttag
{
  HIL_PACKET_HEADER tHead;                 /* packet header */
} HIL_FILE_RENAME_CNF_T;
```

## 3.7.8 Creating a CRC32 Checksum

This is an example which shows the generation of a CRC32 checksum, necessary for certain file functions like a file download (such an example can also be found in the internet).

```
/*****************************************************************************/
/*! Create a CRC32 value from the given buffer data
*   \param ulCRC continued CRC32 value
*   \param pabBuffer buffer to create the CRC from
*   \param ulLength buffer length
*   \return CRC32 value                                                      */
/*****************************************************************************/
static unsigned long CreateCRC32( unsigned long  ulCRC,
                                  unsigned char* pabBuffer,
                                  unsigned long  ulLength )
{
  if( (0 == pabBuffer) || (0 == ulLength) )
  {
    return ulCRC;
  }
  ulCRC = ulCRC ^ 0xffffffff;
  for(;ulLength > 0; --ulLength)
  {
    ulCRC = (Crc32Table[((ulCRC) ^ (*(pabBuffer++)) ) & 0xff] ^ ((ulCRC) >> 8));
  }
  return( ulCRC ^ 0xffffffff );
}
```

```
/*****************************************************************************/
/*! CRC 32 lookup table                                                      */
/*****************************************************************************/
static unsigned long Crc32Table[256]=
{
  0x00000000UL, 0x77073096UL, 0xee0e612cUL, 0x990951baUL, 0x076dc419UL, 0x706af48fUL, 0xe963a535UL,
  0x9e6495a3UL, 0x0edb8832UL, 0x79dcb8a4UL, 0xe0d5e91eUL, 0x97d2d988UL, 0x09b64c2bUL, 0x7eb17cbdUL,
  0xe7b82d07UL, 0x90bf1d91UL, 0x1db71064UL, 0x6ab020f2UL, 0xf3b97148UL, 0x84be41deUL, 0x1adad47dUL,
  0x6ddde4ebUL, 0xf4d4b551UL, 0x83d385c7UL, 0x136c9856UL, 0x646ba8c0UL, 0xfd62f97aUL, 0x8a65c9ecUL,
  0x14015c4fUL, 0x63066cd9UL, 0xfa0f3d63UL, 0x8d080df5UL, 0x3b6e20c8UL, 0x4c69105eUL, 0xd56041e4UL,
  0xa2677172UL, 0x3c03e4d1UL, 0x4b04d447UL, 0xd20d85fdUL, 0xa50ab56bUL, 0x35b5a8faUL, 0x42b2986cUL,
  0xdbbbc9d6UL, 0xacbcf940UL, 0x32d86ce3UL, 0x45df5c75UL, 0xdcd60dcfUL, 0xabd13d59UL, 0x26d930acUL,
  0x51de003aUL, 0xc8d75180UL, 0xbfd06116UL, 0x21b4f4b5UL, 0x56b3c423UL, 0xcfba9599UL, 0xb8bda50fUL,
  0x2802b89eUL, 0x5f058808UL, 0xc60cd9b2UL, 0xb10be924UL, 0x2f6f7c87UL, 0x58684c11UL, 0xc1611dabUL,
  0xb6662d3dUL, 0x76dc4190UL, 0x01db7106UL, 0x98d220bcUL, 0xefd5102aUL, 0x71b18589UL, 0x06b6b51fUL,
  0x9fbfe4a5UL, 0xe8b8d433UL, 0x7807c9a2UL, 0x0f00f934UL, 0x9609a88eUL, 0xe10e9818UL, 0x7f6a0dbbUL,
  0x086d3d2dUL, 0x91646c97UL, 0xe6635c01UL, 0x6b6b51f4UL, 0x1c6c6162UL, 0x856530d8UL, 0xf262004eUL,
  0x6c0695edUL, 0x1b01a57bUL, 0x8208f4c1UL, 0xf50fc457UL, 0x65b0d9c6UL, 0x12b7e950UL, 0x8bbeb8eaUL,
  0xfcb9887cUL, 0x62dd1ddfUL, 0x15da2d49UL, 0x8cd37cf3UL, 0xfbd44c65UL, 0x4db26158UL, 0x3ab551ceUL,
  0xa3bc0074UL, 0xd4bb30e2UL, 0x4adfa541UL, 0x3dd895d7UL, 0xa4d1c46dUL, 0xd3d6f4fbUL, 0x4369e96aUL,
  0x346ed9fcUL, 0xad678846UL, 0xda60b8d0UL, 0x44042d73UL, 0x33031de5UL, 0xaa0a4c5fUL, 0xdd0d7cc9UL,
  0x5005713cUL, 0x270241aaUL, 0xbe0b1010UL, 0xc90c2086UL, 0x5768b525UL, 0x206f85b3UL, 0xb966d409UL,
  0xce61e49fUL, 0x5edef90eUL, 0x29d9c998UL, 0xb0d09822UL, 0xc7d7a8b4UL, 0x59b33d17UL, 0x2eb40d81UL,
  0xb7bd5c3bUL, 0xc0ba6cadUL, 0xedb88320UL, 0x9abfb3b6UL, 0x03b6e20cUL, 0x74b1d29aUL, 0xead54739UL,
  0x9dd277afUL, 0x04db2615UL, 0x73dc1683UL, 0xe3630b12UL, 0x94643b84UL, 0x0d6d6a3eUL, 0x7a6a5aa8UL,
  0xe40ecf0bUL, 0x9309ff9dUL, 0x0a00ae27UL, 0x7d079eb1UL, 0xf00f9344UL, 0x8708a3d2UL, 0x1e01f268UL,
  0x6906c2feUL, 0xf762575dUL, 0x806567cbUL, 0x196c3671UL, 0x6e6b06e7UL, 0xfed41b76UL, 0x89d32be0UL,
  0x10da7a5aUL, 0x67dd4accUL, 0xf9b9df6fUL, 0x8ebeeff9UL, 0x17b7be43UL, 0x60b08ed5UL, 0xd6d6a3e8UL,
  0xa1d1937eUL, 0x38d8c2c4UL, 0x4fdff252UL, 0xd1bb67f1UL, 0xa6bc5767UL, 0x3fb506ddUL, 0x48b2364bUL,
  0xd80d2bdaUL, 0xaf0a1b4cUL, 0x36034af6UL, 0x41047a60UL, 0xdf60efc3UL, 0xa867df55UL, 0x316e8eefUL,
  0x4669be79UL, 0xcb61b38cUL, 0xbc66831aUL, 0x256fd2a0UL, 0x5268e236UL, 0xcc0c7795UL, 0xbb0b4703UL,
  0x220216b9UL, 0x5505262fUL, 0xc5ba3bbeUL, 0xb2bd0b28UL, 0x2bb45a92UL, 0x5cb36a04UL, 0xc2d7ffa7UL,
  0xb5d0cf31UL, 0x2cd99e8bUL, 0x5bdeae1dUL, 0x9b64c2b0UL, 0xec63f226UL, 0x756aa39cUL, 0x026d930aUL,
  0x9c0906a9UL, 0xeb0e363fUL, 0x72076785UL, 0x05005713UL, 0x95bf4a82UL, 0xe2b87a14UL, 0x7bb12baeUL,
  0x0cb61b38UL, 0x92d28e9bUL, 0xe5d5be0dUL, 0x7cdcefb7UL, 0x0bdbdf21UL, 0x86d3d2d4UL, 0xf1d4e242UL,
  0x68ddb3f8UL, 0x1fda836eUL, 0x81be16cdUL, 0xf6b9265bUL, 0x6fb077e1UL, 0x18b74777UL, 0x88085ae6UL,
  0xff0f6a70UL, 0x66063bcaUL, 0x11010b5cUL, 0x8f659effUL, 0xf862ae69UL, 0x616bffd3UL, 0x166ccf45UL,
  0xa00ae278UL, 0xd70dd2eeUL, 0x4e048354UL, 0x3903b3c2UL, 0xa7672661UL, 0xd06016f7UL, 0x4969474dUL,
  0x3e6e77dbUL, 0xaed16a4aUL, 0xd9d65adcUL, 0x40df0b66UL, 0x37d83bf0UL, 0xa9bcae53UL, 0xdebb9ec5UL,
  0x47b2cf7fUL, 0x30b5ffe9UL, 0xbdbdf21cUL, 0xcabac28aUL, 0x53b39330UL, 0x24b4a3a6UL, 0xbad03605UL,
  0xcdd70693UL, 0x54de5729UL, 0x23d967bfUL, 0xb3667a2eUL, 0xc4614ab8UL, 0x5d681b02UL, 0x2a6f2b94UL,
  0xb40bbe37UL, 0xc30c8ea1UL, 0x5a05df1bUL, 0x2d02ef8dUL
};
```

## 3.7.9 Read MD5 File Checksum

This function can be used to read the MD5 checksum of a given file. The checksum will be generated during the request over the actual file data.

### File Get MD5 request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 6 + n | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E68 | HIL_FILE_GET_MD5_REQ |
| Data | | | |
| ulChannelNo | uint32_t | 0 … 3<br>4 … 5<br>0xFFFFFFFF | Channel Number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if file name contains a path information |
| usFileName Length | uint16_t | n | Length of Name<br>Length of the Following File Name (in Bytes) |
| | uint8_t | ASCII | File Name<br>ASCII string, zero terminated |

*Table 43: HIL_FILE_GET_MD5_REQ_T – File Get MD5 request*

### Packet structure reference

```
/* REQUEST MD5 FILE CHECKSUM REQUEST */
#define HIL_FILE_GET_MD5_REQ                0x00001E68

#define HIL_FILE_CHANNEL_0                  (0)
#define HIL_FILE_CHANNEL_1                  (1)
#define HIL_FILE_CHANNEL_2                  (2)
#define HIL_FILE_CHANNEL_3                  (3)
#define HIL_FILE_CHANNEL_4                  (4)
#define HIL_FILE_CHANNEL_5                  (5)
#define HIL_FILE_SYSTEM                     (0xFFFFFFFF)

typedef struct HIL_FILE_GET_MD5_REQ_DATA_Ttag
{
  uint32_t   ulChannelNo;         /* 0 = Channel 0 ... 5 = Channel 5,        */
                                  /* 0xFFFFFFFF = System, see HIL_FILE_xxxx  */
  uint16_t   usFileNameLength;    /* length of NULL-terminated file name     */

  /* a NULL-terminated file name will follow here */
} HIL_FILE_GET_MD5_REQ_DATA_T;

typedef struct HIL_FILE_GET_MD5_REQ_Ttag
{
  PACKET_HEADER                   tHead;       /* packet header              */
  HIL_FILE_GET_MD5_REQ_DATA_T     tData;       /* packet data                */
} HIL_FILE_GET_MD5_REQ_T;
```

### File Get MD5 confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>16<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E69 | HIL_FILE_GET_MD5_CNF |
| Data | | | |
| abMD5[16] | uint8_t | 0 … 0xFF | MD5 checksum |

*Table 44: HIL_FILE_GET_MD5_CNF_T – File Get MD5 confirmation*

### Packet structure reference

```
/* REQUEST MD5 FILE CHECKSUM REQUEST */
#define HIL_FILE_GET_MD5_CNF                HIL_FILE_GET_MD5_REQ+1

typedef struct HIL_FILE_GET_MD5_CNF_DATA_Ttag
{
  uint8_t      abMD5[16];          /* MD5 checksum                */
} HIL_FILE_GET_MD5_CNF_DATA_T;

typedef struct HIL_FILE_GET_MD5_CNFtag
{
  HIL_PACKET_HEADER              tHead;     /* packet header      */
  HIL_FILE_GET_MD5_CNF_DATA_T    tData;     /* packet data        */
} HIL_FILE_GET_MD5_CNF_T;
```

## 3.7.10 Read MD5 File Checksum from File Header

System files like the firmware and the configuration database files are containing a MD5 checksum in their file header. This checksum can be read by using this function.

### File Get Header MD5 request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 6+n | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E72 | HIL_FILE_GET_HEADER_MD5_REQ |
| Data | | | |
| ulChannelNo | uint32_t | 0 … 3<br>4 … 5<br>0xFFFFFFFF | Channel Number<br>Communication Channel 0 … 3<br>Application Channel 0 … 1<br>System Channel<br>**Note:** ignored if file name contains a path information |
| usFileName Length | uint16_t | n | Length of Name<br>Length of the Following File Name (in Bytes) |
| | uint8_t | ASCII | File Name<br>ASCII string, zero terminated |

*Table 45: HIL_FILE_GET_HEADER_MD5_REQ_T – File Get Header MD5 request*

### Packet structure reference

```
/* REQUEST MD5 FILE HEADER CHECKSUM REQUEST */
#define HIL_FILE_GET_HEADER_MD5_REQ        0x00001E72

/* This packet has the same structure, so we are using a typedef here */
typedef HIL_FILE_GET_MD5_REQ_T  HIL_FILE_GET_HEADER_MD5_REQ_T
```

### File Get Header MD5 confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 16<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E73 | HIL_FILE_GET_HEADER_MD5_CNF |
| Data | | | |
| abMD5[16] | uint8_t | 0 … 0xFF | MD5 checksum |

*Table 46: HIL_FILE_GET_HEADER_MD5_CNF_T – File Get Header MD5 confirmation*

### Packet structure reference

```
/* REQUEST MD5 FILE HEADER CHECKSUM CONFIRMATION */
#define HIL_FILE_GET_HEADER_MD5_CNF        HIL_FILE_GET_HEADER_MD5_REQ+1

/* This packet has the same structure, so we are using a typedef here */
typedef HIL_FILE_GET_MD5_CNF_T  HIL_FILE_GET_HEADER_MD5_CNF_T
```

# 3.8 Format the Default Partition

This request can be used to format the default partition of the target file system. This service is only available for a firmware with file system. A format operation can take some time (depends on the size of the partition). A confirmation packet will be receive once the format has finished or if an error has occurred. During the format the SYS-LED will blink green until the operation is finished.

The supported formatting options are a quick format and a full format.

- The quick format will recreate the FAT volume only.
- The full format will erase the Flash, recreate the FTL and a new FAT volume.

The FTL volume is used for wear leveling and should only be created once. Otherwise wear information about the Flash blocks will be lost. Ideally, the full format is only executed once during production.

**Attention:** Formatting the partition will erase all files in the file system. It will not delete installed firmware files since those are not stored in the file system.

### Format request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 8 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001ED6 | HIL_FORMAT_REQ |
| Data | | | |
| ulFlags | uint32_t | 0x00000000<br>0x00000001 | Type of format operation<br>HIL_FORMAT_REQ_DATA_FLAGS_QUICKFORMAT<br>HIL_FORMAT_REQ_DATA_FLAGS_FULLFORMAT |
| ulReserved | uint32_t | 0 | Reserved, unsed |

*Table 47: HIL_FORMAT_REQ_T – Format request*

### Packet structure reference

```
/* FORMAT REQUEST */
#define HIL_FORMAT_REQ                      0x00001ED6

#define HIL_FORMAT_REQ_DATA_FLAGS_QUICKFORMAT 0x00000000
#define HIL_FORMAT_REQ_DATA_FLAGS_FULLFORMAT  0x00000001

typedef struct HIL_FORMAT_REQ_DATA_Ttag
{
  uint32_t  ulFlags;
  uint32_t  ulReserved;
} HIL_FORMAT_REQ_DATA_T;

typedef struct HIL_FORMAT_REQ_Ttag
{
  HIL_PACKET_HEADER                     tHead;                  /* packet header */
  HIL_FORMAT_REQ_DATA_T                 tData;
} HIL_FORMAT_REQ_T;
```

### Format confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 8 | Packet Data Length (in Bytes)<br>Always |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001ED7 | HIL_FORMAT_CNF |
| Data | | | |
| ulExtended ErrorInfo | uint32_t | | Set if full format failed during a verify operation.<br>Last byte verified at offset *ulErrorOffset* (if failed during verify operation). |
| ulErrorOffset | uint32_t | | Offset the error was encountered on |

*Table 48: HIL_FORMAT_CNF_T – Format confirmation*

### Packet structure reference

```
/* FORMAT CONFIRMATION */
#define HIL_FORMAT_CNF                      HIL_FORMAT_REQ+1

typedef struct HIL_FORMAT_CNF_DATA_Ttag
{
  /* Valid if format has failed during a full format with an error during
     verification (ulSta = ERR_HIL_VERIFICATION) */
  uint32_t  ulExtendedErrorInfo;
  uint32_t  ulErrorOffset;
} HIL_FORMAT_CNF_DATA_T;

typedef struct HIL_FORMAT_CNF_Ttag
{
  HIL_PACKET_HEADER                     tHead;                  /* packet header */
  HIL_FORMAT_CNF_DATA_T                 tData;
} HIL_FORMAT_CNF_T;
```

# 3.9 Determining the DPM Layout

The layout of the dual-port memory (DPM) can be determined by evaluating the content of the *System Channel Information Block*.

To obtain the logical layout of a channel, the application has to send a packet to the firmware through the system block's mailbox area. The protocol stack replies with one or more messages containing the description of the channel.

Each memory area of a channel has an offset address and an identifier to indicate the type of area (e.g. IO process data image, send/receive mailbox, parameter, status or port specific area.)

### DPM Get Block Information request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| `ulLen` | uint32_t | 8 | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001EF8 | HIL_DPM_GET_BLOCK_INFO_REQ |
| Data | | | |
| `ulAreaIndex` | uint32_t | 0 … 7 | Area Index (see below) |
| `ulSubblockIndex` | uint32_t | 0 … 0xFFFFFFFF | Sub Block Index (see below) |

*Table 49: HIL_DPM_GET_BLOCK_INFO_REQ_T – DPM Get Block Information request*

### Packet structure reference

```
/* GET BLOCK INFORMATION REQUEST */
#define HIL_DPM_GET_BLOCK_INFO_REQ          0x00001EF8

typedef struct HIL_DPM_GET_BLOCK_INFO_REQ_DATA_Ttag
{
  uint32_t ulAreaIndex;                     /* area index               */
  uint32_t ulSubblockIndex;                 /* sub block index          */
} HIL_DPM_GET_BLOCK_INFO_REQ_DATA_T;

typedef struct HIL_DPM_GET_BLOCK_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER                 tHead;  /* packet header            */
  HIL_DPM_GET_BLOCK_INFO_REQ_DATA_T tData;  /* packet data              */
} HIL_DPM_GET_BLOCK_INFO_REQ_T;
```

### Area Index *ulAreaIndex*

This field holds the index of the channel. The system channel is identified by an index number of 0; the handshake has index 1, the first communication channel has index 2 and so on.

### Sub Block Index *ulSubblockIndex*

The sub block index field identifies each of the blocks that reside in the dual-port memory interface for the specified communication channel.

### DPM Get Block Information confirmation

The firmware replies with the following message.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>28<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EF9 | HIL_GET_BLOCK_INFO_CNF |
| Data | | | |
| ulAreaIndex | uint32_t | 0, 1, … 7 | Area Index (Channel Number) |
| ulSubblockIndex | uint32_t | 0 … 0xFFFFFFFF | Number of Sub Blocks (see below) |
| ulType | uint32_t | 0 … 0x0009 | Type of Sub Block (see below) |
| ulOffset | uint32_t | 0 … 0xFFFFFFFF | Offset of Sub Block within the Area |
| ulSize | uint32_t | 0 … 65535 | Size of Sub Block (see below) |
| usFlags | uint16_t | 0 … 0x0023 | Transmission Flags of Sub Block (see below) |
| usHandshakeMode | uint16_t | 0 … 0x0004 | Handshake Mode (see below) |
| usHandshakeBit | uint16_t | 0 … 0x00FF | Bit Position in the Handshake Register |
| usReserved | uint16_t | 0 | Reserved, unused |

*Table 50: HIL_DPM_GET_BLOCK_INFO_CNF_T – DPM Get Block Information confirmation*

### Packet structure reference

```
/* GET BLOCK INFORMATION CONFIRMATION */
#define HIL_DPM_GET_BLOCK_INFO_CNF          HIL_DPM_GET_BLOCK_INFO_REQ+1

typedef struct HIL_DPM_GET_BLOCK_INFO_CNF_DATA_Ttag
{
  uint32_t ulAreaIndex;      /* area index                                */
  uint32_t ulSubblockIndex;  /* number of sub block                       */
  uint32_t ulType;           /* type of sub block                         */
  uint32_t ulOffset;         /* offset of this sub block within the area  */
  uint32_t ulSize;           /* size of the sub block                     */
  uint16_t usFlags;          /* flags of the sub block                    */
  uint16_t usHandshakeMode;  /* handshake mode                            */
  uint16_t usHandshakeBit;   /* bit position in the handshake register    */
  uint16_t usReserved;       /* reserved                                  */
} HIL_DPM_GET_BLOCK_INFO_CNF_DATA_T;

typedef struct HIL_DPM_GET_BLOCK_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header             */
  HIL_DPM_GET_BLOCK_INFO_CNF_DATA_T tData;   /* packet data               */
} HIL_DPM_GET_BLOCK_INFO_CNF_T;
```

#### Area Index *ulAreaIndex*

This field defines the channel number that the block belongs to. The system channel has the number 0; the handshake channel has the number 1; the first communication channel has the number 2 and so on (max. 7).

#### Sub Block Index *ulSubblockIndex*

This field holds the number of the block.

### Sub Block Type *ulType*

This field is used to identify the sub block type. The following types are defined.

| Value | Definition / Description |
|---|---|
| 0x0000 | UNDEFINED |
| 0x0001 | UNKNOWN |
| 0x0002 | PROCESS DATA IMAGE |
| 0x0003 | HIGH PRIORITY DATA IMAGE |
| 0x0004 | MAILBOX |
| 0x0005 | COMON CONTROL |
| 0x0006 | COMMON STATUS |
| 0x0007 | EXTENDED STATUS |
| 0x0008 | USER |
| 0x0009 | RESERVED |
| Other values are reserved | |

*Table 51: Sub Block Type*

### Offset *ulOffset*

This field holds the offset of the block based on the start offset of the channel.

### Size *ulSize*

The size field holds the length of the block section in multiples of bytes.

### Transmission Flags *usFlags*

The flags field is separated into nibbles (4 bit entities). The lower nibble is the *Transfer Direction* and holds information regarding the data direction from the view point of the application. The *Transmission Type* nibble defines how data are physically exchanged with this sub block.

**Attention**: This information is statically set in the firmware during start-up and not updated during run-time even if options are changed by the application (e.g. switch to DMA mode).

| Bit No. | Definition / Description |
|---|---|
| 0-3 | Transfer Direction<br>0 UNDEFINED<br>1 IN (netX to Host System)<br>2 OUT (Host System to netX)<br>3 IN – OUT (Bi-Directional)<br>Other values are reserved |
| 4-7 | Transmission Type<br>0 UNDEFINED<br>1 DPM (Dual-Port Memory)<br>2 DMA (Direct Memory Access)<br>Other values are reserved |
| 8-15 | Reserved, set to 0 |

*Table 52: Transmission Flags*

**Handshake Mode** *usHandshakeMode*

The handshake mode is defined only for IO data images.

| Value | Definition / Description |
|---|---|
| 0x0000 | UNKNOWN |
| 0x0003 | UNCONTROLLED |
| 0x0004 | BUFFERED, HOST CONTROLLED |
| Other values are reserved | |

*Table 53: Hand Shake Mode*

**Handshake Bit Position** *usHandshakeBit*

Handshake bits are located in the handshake register of a channel and used to synchronize data access to a given data block. The bit position defines the bit number of the used synchronization bit. The handshake registers itself are located in the *Handshake Channel*. The handling of the handshake cells and synchronization bit is described in the *netX DPM interface Manual*.

**Note:** Not all combinations of values from this structure are allowed. Some are even contradictory and do not make sense.

# 3.10 Flash Device Label

A Hilscher device uses a *Flash Device Label* to store device-specific hardware data, e.g. serial number of the device. The FDL has multiple sections describing different kinds of data, has a header and a footer for identifying and validating the content.

The content of the FDL is written during production only. The application can read data stored in the FDL using the *Device Data Provider Get service* (page 81).

The header file `Hil_DeviceProductionData.h` contains definitions and structures for the FDL.

### Header

| Offset | Type | Name | Description |
|---|---|---|---|
| 0 | uint8_t | `abStartToken[12]` | Fixed String to detect the beginning of the device production data: “ProductData>”. |
| 12 | uint16_t | `usLabelSize` | Size of the complete Label inclusive header and the footer. |
| 14 | uint16_t | `usContentSize` | Size of the content only. |

### Basic Device Data

| Offset | Type | Name | Description |
|---|---|---|---|
| 16 | uint16_t | `usManufacturer` | Manufacturer ID managed and assigned by Hilscher GmbH.<br>0 = Undefined; 1 - 255 = Hilscher GmbH; 256 - x = OEM |
| 18 | uint16_t | `usDeviceClass` | Device classification number |
| 20 | uint32_t | `ulDeviceNumber` | Device number.<br>For usManufacturer 1-255 the numbers are managed by Hilscher GmbH. |
| 24 | uint32_t | `ulSerialNumber` | Serial number of the device. |
| 28 | uint8_t | `bHwCompatibility` | Hardware compatibility number. |
| 29 | uint8_t | `bHwRevision` | Hardware revision number. |
| 30 | uint16_t | `usProductionDate` | Production date in the format 0xYYWW:<br>Year = ((usProductionDate >> 8) & 0x00ff) + 2000<br>Week = ((usProductionDate >> 0) & 0x00ff)<br>e.g. 0C2Bh, where 0Ch is year 2012 and 2Bh is week 43. |
| 32 | uint8_t | `bReserved1` | Reserved, set to 0 |
| 33 | uint8_t | `bReserved2` | Reserved, set to 0 |
| 34 | uint8_t | `abReserved[14]` | Reserved, set to 0 |

### MAC addresses for communication side

| Offset | Type | Name | Description |
|---|---|---|---|
| 48 | uint8_t | abMacAddress[6] | 1st MAC address. |
| 54 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 56 | uint8_t | abMacAddress[6] | 2nd MAC address. |
| 62 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 64 | uint8_t | abMacAddress[6] | 3rd MAC address. |
| 70 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 72 | uint8_t | abMacAddress[6] | 4th MAC address. |
| 78 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 80 | uint8_t | abMacAddress[6] | 5th MAC address. |
| 86 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 88 | uint8_t | abMacAddress[6] | 6th MAC address. |
| 94 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 96 | uint8_t | abMacAddress[6] | 7th MAC address. |
| 102 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 104 | uint8_t | abMacAddress[6] | 8th MAC address. |
| 110 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |

### MAC addresses for application side

| Offset | Type | Name | Description |
|---|---|---|---|
| 112 | uint8_t | abMacAddress[6] | 1st MAC address. |
| 118 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 120 | uint8_t | abMacAddress[6] | 2nd MAC address. |
| 126 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 128 | uint8_t | abMacAddress[6] | 3rd MAC address. |
| 134 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |
| 136 | uint8_t | abMacAddress[6] | 4th MAC address. |
| 142 | uint8_t | abReserved[2] | 2 Bytes reserved for alignment, set to 0. |

### Product identification information

| Offset | Type | Name | Description |
|---|---|---|---|
| 144 | uint16_t | usUSBVendorID | USB Device Vendor ID (VID) |
| 146 | uint16_t | usUSBProductID | USB Device Product ID (PID) |
| 148 | uint8_t | abUSBVendorName[16] | USB Vendor Name. If the String has less than 16 char it must be null terminated to signal end of string. |
| 164 | uint8_t | abUSBProductName[16] | USB Product Name. If the String has less than 16 char it must be null terminated to signal end of string. |
| 180 | uint8_t | abReserved[76] | Reserved, set to 0. |

### OEM identification

| Offset | Type | Name | Description |
|---|---|---|---|
| 256 | uint32_t | ulOemDataOptionFlags | OEM Data Option Flags |
| 260 | char | szSerialNumber[28] | Serial number (NULL terminated) |
| 288 | char | szOrderNumber[32] | Order number (NULL terminated) |
| 320 | char | szHardwareRevision[16] | Hardware revision (NULL terminated) |
| 336 | char | szProductionDate[32] | Production date (Null terminated) |
| 368 | uint8_t | abReserved[12] | Reserved, set to 0 |
| 380 | uint8_t | abVendorData[112] | Vendor specific data |

### Flash layout

| Offset | Type | Name | Description |
|---|---|---|---|
| 492 | uint32_t | ulContentType | Area 0 Content Type |
| 496 | uint32_t | ulAreaStart | Area 0 Start Address |
| 500 | uint32_t | ulAreaSize | Area 0 Size |
| 504 | uint32_t | ulChipNumber | Area 0 Chip Number (Instance) |
| 508 | char | szName[16] | Area 0 Name |
| 524 | uint8_t | bAccessType | Area 0 Access Type |
| 525 | uint8_t | abReserved[3] | Reserved, set to 0 |
| 528 | | | Complete Area 1 (see description of Area 0) |
| 564 | | | Complete Area 2 (see description of Area 0) |
| 600 | | | Complete Area 3 (see description of Area 0) |
| 636 | | | Complete Area 4 (see description of Area 0) |
| 672 | | | Complete Area 5 (see description of Area 0) |
| 708 | | | Complete Area 6 (see description of Area 0) |
| 744 | | | Complete Area 7 (see description of Area 0) |
| 780 | | | Complete Area 8 (see description of Area 0) |
| 816 | | | Complete Area 9 (see description of Area 0) |
| 852 | uint32_t | ulChipNumber | Chip 0 Number 0..N (Instance) |
| 856 | char | szFlashName[16] | Chip 0 Flash driver name |
| 872 | uint32_t | ulBlockSize | Chip 0 Block size |
| 876 | uint32_t | ulFlashSize | Chip 0 Flash size |
| 880 | uint32_t | ulMaxEnduranceCycles | Chip 0 Max. number of erase/write cycles |
| 884 | | | Complete Chip 1 (see description of Chip 0) |
| 916 | | | Complete Chip 2 (see description of Chip 0) |
| 948 | | | Complete Chip 3 (see description of Chip 0) |

### Footer

| Offset | Type | Name | Description |
|---|---|---|---|
| 980 | uint32_t | ulChecksum | CRC-32 (IEEE 802.3) of Content |
| 984 | uint8_t | abEndToken[12] | Fixed string to detect the end of the device production data: “<ProductData” |

# 3.11 License Information

### HW Read License request

The application uses the following packet in order to obtain license information from the netX firmware. The packet is send through the system mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulCmd | uint32_t | 0x00001EF4 | HIL_HW_LICENSE_INFO_REQ |

*Table 54: HIL_HW_LICENSE_INFO_REQ_T – HW Read License request*

### Packet structure reference

```
/* OBTAIN LICENSE INFORMATION REQUEST */
#define HIL_HW_LICENSE_INFO_REQ              0x00001EF4

typedef struct HIL_HW_LICENSE_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER     tHead;            /* packet header               */
} HIL_HW_LICENSE_INFO_REQ_T;
```

### HW Read License confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 12<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EF5 | HIL_HW_LICENSE_INFO_CNF |
| Data | | | |
| ulLicenseFlags1 | uint32_t | 0 … 0xFFFFFFFF | License Flags 1 |
| ulLicenseFlags2 | uint32_t | 0 … 0xFFFFFFFF | License Flags 2 |
| usNetxLicenseID | uint16_t | 0 … 0xFFFF | netX License Identification |
| usNetxLicenseFlags | uint16_t | 0 … 0xFFFF | netX License Flags |

*Table 55: HIL_HW_LICENSE_INFO_CNF_T – HW Read License confirmation*

### Packet structure reference

```
/* OBTAIN LICENSE INFORMATION CONFIRMATION */
#define HIL_HW_LICENSE_INFO_CNF              HIL_HW_LICENSE_INFO_REQ+1

typedef struct HIL_HW_LICENSE_INFO_CNF_DATA_Ttag
{
  uint32_t ulLicenseFlags1;        /* License Flags 1        */
  uint32_t ulLicenseFlags2;        /* License Flags 2        */
  uint16_t usNetxLicenseID;        /* License ID             */
  uint16_t usNetxLicenseFlags;     /* License Flags          */
} HIL_HW_LICENSE_INFO_CNF_DATA_T;

typedef struct HIL_HW_LICENSE_INFO_CNFtag
{
  HIL_PACKET_HEADER                tHead;  /* packet header              */
  HIL_HW_LICENSE_INFO_CNF_DATA_T   tData;  /* packet data                */
} HIL_HW_LICENSE_INFO_CNF_T;
```

# 3.12 Error Log information

If an error occurs during the startup phase or in the system channel, the error is stored in an error log with additional information including timestamp and message.

The error log of the system channel can be read or cleared, using this service.

Due to size constraints, the number of error log entries are limited. For example, the request `HIL_SYSTEM_ERRORLOG_CMD_READINDEX` returns an error if no error entry is available or if `ulParameter` exceeds the number of entries.

### Error Log request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| `ulLen` | uint32_t | 8 | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001E12 | HIL_SYSTEM_ERRORLOG_REQ |
| Data | | | |
| `ulCommand` | uint32_t | 0x00000001<br><br>0x00000002<br><br>0x00000004 | HIL_SYSTEM_ERRORLOG_CMD_READINDEX<br>▪ Return error log entry with index ulParameter.<br>HIL_SYSTEM_ERRORLOG_CMD_READCOUNT<br>▪ Return number of logged errors. This value may be larger than the number of errors that can be read.<br>HIL_SYSTEM_ERRORLOG_CMD_CLEARBUFFERS<br>▪ Clear the error log. |
| `ulParameter` | uint32_t | | Supplied parameter of ulCommand:<br>For HIL_SYSTEM_ERRORLOG_CMD_READINDEX<br>▪ Index of error log entry to return |

*Table 56: HIL_SYSTEM_ERRORLOG_REQ_T – Format request*

### Packet structure reference

```
#define HIL_SYSTEM_ERRORLOG_REQ            0x00001E12

#define HIL_SYSTEM_ERRORLOG_CMD_READINDEX    (0x1)
#define HIL_SYSTEM_ERRORLOG_CMD_READCOUNT    (0x2)
#define HIL_SYSTEM_ERRORLOG_CMD_CLEARBUFFERS (0x4)

typedef __HIL_PACKED_PRE struct HIL_SYSTEM_ERRORLOG_REQ_DATA_Ttag
{
  uint32_t ulCommand;   /*!< See command defines above */
  uint32_t ulParameter; /*!< Additional parameters of command */
} __HIL_PACKED_POST HIL_SYSTEM_ERRORLOG_REQ_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_SYSTEM_ERRORLOG_REQ_Ttag
{
  HIL_PACKET_HEADER_T            tHead;     /*!< packet header */
  HIL_SYSTEM_ERRORLOG_REQ_DATA_T tData;     /*!< packet data */
} __HIL_PACKED_POST HIL_SYSTEM_ERRORLOG_REQ_T;
```

### Error log confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 8 + n<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001ED7 | HIL_FORMAT_CNF |
| Data | | | |
| ulCommand | uint32_t | | Requested command (same as in error log request) |
| ulResult | uint32_t | | For HIL_SYSTEM_ERRORLOG_CMD_READINDEX<br>▪ Index of returned error log entry.<br>For HIL_SYSTEM_ERRORLOG_CMD_READCOUNT<br>▪ Number of logged errors<br>For HIL_SYSTEM_ERRORLOG_CMD_CLEARBUFFERS<br>▪ 0 on success |
| | HIL_SYSTEM_ERRORLOG_CNF_DATA_ELEMENT_T | | For HIL_SYSTEM_ERRORLOG_CMD_READINDEX<br>▪ The requested error log entry, consists of error code, timestamp and textual description |

*Table 57: HIL_SYSTEM_ERRORLOG_CNF_T – Format confirmation*

### Packet structure reference

```
#define HIL_SYSTEM_ERRORLOG_CNF            HIL_SYSTEM_ERRORLOG_REQ+1

typedef __HIL_PACKED_PRE struct HIL_SYSTEM_ERRORLOG_CNF_DATA_Ttag
{
  uint32_t ulCommand;   /*!< Requested command */
  uint32_t ulResult;    /*!< Index or returning information of ulCommand */
  /* Here follows one HIL_SYSTEM_ERRORLOG_CNF_DATA_ELEMENT depending on ulCommand
   * of request. If available, ulLen in Header is set accordingly
   */
} __HIL_PACKED_POST HIL_SYSTEM_ERRORLOG_CNF_DATA_T;

/* Description string size (remaining space of the packet)
 * 124 bytes = Packet header + ((ulCommand + ulResult) + (ulTimeStamp + ulError)) +
 *             szDescription
 */
#define HIL_SYSTEM_ERRORLOG_STRING_LENGTH (HIL_DPM_SYSTEM_MAILBOX_MIN_SIZE -
HIL_PACKET_HEADER_SIZE - sizeof(HIL_SYSTEM_ERRORLOG_CNF_DATA_T) - 2*sizeof(uint32_t))

typedef __HIL_PACKED_PRE struct HIL_SYSTEM_ERRORLOG_CNF_DATA_ELEMENT_Ttag
{
  uint32_t ulTimeStamp; /*!< Seconds since startup */
  uint32_t ulError;     /*!< Module specific error value */
  int8_t   szDescription[HIL_SYSTEM_ERRORLOG_STRING_LENGTH]; /*!< Description string,
rest of available space */
} __HIL_PACKED_POST HIL_SYSTEM_ERRORLOG_CNF_DATA_ELEMENT_T;

typedef __HIL_PACKED_PRE struct HIL_SYSTEM_ERRORLOG_CNF_Ttag
{
  HIL_PACKET_HEADER_T                    tHead;     /*!< packet header */
  HIL_SYSTEM_ERRORLOG_CNF_DATA_T         tData;     /*!< packet data */
} __HIL_PACKED_POST HIL_SYSTEM_ERRORLOG_CNF_T;
```

# 3.13 Memory usage information

Retrieve memory usage information as it would be provided by *mallinfo()*.

### Memory information request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 0 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E5A | HIL_MALLINFO_REQ |
| Data | | | |

*Table 58: HIL_MALLINFO_REQ_T – Memory usage request*

### Packet structure reference

```
/* MEMORY USAGE INFORMATION REQUEST */
#define HIL_SYSTEM_INFORMATION_BLOCK_REQ     0x00001E5A

typedef struct HIL_MALLINFO_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_MALLINFO_REQ_T;
```

### Memory information confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>32<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / error code, see Section 6 |
| ulCmd | uint32_t | 0x00001E5B | HIL_FORMAT_CNF |
| Data | | | |
| area | int32_t | | Total space allocated from system |
| ordblks | int32_t | | Number of non-inuse chunks |
| hblks | int32_t | | Number of mmapped regions |
| hblkhd | int32_t | | Total space in mmapped regions |
| uordblks | int32_t | | Total allocated space |
| fordblks | int32_t | | Total non-inuse space |
| keepcost | int32_t | | Top-most, releasable space |
| ulTotalHeap | uint32_t | | Total heap area size in bytes |

*Table 59: HIL_MALLINFO_CNF_T – Memory usage confirmation*

### Packet structure reference

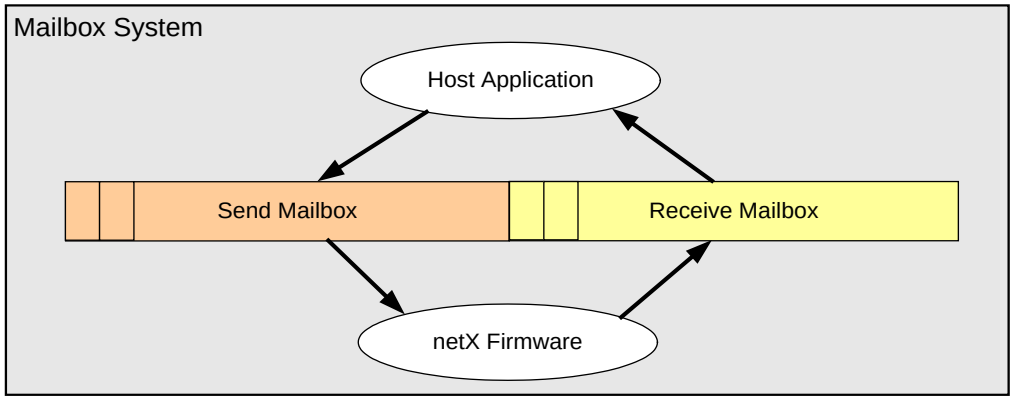
```
#define HIL_MALLINFO_CNF                    HIL_MALLINFO_REQ+1

typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST HIL_MALLINFO_CNF_DATA_Ttag
{
  /* values reported by mallinfo() call, see malloc documentation for further description
*/
  int32_t  arena;       /* total space allocated from system */
  int32_t  ordblks;     /* number of non-inuse chunks */
  int32_t  hblks;       /* number of mmapped regions */
  int32_t  hblkhd;      /* total space in mmapped regions */
  int32_t  uordblks;    /* total allocated space */
  int32_t  fordblks;    /* total non-inuse space */
  int32_t  keepcost;    /* top-most, releasable (via malloc_trim) space */
  uint32_t ulTotalHeap; /* Total Heap area size in bytes */
} HIL_MALLINFO_CNF_DATA_T;

typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST HIL_MALLINFO_CNF_Ttag
{
  HIL_PACKET_HEADER_T tHead;
  HIL_MALLINFO_CNF_DATA_T tData;
} HIL_MALLINFO_CNF_T;
```

# 3.14 General packet fragmentation

Two mailboxes are used to transfer a packet from the host application to the netX firmware or visa versa. Each mailbox has a limited size (= mailbox size). If the packet to be transferred is larger than the mailbox size, the packet has to be fragmented.

The mechanism of transferring packets in a fragmented manner is used

- in case the packet (size of packet header and user data) exceeds the size of the mailbox or
- in case the confirmation to a command packet has a variable data size, which exceeds the size of the mailbox.




### Overview

Two fragmentation mechanisms exist.

| **Packet fragmentation** | |
|---|---|
| For the system channel,<br>**General packet fragmentation** is used as described in this section. | For the communication channel,<br>**Communication channel packet fragmentation** is used. For a basic description, see section *Communication channel packet fragmentation* on page 112, for a detailed description see reference [2]. |

*Table 60: Packet fragmentation overview*

**Note:** *Packet Fragmentation* is not a default mechanism for all packet commands. The general handling is described in this section and if supported it is explicitly noted in the packet command definition!

### Handling for general packet fragmentation

Packet fragmentation is handled by the *ulExt* and *ulId* variable in the packet header. The *ulExt* variable defines whether a packet belongs to a sequence and indicates the state of a sequenced transfer (first/middle/last). *ulId* is used as a packet index within a sequence to ensure a strict packet order handling during a transfer.

**Note:** Fragmented packets must be sent in a strict order given by *ulId*. Out of order transfers are not supported.

| Header variable | Description |
|---|---|
| *ulExt* | Indication of a sequenced packet transfer<br>0x00000000 = HIL_PACKET_SEQ_NONE — None sequenced (default)<br>0x00000080 = HIL_PACKET_SEQ_FIRST — First packet of a sequence<br>0x000000C0 = HIL_PACKET_SEQ_MIDDLE — Packet inside a sequence<br>0x00000040 = HIL_PACKET_SEQ_LAST — Last packet of a sequence |
| *ulId* | Packet number within a sequence<br>▪ Start value<br>▪ Incremented by one for each packet in a sequence |

*Table 61: Packet Fragmentation: Extension and Identifier Field*

**Example**

### Fragmented Transfer Host → netX Firmware (Initiated by host application)

Host application knows that data does not fit into the send mailbox.

| Step | Direction (App \| Task) | Description | *ulCmd* | *ulId* | ulExt |
|---|---|---|---|---|---|
| 1 | → | Command | CMD | X+0 | HIL_PACKET_SEQ_FIRST |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_FIRST |
| 2 | → | Command | CMD | X+1 | HIL_PACKET_SEQ_MIDDLE |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_MIDDLE |
| 3 | → | Command | CMD | X+2 | HIL_PACKET_SEQ_MIDDLE |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_MIDDLE |
| … | … | … | … | … | … |
| n | → | Command | CMD | X+n | HIL_PACKET_SEQ_LAST |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_LAST |

*Table 62: Packet Fragmentation: Example - Host to netX Firmware*

### Fragmented Transfer netX Firmware → Host (Initiated by host application)

Host application does not know how many packets will be received.

| Step | Direction (App \| Task) | Description | *ulCmd* | *ulId* | ulExt |
|---|---|---|---|---|---|
| 1 | → | Command | CMD | X+0 | HIL_PACKET_SEQ_NONE |
| | ← | Answer | CMD + 1 | | **HIL_PACKET_SEQ_FIRST** |
| 2 | → | Command | CMD | X+1 | HIL_PACKET_SEQ_MIDDLE |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_MIDDLE |
| 3 | → | Command | CMD | X+2 | HIL_PACKET_SEQ_MIDDLE |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_MIDDLE |
| … | … | … | … | … | … |
| n | → | Command | CMD | X+n | HIL_PACKET_SEQ_MIDDLE |
| | ← | Answer | CMD + 1 | | HIL_PACKET_SEQ_LAST |

*Table 63: Packet Fragmentation: Example - netX Firmware to Host*

**General Abort Handling**

If an error is detected during a fragmented packet transfer, the transfer has to be aborted before the last packet is transferred. Examples for a fragmented packet transfers are file download and file upload functions.

Possible Errors:

- *ulId*, index skipped, used twice, or out of order
- *ulExt*, state out of order
- *ulSta* in the answer not zero, returned by the answering process

**Note:** If a service needs an abort handling will be mentioned in this manual.

### Abort – Command

| **Structure Information:** *HIL_PACKET_HEADER* | | | | |
|---|---|---|---|---|
| **Area** | **Variable** | **Type** | **Value / Range** | **Description** |
| tHead | ulDest | UINT32 | n | Destination Address / Handle |
| | ulSrc | UINT32 | n | Source Address / Handle |
| | ulDestId | UINT32 | n | Destination Identifier |
| | ulSrcId | UINT32 | n | Source Identifier |
| | ulLen | UINT32 | **0** | Packet Data Length (in Byte) |
| | ulId | UINT32 | **ANY** | Packet Identifier |
| | ulSta | UINT32 | 0 | Packet State / Error |
| | ulCmd | UINT32 | **CMD** | Packet Command / Confirmation |
| | ulExt | UINT32 | **0x00000040** | Packet Extension<br>Last Packet of Sequence |
| | ulRout | UINT32 | 0x00000000 | Reserved (routing information) |

*Table 64: Packet Fragmentation: Abort Command*

### Abort - Confirmation

| **Structure Information:** *HIL_PACKET_HEADER* | | | | |
|---|---|---|---|---|
| **Area** | **Variable** | **Type** | **Value / Range** | **Description** |
| tHead | ulDest | UINT32 | From Request | Destination Address / Handle |
| | ulSrc | UINT32 | From Request | Source Address / Handle |
| | ulDestId | UINT32 | From Request | Destination Identifier |
| | ulSrcId | UINT32 | From Request | Source Identifier |
| | ulLen | UINT32 | **0** | Packet Data Length (in Byte) |
| | ulId | UINT32 | From Request | Packet Identifier |
| | ulSta | UINT32 | **0** | Packet State / Error<br>SUCCESS_HIL_OK (always) |
| | ulCmd | UINT32 | **CMD+1** | Packet Command / Confirmation |
| | ulExt | UINT32 | **0x00000040** | Packet Extension<br>Last Packet of Sequence |
| | ulRout | UINT32 | | Reserved (routing information) |

*Table 65: Packet Fragmentation: Abort Confirmation*

# 3.15 Device Data Provider

The Device Data Provider (DDP) contains device-specific data e.g. the MAC addresses of the device. The Device Data Provider reads the device data from an underlying data source e.g. from the Flash Device Label (FDL) and stores these data in the RAM.

The application can use the *Device Data Provider Get service* (page 81) to read device data from the Device Data Provider.

Some of this data is as read-only, other data is writeable in general. However, the DDP itself has a state that represents, whether or not data is changeable at all. This DDP state is either “passive”, which allows writing data, or “active”, which does not allow writing data.

The application can use the *Device Data Provider Set service* (page 83) to change writeable device data in the Device Data Provider. Changed device data will be stored in a **temporary** buffer only and is not written to the underlying data source.

This service uses a maximum payload of 80 byte in order to fit into the smallest mailbox e.g. the system mailbox.

The following table lists the device data information provided by the DDP service. If the `ulDataType` is listed in the table with “Yes”, the application can change this device data. Each device data has its specific data format, e.g. data-specific structures or generic types as 32-bit value or strings.

| **ulDataType (prefix HIL_DDP_SERVICE_DATATYPE_)** | **Writeable** | **Access** |
|---|---|---|
| BASE_DEVICE_DATA | No | uDataType.tBaseDeviceData |
| MAC_ADDRESSES_APP | Yes | uDataType.atMacAddress |
| MAC_ADDRESSES_COM | Yes | uDataType.atMacAddress |
| USB_INFORMATION | No | uDataType.tUSBInfo |
| STORAGE_FLASH_AREA_0<br>…<br>STORAGE_FLASH_AREA_9 | No | uDataType.tFlashArea |
| STORAGE_FLASH_CHIP_0<br>…<br>STORAGE_FLASH_CHIP_3 | No | uDataType.tFlashChip |
| OEM_OPTIONS | Yes | uDataType.ulValue |
| OEM_SERIALNUMBER | Yes | uDataType.szString |
| OEM_ORDERNUMBER | Yes | uDataType.szString |
| OEM_HARDWAREREVISION | Yes | uDataType.szString |
| OEM_PRODUCTIONDATE | Yes | uDataType.szString |
| OEM_VEDORDATA_0<br>OEM_VEDORDATA_1 | Yes | uDataType.abData |
| STATE | Yes | uDataType.ulValue |

*Table 66: Device data identification (Device Data Provider)*

The Device Data Provider supports two states:

- HIL_DDP_SERVICE_STATE_PASSIVE
- HIL_DDP_SERVICE_STATE_ACTIVE

While in passive state, the information marked as “writeable” (*Table 66*) are allowed to be changed. In passive state, writeable data is volatile and not used for configuration.

While in passive state, the HIL_DDP_SERVICE_GET_REQ will return the error ERR_HIL_DDP_STATE_INVALID in the ulSta field together with the requested information. The ulSta field has to be evaluated to identify if the information are considered valid. In active state, this information cannot be changed anymore.

Once the state has been switched to active, these parameters are considered as valid and they cannot be changed anymore. These parameters can now be used for firmware configuration. A switch of the state from active to passive is not supported.

When the state is switched from passive to active, the firmware requires a specific time until all components are switch to active state. The application has to wait. If the application receives a confirmation packet with error ERR_HIL_DDP_STATE_INVALID in the ulSta field, the application can send the last request packet again.

To identify the current DDP state, the HIL_DDP_SERVICE_GET_REQ can be used with ulDataType parameter set to HIL_DDP_SERVICE_DATATYPE_STATE.

To change the state from passive to active, the HIL_DDP_SERVICE_SET_REQ has to be sent with the ulDataType parameter set to HIL_DDP_SERVICE_DATATYPE_STATE and ulValue parameter set to HIL_DDP_SERVICE_STATE_ACTIVE.

The following defines and structures are used by the Get and Set services.

```
#define HIL_PRODUCT_DATA_OEM_IDENTIFICATION_FLAG_SERIALNUMBER_VALID       0x00000001
     /*!< OEM serial number stored in szSerialNumber field is valid */
#define HIL_PRODUCT_DATA_OEM_IDENTIFICATION_FLAG_ORDERNUMBER_VALID        0x00000002
     /*!< OEM order number stored in szOrderNumber is valid */
#define HIL_PRODUCT_DATA_OEM_IDENTIFICATION_FLAG_HARDWAREREVISION_VALID   0x00000004
     /*!< OEM hardware revision stored in szHardwareRevision field is valid */
#define HIL_PRODUCT_DATA_OEM_IDENTIFICATION_FLAG_PRODUCTIONDATA_VALID     0x00000008
     /*!< OEM production date stored in szProductionDate field is valid */

#define HIL_DDP_SERVICE_DATATYPE_BASE_DEVICE_DATA        (0x00)

#define HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_APP       (0x10)

#define HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_COM       (0x20)

#define HIL_DDP_SERVICE_DATATYPE_USB_INFORMATION         (0x30)

#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_0    (0x41)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_1    (0x42)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_2    (0x43)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_3    (0x44)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_4    (0x45)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_5    (0x46)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_6    (0x47)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_7    (0x48)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_8    (0x49)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_9    (0x4A)

#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_0    (0x51)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_1    (0x52)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_2    (0x53)
#define HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_3    (0x54)

#define HIL_DDP_SERVICE_DATATYPE_OEM_OPTIONS             (0x60)
#define HIL_DDP_SERVICE_DATATYPE_OEM_SERIALNUMBER        (0x61)
#define HIL_DDP_SERVICE_DATATYPE_OEM_ORDERNUMBER         (0x62)
#define HIL_DDP_SERVICE_DATATYPE_OEM_HARDWAREREVISION    (0x63)
#define HIL_DDP_SERVICE_DATATYPE_OEM_PRODUCTIONDATE      (0x64)
#define HIL_DDP_SERVICE_DATATYPE_OEM_VEDORDATA_0         (0x66) /* 80 Bytes payload */
#define HIL_DDP_SERVICE_DATATYPE_OEM_VEDORDATA_1         (0x67) /* 32 Bytes payload */

#define HIL_DDP_SERVICE_DATATYPE_STATE                   (0x70)

/* DDP number definitions, compare with values in DeviceProductionData.h */
```

```
#define HIL_DDP_SERVICE_DEFAULT_NAME_SIZE               (16)

#define HIL_DDP_SERVICE_MAC_APP_NUM                     (4)
#define HIL_DDP_SERVICE_MAC_COM_NUM                     (8)

#define HIL_DDP_SERVICE_FLASH_AREA_NUM                  (10)
#define HIL_DDP_SERVICE_FLASH_CHIP_NUM                  (4)

/* DDP state definitions. */
#define HIL_DDP_SERVICE_STATE_PASSIVE                   (0)
#define HIL_DDP_SERVICE_STATE_ACTIVE                    (1)

/* DDP service structures */
typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_BASE_DEVICE_DATA_Ttag
{
  /* Members as defined in HIL_PRODUCT_DATA_BASIC_DEVICE_DATA_T of
     DeviceProductionData.h */
  uint16_t  usManufacturer;
  uint16_t  usDeviceClass;
  uint32_t  ulDeviceNumber;
  uint32_t  ulSerialNumber;
  uint8_t   bHwCompatibility;
  uint8_t   bHwRevision;
  uint16_t  usProductionDate;
} __HIL_PACKED_POST HIL_DDP_SERVICE_BASE_DEVICE_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_MAC_ADDRESS_Ttag
{
  uint8_t   abMacAddress[6];
} __HIL_PACKED_POST HIL_DDP_SERVICE_MAC_ADDRESS_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_USB_INFO_Ttag
{
  uint16_t  usUSBVendorID;          /*!< USB Device vendor ID (VID) */
  uint16_t  usUSBProductID;         /*!< USB Device product ID (PID) */
  uint8_t   abUSBVendorName[HIL_DDP_SERVICE_DEFAULT_NAME_SIZE];
                                    /*!< USB Product name (Byte array) */
  uint8_t   abUSBProductName[HIL_DDP_SERVICE_DEFAULT_NAME_SIZE];
                                    /*!< USB Product name string (Byte array) */
} __HIL_PACKED_POST HIL_DDP_SERVICE_USB_INFO_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_LIBSTORAGE_AREA_Ttag
{
  /* Members as defined in HIL_PRODUCT_DATA_LIBSTORAGE_AREAS_T of
     DeviceProductionData.h */
  uint32_t  ulContentType;
  uint32_t  ulAreaStart;
  uint32_t  ulAreaSize;
  uint32_t  ulChipNumber;
  int8_t    szName[HIL_DDP_SERVICE_DEFAULT_NAME_SIZE];
  uint8_t   bAccessTyp;
} __HIL_PACKED_POST HIL_DDP_SERVICE_LIBSTORAGE_AREA_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_LIBSTORAGE_CHIP_Ttag
{
  /* Members as defined in HIL_PRODUCT_DATA_LIBSTORAGE_CHIPS_T of
     DeviceProductionData.h */
  uint32_t  ulChipNumber;
  int8_t    szFlashName[HIL_DDP_SERVICE_DEFAULT_NAME_SIZE];
  uint32_t  ulBlockSize;
  uint32_t  ulFlashSize;
  uint32_t  ulMaxEnduranceCycles;
} __HIL_PACKED_POST HIL_DDP_SERVICE_LIBSTORAGE_CHIP_T;
```

## 3.15.1 Device Data Provider Get service

The application can use this service to read device data from the Device Data Provider (DDP).

### Device Data Provider Get request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001EEA | HIL_DDP_SERVICE_GET_REQ |
| Data | | | |
| ulDataType | uint32_t | | One of the HIL_DDP_SERVICE_DATATYPE_* defines described above. |

*Table 67: HIL_DDP_SERVICE_GET_REQ_T – Device Data Provider Get request*

### Packet structure reference

```
/* DDP SERVICE GET REQUEST */
#define HIL_DDP_SERVICE_GET_REQ            0x00001EEA

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_GET_REQ_DATA_Ttag
{
  uint32_t                         ulDataType; /*!< DDP_SERVICE_DATATYPE_* definitions */
} __HIL_PACKED_POST HIL_DDP_SERVICE_GET_REQ_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_GET_REQ_Ttag
{
  HIL_PACKET_HEADER_T              tHead;      /*!< packet header */
  HIL_DDP_SERVICE_GET_REQ_DATA_T   tData;      /*!< packet data */
} __HIL_PACKED_POST HIL_DDP_SERVICE_GET_REQ_T;
```

### Device Data Provider Get confirmation

Changeable parameter (see *Table 66*) will return ERR_HIL_DDP_STATE_INVALID in ulSta and the corresponding data if the DDP is in state passive.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 + n<br>4 + n<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>If ulSta = ERR_HIL_DDP_STATE_INVALID<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EEB | HIL_DDP_SERVICE_GET_CNF |
| Data | | | |
| ulDataType | uint32_t | | The HIL_DDP_SERVICE_DATATYPE_* define sent in the request packet. |
| uDataType | union | | A union of structures corresponding to ulDataType. |

*Table 68: HIL_DDP_SERVICE_GET_CNF_T – Device Data Provider Get confirmation*

### Packet structure reference

```
/* DDP SERVICE GET CONFIRMATION */
#define HIL_DDP_SERVICE_GET_CNF            HIL_DDP_SERVICE_GET_REQ+1

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_GET_CNF_DATA_Ttag
{
  uint32_t                              ulDataType;       /*!< DDP_SERVICE_DATATYPE_*
definitions */
  union HIL_DDP_SERVICE_GET_DATATYPE_U
  {
    /* Fixed structures for specific ulDataType */
    HIL_DDP_SERVICE_BASE_DEVICE_DATA_T tBaseDeviceData;
                            /*!< HIL_DDP_SERVICE_DATATYPE_BASE_DEVICE_DATA */
    HIL_DDP_SERVICE_USB_INFO_T         tUSBInfo;
                            /*!< HIL_DDP_SERVICE_DATATYPE_USB_INFORMATION */
    HIL_DDP_SERVICE_LIBSTORAGE_AREA_T  tFlashArea;
                            /*!< HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_* */
    HIL_DDP_SERVICE_LIBSTORAGE_CHIP_T  tFlashChip;
                            /*!< HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_* */

    /* Members for multiple keys (ulDataType) */
    uint32_t ulValue;       /*!< Keys with 32bit values, e.g. OEM Option Flags */
    /* The following arrays are defined with maximum values.
       Actual valid or used length/sizes dependent on DataType and my be smaller. */
    int8_t   szString[80];  /*!< Strings, e.g. OEM Serial Number; maximum 80 bytes
                                 (including NULL termination) */
    uint8_t  abData[80];    /*!< Binary data, e.g. OEM Vendor Data; maximum 80 bytes */
    HIL_DDP_SERVICE_MAC_ADDRESS_T  atMacAddress[13];
                            /*!< HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_*;
                                 maximum 13 addresses (6bytes*13=78) */
  } uDataType;
} __HIL_PACKED_POST HIL_DDP_SERVICE_GET_CNF_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_GET_CNF_Ttag
{
  HIL_PACKET_HEADER_T                tHead;       /*!< packet header */
  HIL_DDP_SERVICE_GET_CNF_DATA_T     tData;       /*!< packet data */
} __HIL_PACKED_POST HIL_DDP_SERVICE_GET_CNF_T;
```

The atMacAdress[13] structure can hold a maximum of 13 different MAC addresses, but the actual number of returned MAC addresses is 8 for the communication side and 4 for the application side.

The abData field is an 80 byte blob that will be read/written as it is stored in the DDP.

The OEM vendor data is defined as a 112 byte area in the DDP. To read the OEM vendor data, the application has to use two Device Data Provider Get services: OEM_VENDORDATA_0 to read the first 80 byte and OEM_VENDORDATA_1 to read the rest of the area.

The szString field is a NULL-terminated string.

The ulValue field is a 32-bit value.

## 3.15.2 Device Data Provider Set service

The application can use this service to change device data in the Device Data Provider, e.g. to change a MAC address.

During start of the device, the firmware reads the static device data, which is read-only, from the Flash Device Label. The application can change writeable device data using this service before configuring the firmware. Once the device data is set, the application has to switch the DDP state to HIL_DDP_SERVICE_STATE_ACTIVE using the ulDataType parameter HIL_DDP_SERVICE_DATATYPE_STATE. Only when the DDP state is set to active, the firmware will consider the information valid and configure its resources. Information can only be changed while the DDP is in passive state.

The changed device data will be stored in a **temporary** buffer only and will not be written to the underlying data source e.g. Flash Device Label. After a system reset or power cycle, the application must use this service again.

**Device Data Provider Set request**

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 4 + n | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001EEC | HIL_DDP_SERVICE_SET_REQ |
| Data | | | |
| ulDataType | uint32_t | | One of the HIL_DDP_SERVICE_DATATYPE_* defines described above. |
| uDataType | union | | A union of structures corresponding to ulDataType. |

*Table 69: HIL_DDP_SERVICE_SET_REQ_T – Device Data Provider Set request*

### Packet structure reference

```
/* DDP SERVICE SET REQUEST */
#define HIL_DDP_SERVICE_SET_REQ            0x00001EEC

typedef HIL_DDP_SERVICE_GET_CNF_DATA_T HIL_DDP_SERVICE_SET_REQ_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_SET_REQ_Ttag
{
  HIL_PACKET_HEADER_T                tHead;       /*!< packet header */
  HIL_DDP_SERVICE_SET_REQ_DATA_T     tData;       /*!< packet data */
} __HIL_PACKED_POST HIL_DDP_SERVICE_SET_REQ_T;
```

### Device Data Provider Set confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EED | HIL_DDP_SERVICE_SET_CNF |

*Table 70: HIL_DDP_SERVICE_SET_CNF_T – Device Data Provider Set confirmation*

```
/* DDP SERVICE SET CONFIRMATION */

#define HIL_DDP_SERVICE_SET_CNF            HIL_DDP_SERVICE_SET_REQ+1

typedef __HIL_PACKED_PRE struct HIL_DDP_SERVICE_SET_CNF_Ttag
{
  HIL_PACKET_HEADER_T                tHead;       /*!< packet header */
} __HIL_PACKED_POST HIL_DDP_SERVICE_SET_CNF_T;
```

# 3.16 Exception handler

The exception handler is started when a firmware crashes. It supports a small number of packet services, which can help identify the cause of the exception.

The execution of the exception handler is identified by

- the blink pattern of the SYS-LED (3x yellow, 3x green)
- a HIL_FIRMWARE_IDENTIFY_REQ will be answered with “ExceptionHandler”
- ulSystemError and ulCommunicationError in the DPM have error code ERR_HIL_FIRMWARE_CRASHED

The services supported by the exception handler are listed in the following table.

| Exception handler services | | |
|---|---|---|
| Read the name and version or firmware, operating system or protocol stack running on a communication channel | HIL_FIRMWARE_IDENTIFY_REQ | 21 |
| Firmware and system reset | HIL_FIRMWARE_RESET_REQ | 13 |
| Get exception context from crashed firmware | HIL_EXCEPTION_INFO_REQ | 85 |
| Read physical memory from crashed firmware | HIL_PHYSMEM_READ_REQ | 88 |

Commands that are not supported will return the ERR_HIL_FIRMWARE_CRASHED error code in the *ulSta* field.

## 3.16.1 Exception Information service

Using this service, the exception context of a crashed firmware can be retrieved.

### Exception Context Information request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 0 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001E14 | HIL_EXCEPTION_INFO_REQ |

*Table 71: HIL_EXCEPTION_INFO_REQ_T – Exception Information request*

### Packet structure reference

```
/* EXCEPTION INFO REQUEST */
#define HIL_EXCEPTION_INFO_REQ             0x00001E14

typedef __HIL_PACKED_PRE struct HIL_EXCEPTION_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER_T              tHead;
} __HIL_PACKED_POST HIL_EXCEPTION_INFO_REQ_T;
```

### Exception Information confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>84<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E15 | HIL_EXCEPTION_INFO_CNF |
| Data | | | |
| ulType | uint32_t | <br>1<br>2<br>3 | Exception type<br>HIL_EXCEPTION_TYPE_EXCEPTION<br>HIL_EXCEPTION_TYPE_THREAD<br>HIL_EXCEPTION_TYPE_INTERRUPT |
| ulVector | uint32_t | | Exception vector |
| aulR[11] | uint32_t[11] | | Registers r0-r10 |
| ulFP | uint32_t | | Frame pointer (r11) |
| ulIP | uint32_t | | Intra-procedure call scratch register (r12) |
| ulSP | uint32_t | | Stack pointer (r13) |
| ulLR | uint32_t | | Linker register (r14) |
| ulPC | uint32_t | | Program counter (r15) |
| ulPSR | uint32_t | | Program status register (PSR/CPSR) |
| ulDFSR/ulXLR | uint32_t | | Cortex-R: ulDFSR<br>Cortex-M: ulXLR |
| ulDFAR/ulBASEPRI | uint32_t | | Cortex-R: ulDFAR<br>Cortex-M: ulBASEPRI |

*Table 72: HIL_EXCEPTION_INFO_CNF_T – Exception Information confirmation*

Depending on the exception type (ulType), fields are not used (set to zero) in the specified architectures.

| Exception type (ulType) | Cortex-M | Cortex-R |
|---|---|---|
| HIL_EXCEPTION_TYPE_EXCEPTION | ulSP | All fields are used |
| HIL_EXCEPTION_TYPE_THREAD | ulLR, ulPSR, ulVector, ulXLR | not available |
| HIL_EXCEPTION_TYPE_INTERRUPT | aulR[4]-aulR[10], ulFP, ulBASEPRIO, ulSP, ulVector, ulXLR | not available |

### Packet structure reference

```
/* EXCEPTION INFO CONFIRMATION */
#define HIL_FORMAT_CNF                     HIL_EXCEPTION_INFO_REQ+1

typedef __HIL_PACKED_PRE struct HIL_EXCEPTION_INFO_CNF_DATA_Ttag
{
  uint32_t                        ulType;      /* State type:  exception, thread,
interrupt */
  uint32_t                        ulVector;    /* Vector number */

  uint32_t                        aulR[11];    /* General purpose registers (R0..R10) */
  uint32_t                        ulFP;        /* Frame pointer (R11) */
  uint32_t                        ulIP;        /* Intra-procedure call scratch register
(R12) */
  uint32_t                        ulSP;        /* Stack pointer (R13) */
  uint32_t                        ulLR;        /* Link register (R14) */
  uint32_t                        ulPC;        /* Program counter (R15) */
  uint32_t                        ulPSR;       /* Program status register (PSR/CPSR) */

  union
  {
    /* ARM/Cortex-R */
    struct
    {
      uint32_t                    ulDFSR;      /* Data fault status register */
      uint32_t                    ulDFAR;      /* Data fault address register */
    } arm;

    /* Cortex-M */
    struct
    {
      uint32_t                    ulXLR;       /* Exception return LR (Cortex-M) */
      uint32_t                    ulBASEPRI;   /* Base priority level (Cortex-M) */
    } cm;
  } u;
} __HIL_PACKED_POST HIL_EXCEPTION_INFO_CNF_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_EXCEPTION_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER_T             tHead;
  HIL_EXCEPTION_INFO_CNF_DATA_T   tData;
} __HIL_PACKED_POST HIL_EXCEPTION_INFO_CNF_T;
```

## 3.16.2 Read Physical Memory service

Using this service, physical memory can be read from the netX.

**Note:** The physical memory read request allows reading of **any** memory address within the netX. This service should only be used with a good understanding of the netX specific memory layout. By accessing unmapped locations, the CPU might access a locked-up state and the netX won't react to any further commands.

### Read Physical Memory request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| ulLen | uint32_t | 12 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00001EA8 | HIL_PHYSMEM_READ_REQ |
| Data | | | |
| ulPhysicalAddress | uint32_t | | Address to read from.<br>Depending on access type, address needs to be 8, 16, or 32-bit aligned. |
| ulAccessType | uint32_t | 0<br>1<br>2<br>3 | Type of memory access<br>HIL_PHYSMEM_ACCESSTYPE_8BIT<br>HIL_PHYSMEM_ACCESSTYPE_16BIT<br>HIL_PHYSMEM_ACCESSTYPE_32BIT<br>HIL_PHYSMEM_ACCESSTYPE_TASK (not supported) |
| ulReadLength | uint32_t | | Length to be read (limited by mailbox size). |

*Table 73: HIL_PHYSMEM_READ_REQ_T – Read Physical Memory request*

### Packet structure reference

```
/* PHYSICAL MEMORY READ REQUEST */
#define HIL_PHYSMEM_READ_REQ               0x00001EA8

#define HIL_PHYSMEM_ACCESSTYPE_8BIT     0
#define HIL_PHYSMEM_ACCESSTYPE_16BIT    1
#define HIL_PHYSMEM_ACCESSTYPE_32BIT    2
#define HIL_PHYSMEM_ACCESSTYPE_TASK     3

/***** request packet *****/
typedef __HIL_PACKED_PRE struct HIL_PHYSMEM_READ_REQ_DATA_Ttag
{
  uint32_t ulPhysicalAddress;
  uint32_t ulAccessType;
  uint32_t ulReadLength;

} __HIL_PACKED_POST HIL_PHYSMEM_READ_REQ_DATA_T;

typedef __HIL_PACKED_PRE struct HIL_PHYSMEM_READ_REQ_Ttag
{
  HIL_PACKET_HEADER_T               tHead;
  HIL_PHYSMEM_READ_REQ_DATA_T       tData;
} __HIL_PACKED_POST HIL_PHYSMEM_READ_REQ_T;
```

### Read Physical Memory confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>n<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EA9 | HIL_PHYSMEM_READ_CNF |
| Data | | | |
| | | | Data read from netX |

*Table 74: HIL_PHYSMEM_READ_CNF_T – Read Physical Memory confirmation*

### Packet structure reference

```
/* PHYSICAL MEMORY READ CONFIRMATION */
#define HIL_PHYSMEM_READ_CNF                HIL_PHYSMEM_READ_REQ+1

/***** confirmation packet *****/
typedef __HIL_PACKED_PRE struct HIL_PHYSMEM_READ_CNF_Ttag
{
  HIL_PACKET_HEADER_T               tHead;
} __HIL_PACKED_POST HIL_PHYSMEM_READ_CNF_T;
```

# 4 Communication Channel services

The following functions corresponding to information and functionalities of a **communication channel**.

## 4.1 Function overview

| **Communication Channel services** | | |
|---|---|---|
| **Service** | **Command definition** | **Page** |
| **Communication Channel Information Blocks** | | |
| Read the Common Control Block of a channel | HIL_CONTROL_BLOCK_REQ | 91 |
| Read the Common Status Block of a channel | HIL_DPM_GET_COMMON_STATE_REQ | 93 |
| Read the Extended Status Block of a channel | HIL_DPM_GET_EXTENDED_STATE_REQ | 95 |
| **Read Communication Flag States** | | |
| Read the communication flags of a specified communication channel | HIL_DPM_GET_COMFLAG_INFO_REQ | 97 |
| **Read the I/O Process Data Image Size** | | |
| Read the configured size of the I/O process data image | HIL_GET_DPM_IO_INFO_REQ | 99 |
| **Channel Initialization** | | |
| Re-initialize / re-configure a protocol stack | HIL_CHANNEL_INIT_REQ | 102 |
| **Delete Protocol Stack Configuration** | | |
| Delete a actual configuration of a protocol stack | HIL_DELETE_CONFIG_REQ | 104 |
| **Lock / Unlock Configuration** | | |
| Lock or unlock a configuration against changes | HIL_LOCK_UNLOCK_CONFIG_REQ | 106 |
| **Start / Stop Communication** | | |
| Start or stop network communication | HIL_START_STOP_COMM_REQ | 107 |
| **Channel Watchdog Time** | | |
| Read the actual watchdog time of a communication channel | HIL_GET_WATCHDOG_TIME_REQ | 108 |
| Set the watchdog time of a communication channel | HIL_SET_WATCHDOG_TIME_REQ | 109 |
| **Channel Component Information** | | |
| Read information about all components of one channel | GENAP_GET_COMPONENT_IDS_REQ | 110 |

*Table 75: Communication Channel services (function overview)*

# 4.2 Communication Channel Information Blocks

The following packets are used to make certain data blocks, located in the communication channel, available for read access through the communication channel mailbox.

These data blocks are useful for applications and configuration tool like SYCON.net because the blocks contain important states and information about a fieldbus protocol stack.

If the requested data block exceeds the maximum mailbox size, the block is transferred using packet fragmentation as described in section *General packet fragmentation* on page 74.

## 4.2.1 Read Common Control Block

**Note**: For a detailed description about the *Common Control Block*, see reference [1].

### Read Common Control Block request

This packet is used to request the *Common Control Block*. The firmware returns the *Common Control Block* of the used Communication Channel and ignores the communication channel identifier `ulChannelId`. If the System Channel is used, the firmware will return the *Common Control Block* addressed by `ulChannelId`.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| `ulLen` | uint32_t | 4 | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001E3A | HIL_CONTROL_BLOCK_REQ |
| Data | | | |
| `ulChannelId` | uint32_t | 0 … 3<br>4 … 5 | Communication Channel Number<br>Application Channel Number |

*Table 76: HIL_READ_COMM_CNTRL_BLOCK_REQ_T – Read Common Control Block request*

### Packet structure reference

```
/* READ COMMUNICATION CONTROL BLOCK REQUEST */
#define HIL_CONTROL_BLOCK_REQ                0x00001E3A

typedef struct HIL_READ_COMM_CNTRL_BLOCK_REQ_DATA_Ttag
{
  uint32_t ulChannelId;                        /* channel identifier      */
} HIL_READ_COMM_CNTRL_BLOCK_REQ_DATA_T;

typedef struct HIL_READ_COMM_CNTRL_BLOCK_REQ_Ttag
{
  HIL_PACKET_HEADER                     tHead;     /* packet header        */
  HIL_READ_COMM_CNTRL_BLOCK_REQ_DATA_T  tData;     /* packet data          */
} HIL_READ_COMM_CNTRL_BLOCK_REQ_T;
```

### Read Common Control Block confirmation

The following packet is returned by the firmware.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>8<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001E3B | HIL_CONTROL_BLOCK_CNF |
| Data | | | |
| tControl | Structure | | Communication Control Block |

*Table 77: HIL_READ_COMM_CNTRL_BLOCK_CNF_T – Read Common Control Block confirmation*

### Packet structure reference

```
/* READ COMMUNICATION CONTROL BLOCK CONFIRMATION */
#define HIL_CONTROL_BLOCK_CNF                HIL_CONTROL_BLOCK_REQ+1

typedef struct HIL_READ_COMM_CNTRL_BLOCK_CNF_DATA_Ttag
{
  HIL_DPM_CONTROL_BLOCK_T               tControl;  /* control block       */
} HIL_READ_COMM_CNTRL_BLOCK_CNF_DATA_T;

typedef struct HIL_READ_COMM_CNTRL_BLOCK_CNF_Ttag
{
  HIL_PACKET_HEADER                     tHead;     /* packet header       */
  HIL_READ_COMM_CNTRL_BLOCK_CNF_DATA_T  tData;     /* packet data         */
} HIL_READ_COMM_CNTRL_BLOCK_CNF_T;
```

## 4.2.2 Read Common Status Block

The *Common Status Block* contains common fieldbus information offered by all fieldbus systems.

**Note**: For a detailed description about the *Common Status Block*, see reference [1].

### Read Common Status Block request

This packet is used to request the *Common Status Block*. The firmware returns the *Common Status Block* of the used Communication Channel and ignores the communication channel identifier `ulChannelId`. If the System Channel is used, the firmware return the *Common Status Block* addressed by `ulChannelId`.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| `ulLen` | uint32_t | 4 | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001EFC | HIL_DPM_GET_COMMON_STATE_REQ |
| Data | | | |
| `ulChannelId` | uint32_t | 0 … 3<br>4 … 5 | Communication Channel Number<br>Application Channel Number |

*Table 78: HIL_READ_COMMON_STS_BLOCK_REQ_T – Read Common Status Block request*

### Packet structure reference

```
/* READ COMMON STATUS BLOCK REQUEST */
#define HIL_DPM_GET_COMMON_STATE_REQ         0x00001EFC

typedef struct HIL_READ_COMMON_STS_BLOCK_REQ_DATA_Ttag
{
  uint32_t ulChannelId;                       /* channel identifier       */
} HIL_READ_COMMON_STS_BLOCK_REQ_DATA_T;

typedef struct HIL_READ_COMMON_STS_BLOCK_REQ_Ttag
{
  HIL_PACKET_HEADER                     tHead;     /* packet header        */
  HIL_READ_COMMON_STS_BLOCK_REQ_DATA_T  tData;     /* packet data          */
} HIL_READ_COMMON_STS_BLOCK_REQ_T;
```

### Read Common Status Block confirmation

The following packet is returned by the firmware.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>64<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EFD | HIL_DPM_GET_COMMON_STATE_CNF |
| Data | | | |
| tCommonStatus | Structure | | Common Status Block |

*Table 79: HIL_READ_COMMON_STS_BLOCK_CNF_T – Read Common Status Block confirmation*

### Packet structure reference

```
/* READ COMMON STATUS BLOCK CONFIRMATION */
#define HIL_DPM_GET_COMMON_STATE_CNF         HIL_DPM_GET_COMMON_STATE_REQ+1

typedef struct HIL_READ_COMMON_STS_BLOCK_CNF_DATA_Ttag
{
  HIL_DPM_COMMON_STATUS_BLOCK_T         tCommonStatus;  /* common status   */
} HIL_READ_COMMON_STS_BLOCK_CNF_DATA_T;

typedef struct HIL_READ_COMMON_STS_BLOCK_CNF_Ttag
{
  HIL_PACKET_HEADER                     tHead;  /* packet header          */
  HIL_READ_COMMON_STS_BLOCK_CNF_DATA_T  tData;  /* packet data            */
} HIL_READ_COMMON_STS_BLOCK_CNF_T;
```

### 4.2.3 Read Extended Status Block

This packet is used to read the *Extended Status Block*. This block contains protocol stack and fieldbus-specific information (e.g. specific master state information).

**Note**: For a detailed description about the *Extended Status Block*, see reference [1].

This packet is used to request the *Extended Status Block*. The firmware returns the *Extended Status Block* of the used Communication Channel and ignores the communication channel identifier `ulChannelId`. If the System Channel is used, the firmware returns the *Extended Status Block* addressed by `ulChannelId`.

This service does not support fragmentation.

#### Read Extended Status Block request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| `ulLen` | uint32_t | 12 | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001EFE | HIL_DPM_GET_EXTENDED_STATE_REQ |
| Data | | | |
| `ulOffset` | uint32_t | 0 … 431 | Byte offset in extended status block structure |
| `ulDataLen` | uint32_t | 1 … 432 | Length in byte read |
| `ulChannel Index` | uint32_t | 0 … 3<br>4 … 5 | Communication Channel Number<br>Application Channel Number |

*Table 80: HIL_DPM_GET_EXTENDED_STATE_REQ_T – Read Extended Status Block request*

#### Packet structure reference

```
/* READ EXTENDED STATUS BLOCK REQUEST */
#define HIL_DPM_GET_EXTENDED_STATE_REQ      0x00001EFE

typedef struct HIL_DPM_GET_EXTENDED_STATE_REQ_DATA_Ttag
{
  uint32_t ulOffset;           /* offset in extended status block        */
  uint32_t ulDataLen;          /* size of block to read                  */
  uint32_t ulChannelIndex;     /* channel number                         */
} HIL_DPM_GET_EXTENDED_STATE_REQ_DATA_T;

typedef struct HIL_DPM_GET_EXTENDED_STATE_REQ_Ttag
{
  HIL_PACKET_HEADER                      tHead;   /* packet header       */
  HIL_DPM_GET_EXTENDED_STATE_REQ_DATA_T  tData;   /* packet data         */
} HIL_DPM_GET_EXTENDED_STATE_REQ_T;
```

### Read Extended Status Block confirmation

The following packet is returned by the firmware.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 1 … 432<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EFF | HIL_DPM_GET_EXTENDED_STATE_CNF |
| Data | | | |
| ulOffset | uint32_t | 0 … 431 | Byte offset in extended status block structure |
| ulDataLen | uint32_t | 1 … 432 | Length in byte |
| abData[432] | uint8_t | 0 … n | Extended Status Block data |

*Table 81: HIL_DPM_GET_EXTENDED_STATE_CNF_T – Read Extended Status Block confirmation*

### Packet structure reference

```
/* READ EXTENDED STATUS BLOCK CONFIRMATION */
#define HIL_DPM_GET_EXTENDED_STATE_CNF       HIL_DPM_GET_EXTENDED_STATE_REQ+1

typedef struct HIL_DPM_GET_EXTENDED_STATE_CNF_DATA_Ttag
{
  uint32_t ulOffset;           /* offset in extended status block        */
  uint32_t ulDataLen;          /* size of block returned                 */
  uint8_t  abData[432];        /* data block                             */
} HIL_DPM_GET_EXTENDED_STATE_CNF_DATA_T;

typedef struct HIL_DPM_GET_EXTENDED_STATE_CNF_Ttag
{
  HIL_PACKET_HEADER                      tHead;     /* packet header      */
  HIL_DPM_GET_EXTENDED_STATE_CNF_DATA_T  tData;     /* packet data        */
} HIL_DPM_GET_EXTENDED_STATE_CNF_T;
```

# 4.3 Read the Communication Flag States

This service allows reading the *Communication Flags* of a specified channel. These flags are used to synchronise the data transfer between a host and a netX target and containing general system states information like *NCF_COMMUNICATING* or *NCF_ERROR*.

**Note:** The functionality and the content of the *Communication Flags* are described in the *netX DPM Interface Manual.*

### DPM Get ComFlag Info request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000000 | HIL_PACKET_DEST_SYSTEM |
| `ulLen` | uint32_t | 4 | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00001EFA | HIL_DPM_GET_COMFLAG_INFO_REQ |
| Data | | | |
| `ulAreaIndex` | uint32_t | 0 … 7 | Area Index (see below) |

*Table 82: HIL_DPM_GET_COMFLAG_INFO_REQ_T – DPM Get ComFlag Info request*

### Packet structure reference

```
/* DPM GET COMFLAG INFO REQUEST */
#define HIL_DPM_GET_COMFLAG_INFO_REQ       0x00001EFA

typedef struct HIL_DPM_GET_COMFLAG_INFO_REQ_DATA_Ttag
{
  uint32_t                          ulAreaIndex;           /* area index */
} HIL_DPM_GET_COMFLAG_INFO_REQ_DATA_T;

typedef struct HIL_DPM_GET_COMFLAG_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER_T                   tHead;             /* packet header */
  HIL_DPM_GET_COMFLAG_INFO_REQ_DATA_T   tData;             /* packet data */
} HIL_DPM_GET_COMFLAG_INFO_REQ_T;
```

### Area Index: *ulAreaIndex*

This field holds the index of the channel. The area index counts all channels in a firmware starting with index 0 for the system channel. The first communication channel will have the index 2 and so on.

| Index | Channel Description |
|---|---|
| 0 | System Channel |
| 1 | Handshake Channel |
| 2 | Communication Channel 0 |
| 3 | Communication Channel 1 |
| 4 | Communication Channel 2 |
| 5 | Communication Channel 3 |
| 6 | Application Channel 0 |
| 7 | Application Channel 1 |

*Table 83: Area Index*

### DPM Get ComFlag Info confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>12<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00001EFB | HIL_DPM_GET_COMFLAG_INFO_CNF |
| Data | | | |
| ulAreaIndex | uint32_t | 0 … 5 | Area Index (see above) |
| ulNetxComFlag | uint32_t | Bit Field | Current netX Communication Flags |
| ulHostComFlag | uint32_t | Bit Field | Current Host Communication Flags |

*Table 84: HIL_DPM_GET_COMFLAG_INFO_CNF_T – DPM Get ComFlag Info confirmation*

### Packet structure reference

```
/* DPM GET COMFLAG INFO CONFIRMATION */
#define HIL_DPM_GET_COMFLAG_INFO_CNF       HIL_DPM_GET_COMFLAG_INFO_REQ+1

typedef struct HIL_DPM_GET_COMFLAG_INFO_CNF_DATA_Ttag
{
  uint32_t ulAreaIndex;                         /* area index */
  uint32_t ulNetxComFlag;
  uint32_t ulHostComFlag;
} HIL_DPM_GET_COMFLAG_INFO_CNF_DATA_T;

typedef struct HIL_DPM_GET_COMFLAG_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER_T                 tHead;    /* packet header */
  HIL_DPM_GET_COMFLAG_INFO_CNF_DATA_T tData;    /* packet data */
} HIL_DPM_GET_COMFLAG_INFO_CNF_T;
```

# 4.4 Read I/O Process Data Image Size

The application can request information about the length of the configured I/O process data image. The length information is useful to adjust copy functions in terms of the amount of data that are defined by the fieldbus protocol configuration.

**Note:** Some of the protocol stacks are able to map additional state information into the I/O data image. The **additional** length must be obtained from the extended state block information (see section *Read Extended Status Block* on page 95) because this service does not report the additional length.

**Note:** If the process data is configured to be input only or output only, the confirmation packet will report two blocks (input and output) stating that the unused block has a length of 0.

The answer packet returns the offset of the first used byte used in the I/O data image and the length of configured I/O data.

### Get DPM I/O Information request

This packet is used to obtain offset and length of the used I/O data space.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F0C | HIL_GET_DPM_IO_INFO_REQ |

*Table 85: HIL_GET_DPM_IO_INFO_REQ_T – Get DPM I/O Information request*

### Packet structure reference

```
/* GET DPM I/O INFORMATION REQUEST */
#define HIL_GET_DPM_IO_INFO_REQ             0x00002F0C

typedef struct HIL_GET_DPM_IO_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header     */
} HIL_GET_DPM_IO_INFO_REQ_T;
```

### Get DPM I/O Information confirmation

The confirmation packet returns offset and length of the requested input and the output data area. The application may receive the packet in a sequenced manner. So the *ulExt* field has to be evaluated!

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 + (20 * n)<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulId | uint32_t | From Request | Packet Identification as Unique Number |
| ulSta | uint32_t | See Below | Status / Error Code see Section 6 |
| ulCmd | uint32_t | 0x00002F0D | HIL_GET_DPM_IO_INFO_CNF |
| ulExt | uint32_t | 0x00000000<br>0x00000080<br>0x000000C0<br>0x00000040 | Extension<br>No Sequenced Packet<br>First Packet of Sequence<br>Sequenced Packet<br>Last Packet of Sequence |
| Data | | | |
| ulNumIOBlock Info | uint32_t | 0 … 10 | Number **n** of Block Definitions in this packet |
| atIoBlockInfo [2] | Array of Structure | | I/O Block definition structure(s)<br>HIL_DPM_IO_BLOCK_INFO |

*Table 86: HIL_GET_DPM_IO_INFO_CNF_T – Get DPM I/O Information confirmation*

### Packet structure reference

```
/* GET DPM I/O INFORMATION CONFIRMATION */
#define HIL_GET_DPM_IO_INFO_CNF             HIL_GET_DPM_IO_INFO_REQ+1

typedef struct HIL_DPM_IO_BLOCK_INFO_Ttag
{
  uint32_t ulSubblockIndex;  /* index of sub block                       */
  uint32_t ulType;           /* type of sub block                        */
  uint16_t usFlags;          /* flags of the sub block                   */
  uint16_t usReserved;       /* reserved                                 */
  uint32_t ulOffset;         /* offset                                   */
  uint32_t ulLength;         /* length of I/O data in bytes              */
} HIL_DPM_IO_BLOCK_INFO_T;

typedef struct HIL_GET_DPM_IO_INFO_CNF_DATA_Ttag
{
  uint32_t                 ulNumIOBlockInfo; /* Number of IO Block Info        */
  HIL_DPM_IO_BLOCK_INFO_T  atIoBlock[2];     /* Array of I/O Block information */
} HIL_GET_DPM_IO_INFO_CNF_DATA_T;

typedef struct HIL_GET_DPM_IO_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
  HIL_GET_DPM_IO_INFO_CNF_DATA_T   tData;   /* packet data              */
} HIL_GET_DPM_IO_INFO_CNF_T;
```

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSubblockIndex | uint32_t | 5, 6 | Index of sub block<br>The value identifies the index of the sub block. This field is only informative and shall not be used by an application.<br>Value 5 for standard output image.<br>Value 6 for standard input image. |
| ulType | uint32_t | | Type of sub block<br>HIL_BLOCK_* type definitions, see Hil_DualPortMemory.h. |
| usFlags | uint16_t | | Flags of the sub block<br>HIL_DIRECTION_* and HIL_TRANSMISSION_TYPE_* type definitions, see Hil_DualPortMemory.h |
| usReserved | uint16_t | | Reserved |
| ulOffset | uint32_t | 0 | Offset<br>Offset is always 0, even if the application has not configured any I/O data to offset 0. |
| ulLength | uint32_t | | Length of I/O data in bytes<br>Highest offset address of input data or output data used in the process data image (starting with offset 0, even if the application has not configured any I/O data to offset 0). |

*Table 87: Structure HIL_DPM_IO_BLOCK_INFO*

## 4.5 Channel Initialization

A *Channel Initialization* affects only the designated communication channel. It forces the protocol stack to immediately close all network connections and to proceed with a re-initialization. While the stack is started the configuration settings are evaluated again.

This service may be negatively responded by a protocol stack to indicate that no configuration was applied e.g. because no configuration is available that can be used or because no valid MAC address is available.

**Note:** If the configuration is locked, re-initialization of a channel is not allowed.

In order to avoid race conditions in firmware (e.g. mailbox events generated by firmware are not recognized by the application), best practice is to use the following flow diagram to perform a ChannelInit.

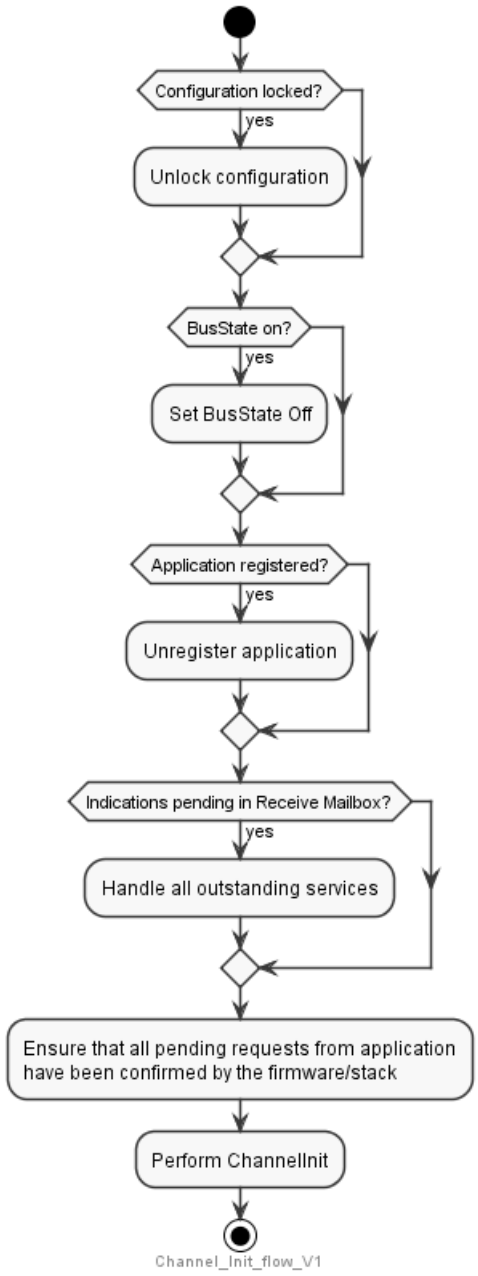



*Figure 3: Flow chart ChannelInit (Best practise pattern for the host application)*

### Channel Initialization request

The packet is send through the channel mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F80 | HIL_CHANNEL_INIT_REQ |

*Table 88: HIL_CHANNEL_INIT_REQ_T – Channel Initialization request*

### Packet structure reference

```
/* CHANNEL INITIALIZATION REQUEST */
#define HIL_CHANNEL_INIT_REQ                0x00002F80

typedef struct HIL_CHANNEL_INIT_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header             */
} HIL_CHANNEL_INIT_REQ_T;
```

### Channel Initialization confirmation

The channel firmware returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F81 | HIL_CHANNEL_INIT_CNF |

*Table 89: HIL_CHANNEL_INIT_CNF_T – Channel Initialization confirmation*

### Packet structure reference

```
/* CHANNEL INITIALIZATION CONFIRMATION */
#define HIL_CHANNEL_INIT_CNF                HIL_CHANNEL_INIT_REQ+1

typedef struct HIL_CHANNEL_INIT_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header             */
} HIL_CHANNEL_INIT_CNF_T;
```

# 4.6 Delete Protocol Stack Configuration

A protocol stack can be configured

- via packet services (Set Configuration packets) or
- via a configuration database file.

The application can use this packet to delete the configuration in the RAM. This service will overwrite remanent data stored in non-volatile memory with default data.

| Configured via packets | Configured via configuration database |
|---|---|
| The configuration stored in RAM will be deleted.<br>The application has to use the Set Configuration service again. Otherwise (after a channel initialization) the protocol stack won't startup properly due to the missing configuration. | This service has no effect, if the protocol stack is configured via a configuration database file. To delete a configuration file, the standard file functions has to be used. For details, see section *Delete a File* page 52. |

*Table 90: Delete protocol stack configuration*

As long as the *Configuration Locked* flag in *ulCommunicationCOS* is set, the configuration cannot be deleted.

### Delete Configuration request

The application uses the following packet in order to delete the current configuration of the protocol stack. The packet is send through the channel mailbox to the protocol stack.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F14 | HIL_DELETE_CONFIG_REQ |

*Table 91: HIL_DELETE_CONFIG_REQ_T – Delete Configuration request*

### Packet structure reference

```
/* DELETE CONFIGURATION REQUEST */
#define HIL_DELETE_CONFIG_REQ                0x00002F14

typedef struct HIL_DELETE_CONFIG_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_DELETE_CONFIG_REQ_T;
```

### Delete Configuration confirmation

The system returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F15 | HIL_DELETE_CONFIG_CNF |

*Table 92: HIL_DELETE_CONFIG_CNF_T – Delete Configuration confirmation*

### Packet structure reference

```
/* DELETE CONFIGURATION CONFIRMATION */
#define HIL_DELETE_CONFIG_CNF                HIL_DELETE_CONFIG_REQ+1

typedef struct HIL_DELETE_CONFIG_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header             */
} HIL_DELETE_CONFIG_CNF_T;
```

# 4.7 Lock / Unlock Configuration

The lock configuration mechanism is used to prevent the configuration settings from being altered during protocol stack execution. The request packet is passed through the channel mailbox only and also affects the *Configuration Locked* flag in the *Common Control Block.*

The protocol stack modifies this flag in order to signal its current state.

### Lock / Unlock Config request

The packet is send through the channel mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F32 | HIL_LOCK_UNLOCK_CONFIG_REQ |
| Data | | | |
| ulParam | uint32_t | 0x00000001<br>0x00000002 | Parameter<br>Lock Configuration<br>Unlock Configuration |

*Table 93: HIL_LOCK_UNLOCK_CONFIG_REQ_T – Lock / Unlock Config request*

### Packet structure reference

```
/* LOCK – UNLOCK CONFIGURATION REQUEST */
#define HIL_LOCK_UNLOCK_CONFIG_REQ          0x00002F32

typedef struct HIL_LOCK_UNLOCK_CONFIG_REQ_DATA_Ttag
{
  uint32_t ulParam;                            /* lock/unlock parameter  */
} HIL_LOCK_UNLOCK_CONFIG_REQ_DATA_T;

typedef struct HIL_LOCK_UNLOCK_CONFIG_REQ_Ttag
{
  HIL_PACKET_HEADER                   tHead;   /* packet header          */
  HIL_LOCK_UNLOCK_CONFIG_REQ_DATA_T   tData;   /* packet data            */
} HIL_LOCK_UNLOCK_CONFIG_REQ_T;
```

### Lock / Unlock Config confirmation

The channel firmware returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F33 | HIL_LOCK_UNLOCK_CONFIG_CNF |

*Table 94: HIL_LOCK_UNLOCK_CONFIG_CNF_T – Lock / Unlock Config confirmation*

### Packet structure reference

```
/* LOCK – UNLOCK CONFIGURATION CONFIRMATION */
#define HIL_LOCK_UNLOCK_CONFIG_CNF          HIL_LOCK_UNLOCK_CONFIG_REQ+1

typedef struct HIL_LOCK_UNLOCK_CONFIG_CNF_Ttag
{
  HIL_PACKET_HEADER    tHead;            /* packet header               */
} HIL_LOCK_UNLOCK_CONFIG_CNF_T;
```

# 4.8 Start / Stop Communication

The command is used to force a protocol stack to start or stop network communication. It is passed to the protocol stack through the channel mailbox. Starting and stopping network communication affects the *Bus On* flag (see *Communication Change of State* register).

### Start / Stop Communication request

The application uses the following packet in order to start or stop network communication. The packet is send through the channel mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F30 | HIL_START_STOP_COMM_REQ |
| Data | | | |
| ulParam | uint32_t | 0x00000001<br>0x00000002 | Parameter<br>HIL_START_STOP_COMM_PARAM_START<br>HIL_START_STOP_COMM_PARAM_STOP |

*Table 95: HIL_START_STOP_COMM_REQ_T – Start / Stop Communication request*

### Packet structure reference

```
/* START – STOP COMMUNICATION REQUEST */
#define HIL_START_STOP_COMM_REQ              0x00002F30

#define HIL_START_STOP_COMM_PARAM_START 0x00000001
#define HIL_START_STOP_COMM_PARAM_STOP  0x00000002

typedef struct HIL_START_STOP_COMM_REQ_DATA_Ttag
{
  uint32_t ulParam;                      /* start/stop communication      */
} HIL_START_STOP_COMM_REQ_DATA_T;

typedef struct HIL_START_STOP_COMM_REQ_Ttag
{
  HIL_PACKET_HEADER               tHead;       /* packet header          */
  HIL_START_STOP_COMM_REQ_DATA_T  tData;       /* packet data            */
} HIL_START_STOP_COMM_REQ_T;
```

### Start / Stop Communication confirmation

The firmware returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F31 | HIL_START_STOP_COMM_CNF |

*Table 96: HIL_START_STOP_COMM_CNF_T – Start / Stop Communication confirmation*

### Packet structure reference

```
/* START – STOP COMMUNICATION CONFIRMATION    */
#define HIL_START_STOP_COMM_CNF              HIL_START_STOP_COMM_REQ+1

typedef struct HIL_START_STOP_COMM_CNF_Ttag
{
  HIL_PACKET_HEADER     tHead;            /* packet header               */
} HIL_START_STOP_COMM_CNF_T;
```

# 4.9 Channel Watchdog Time

The communication channel watchdog time can be retrieved and set using the following watchdog time commands.

## 4.9.1 Get Channel Watchdog Time

### Get Watchdog Time request

The application can use the following packet to read the actual configured watchdog.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F02 | HIL_GET_WATCHDOG_TIME_REQ |

*Table 97: HIL_GET_WATCHDOG_TIME_REQ_T – Get Watchdog Time request*

### Packet structure reference

```
/* GET WATCHDOG TIME REQUEST */
#define HIL_GET_WATCHDOG_TIME_REQ            0x00002F02

typedef struct HIL_GET_WATCHDOG_TIME_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header     */
} HIL_GET_WATCHDOG_TIME_REQ_T;
```

### Get Watchdog Time confirmation

The system channel returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F03 | HIL_GET_WATCHDOG_TIME_CNF |
| Data | | | |
| ulWdgTime | uint32_t | 0<br>20 … 0xFFFF | Watchdog Time in milliseconds [ms]<br>= not set<br>20 > WDT < 0xFFFF |

*Table 98: HIL_GET_WATCHDOG_TIME_CNF_T – Get Watchdog Time confirmation*

### Packet structure reference

```
/* GET WATCHDOG TIME CONFIRMATION */
#define HIL_GET_WATCHDOG_TIME_CNF            HIL_GET_WATCHDOG_TIME_REQ+1

typedef struct HIL_GET_WATCHDOG_TIME_CNF_DATA_Ttag
{
  uint32_t             ulWdgTime;   /* current watchdog time            */
} HIL_GET_WATCHDOG_TIME_CNF_DATA_T;

typedef struct HIL_GET_WATCHDOG_TIME_CNF_Ttag
{
  HIL_PACKET_HEADER                  tHead;     /* packet header          */
  HIL_GET_WATCHDOG_TIME_CNF_DATA_T   tData;     /* packet data            */
} HIL_GET_WATCHDOG_TIME_CNF_T;
```

## 4.9.2 Set Watchdog Time

The application can use the following packet to set the watchdog time of a *Communication Channel*.

### Set Watchdog Time request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F04 | HIL_SET_WATCHDOG_TIME_REQ |
| Data | | | |
| ulWdgTime | uint32_t | 0<br>20 … 65535 | Watchdog Time<br>Watchdog inactive<br>Watchdog time in milliseconds |

*Table 99: HIL_SET_WATCHDOG_TIME_REQ_T – Set Watchdog Time request*

### Packet structure reference

```
/* SET WATCHDOG TIME REQUEST */
#define HIL_SET_WATCHDOG_TIME_REQ           0x00002F04

typedef struct HIL_SET_WATCHDOG_TIME_REQ_DATA_Ttag
{
  /** watchdog time in milliseconds */
  uint32_t ulWdgTime;
} HIL_SET_WATCHDOG_TIME_REQ_DATA_T;

typedef struct HIL_SET_WATCHDOG_TIME_REQ_Ttag
{
  HIL_PACKET_HEADER                 tHead;
  HIL_SET_WATCHDOG_TIME_REQ_DATA_T  tData;
} HIL_SET_WATCHDOG_TIME_REQ_T;
```

### Set Watchdog Time confirmation

The system channel returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F05 | HIL_SET_WATCHDOG_TIME_CNF |

*Table 100: HIL_SET_WATCHDOG_TIME_CNF_T – Set Watchdog Time confirmation*

### Packet structure reference

```
/* SET WATCHDOG TIME CONFIRMATION */
#define HIL_SET_WATCHDOG_TIME_CNF    HIL_SET_WATCHDOG_TIME_REQ+1

typedef struct HIL_SET_WATCHDOG_TIME_CNF_Ttag
{
  HIL_PACKET_HEADER                 tHead;   /* packet header            */
} HIL_SET_WATCHDOG_TIME_CNF_T;
```

# 4.10 Channel Component Information

This service provides information about the number of protocol stack components reacheable via a specific Communication Channel mailbox. The information provided includes

- the component id,
- the remanent data size, and
- version information

for each (protocol stack) component.

In case, the host application requires to store remanent data, the host application has to iterate over all components that indicate remanent data (`ulRemanentDataSize` > 0) and generate a `HIL_SET_REMANENT_DATA_REQ` with the respective Component ID during the configuration phase. If the component has no remanent data (`ulRemanentDataSize` = 0), the application does not need to use the `HIL_SET_REMANENT_DATA_REQ` for this component.

For details about remanent data handling, see section *Remanent Data* on page 144.

### Get Component IDs request

The application can use the following packet to read the available components.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| `ulCmd` | uint32_t | 0x0000AD00 | GENAP_GET_COMPONENT_IDS_REQ |

*Table 101: GENAP_GET_COMPONENT_IDS_REQ_T – Get Component IDs request*

### Packet structure reference

```
/*! Get ComponentIDs Request structure. */
typedef HIL_EMPTY_PACKET_T      GENAP_GET_COMPONENT_IDS_REQ_T;
```

### Get Component IDs confirmation

The communication channel returns the following packet containing all components available.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 + n * 16 | Packet Data Length (in Bytes) |
| ulSta | uint32_t | | See section *Status and error codes*. |
| ulCmd | uint32_t | 0x0000AD01 | GENAP_GET_COMPONENT_IDS_CNF |
| Data | | | |
| ulNumberComponents | uint32_t | 1 … 16 | Number of component details contained in this confirmation packet. |
| Data | | | |
| ulComponentID | uint32_t | | The Component ID of the component.<br>See file Hil_ComponentID.h for details. |
| ulRemanentDataSize | uint32_t | | The size of this components remanent data.<br>0: component has no remanent data.<br>>0: remanent data size in bytes. |
| usVersionMajor | uint16_t | | The major version number of this component. |
| usVersionMinor | uint16_t | | The minor version number of this component. |
| usVersionBuild | uint16_t | | The build version number of this component. |
| usVersionRevision | uint16_t | | The revision version number of this component. |

*Table 102: GENAP_GET_COMPONENT_IDS_CNF_T – Get Component IDs confirmation*

### Packet structure reference

```
/*! Component Details data structure */
typedef __HIL_PACKED_PRE struct GENAP_GET_COMPONENT_DETAILS_DATA_Ttag
{
  /*! Component ID */
  uint32_t ulComponentId;
  /*! Remanent Data size in bytes.
   * \note In case of zero the component has no remanent data. */
  uint32_t ulRemanentdataSize;
  /*! Major version */
  uint16_t usVersionMajor;
  /*! Minor version */
  uint16_t usVersionMinor;
  /*! Build version */
  uint16_t usVersionBuild;
  /*! Revision version */
  uint16_t usVersionRevision;
} __HIL_PACKED_POST GENAP_GET_COMPONENT_DETAILS_DATA_T;

/*! Get ComponentIDs Confirmation data structure */
typedef __HIL_PACKED_PRE struct GENAP_GET_COMPONENT_IDS_CNF_DATA_Ttag
{
  /*! Number of components in this confirmation */
  uint32_t ulNumberComponents;
  /*! Array of components registered at GenAP */
  GENAP_GET_COMPONENT_DETAILS_DATA_T atlComponents[];
} __HIL_PACKED_POST GENAP_GET_COMPONENT_IDS_CNF_DATA_T;

/*! Get ComponentIDs Confirmation structure */
typedef __HIL_PACKED_PRE struct GENAP_GET_COMPONENT_IDS_CNF_Ttag
{
  HIL_PACKET_HEADER_T                tHead;
  GENAP_GET_COMPONENT_IDS_CNF_DATA_T  tData;
} __HIL_PACKED_POST GENAP_GET_COMPONENT_IDS_CNF_T;
```

# 4.11 Communication channel packet fragmentation

The mechanism of transferring packets in a fragmented manner is used in case the packet (size of packet header and user data) exceeds the size of the mailbox.

The host application or the protocol stack splits the entire data block to be transferred (with one service) into smaller fragments. One fragment fits into the mailbox. To transfer all fragments of the entire data block, several packets are used.

This section describes the packet fragmentation used for Communication Channels and differs (not compatible) from the packet fragmentation used for the System Channel. Section in section *General packet fragmentation* (page 74) describes the packet fragmentation for the System Channel.

**Note:** *Packet fragmentation* is not a default mechanism for all packet commands. The handling (for using the communication channel) is described in this section and if supported it is explicitly noted in the packet command definition!

### Principle of data fragmentation (packet fragmentation)

Figure 4 shows the fragmentation principle. The host application or the protocol stack splits the entire data block into smaller parts (fragments). The host application or the protocol stack sends each fragment with a specific header. These packets fit in a mailbox. The amount of packets depend on the size of the entire data block and on the size of the mailbox.

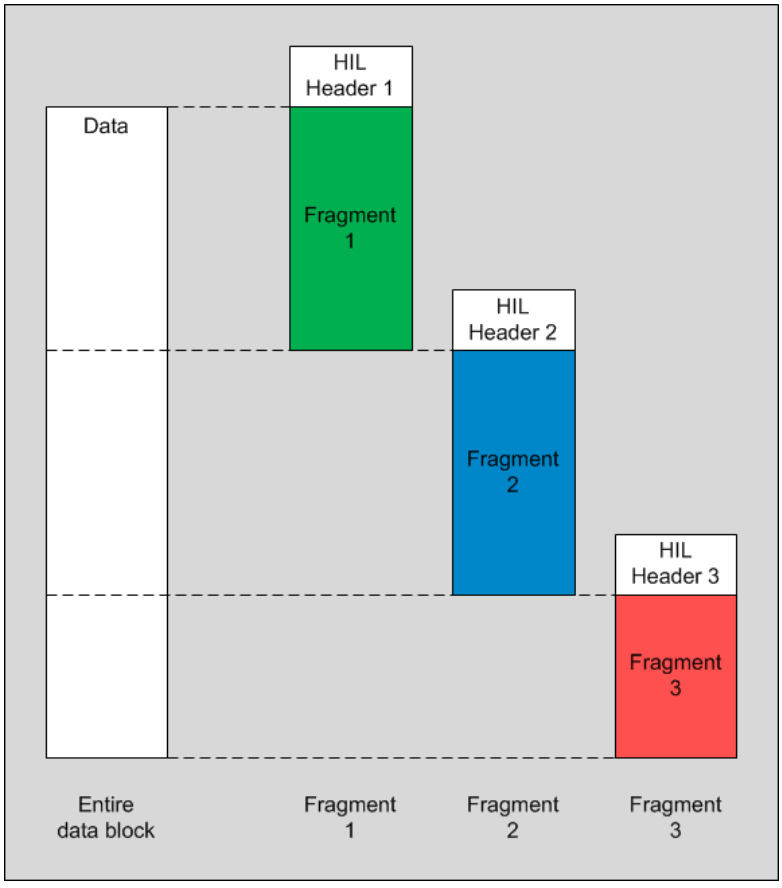



*Figure 4: Packet fragmentation principle (splitting the entire data block into fragments)*

### Handling of packet reassembly

The host application or the protocol stack can rebuild the entire data block as shown in Figure 6. Each packet has a unique sequence number and states whether more packet fragments will follow.

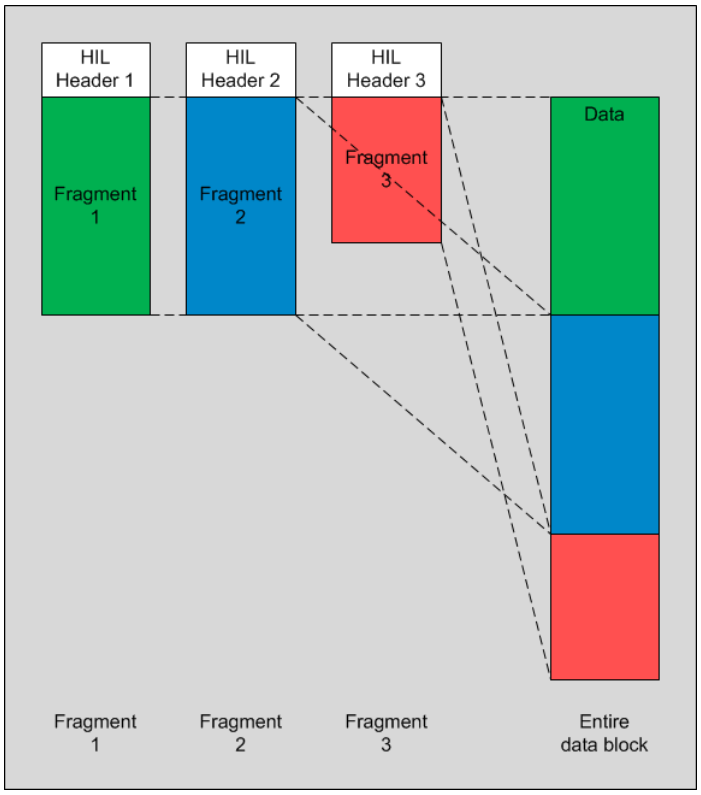



*Figure 5: Packet fragmentation principle (rebuild entire data block)*

### Limitations

- The mechanism described here does not offer possibilities for retransmission. One fragment of data will be transferred after the other. There is no no possibility to retransmit a (previous) fragment.
- The mechanism described here does not give any information about the total size of original message to the receiver with the first packet fragment.

### Packet header used for packet fragmentation

Table 103 lists the variables of the packet header and their use in case of packet fragmentation.

| Variable | Used for | Remark |
|---|---|---|
| ulExt | ▪ indicate fragmented transfer<br>▪ indicate whether more fragments will follow: first fragment, middle fragment<br>▪ indicate whether the service is complete: last fragment | ulExt:SEQ_MASK is used (Hil_Packet.h)<br>`HIL_PACKET_SEQ_NONE (0x00000000)`<br>`HIL_PACKET_SEQ_LAST (0x00000040)`<br>`HIL_PACKET_SEQ_FIRST (0x00000080)`<br>`HIL_PACKET_SEQ_MIDDLE (0x000000C0)` |
| | ▪ indicate the sequence number of fragmented packet<br>▪ the first fragment starts with 0<br>▪ wrap around to 0 after 63 was reached | ulExt:SEQ_NR_MASK is used (Hil_Packet.h)<br>`HIL_PACKET_SEQ_NR_MASK (0x0000003F)` |
| ulDestId | ▪ the service requester uses value 0 for the first fragment<br>▪ the service provider defines the value for ulDestId in the first answer<br>▪ the service requester must use this value of ulDestId for all other packets (middle and last) of this fragmentation sequence | Used as "Service identifier" to allow the application using the same service in parallel. |
| ulSrc | ▪ identifies the service requester of the service<br>▪ the value must be stable for all other packets (middle and last) of this fragmentation sequence | May be used by packet receiver to identify the service requestor. |
| ulSrcId | ▪ the service requester can freely chose this identifier<br>▪ the service requester and service provider must use this value for all other packets (middle and last) of this fragmentation sequence | - |

*Table 103: Packet header used for packet fragmentation*

### Fragmented transfer

Packet fragmentation allows the host application to transfer data from the host application to the stack and allows the stack to transfer data from the stack to the host application. A separate manual describes all use cases and the fragmentation of requests, indications, confirmations and responses. For a detailed description about packet fragmentation including sequence diagrams, see reference [2].

# 5 Protocol Stack services

Protocol stack services are functions handled by the protocol stacks.

These functions are also fieldbus depending and not all of the fieldbus systems are offering the same information or functions.

## 5.1 Function overview

| Protocol stack services | | |
|---|---|---|
| **Service** | **Command definition** | **Page** |
| **Change the Process Data Handshake Configuration** | | |
| Set the mode how I/O data are synchronized with the host | HIL_SET_TRIGGER_TYPE_REQ / HIL_GET_TRIGGER_TYPE_REQ or HIL_SET_HANDSHAKE_CONFIG_REQ | 116 |
| **Modify Configuration Settings** | | |
| Set protocol stack configuration parameters to new values | HIL_SET_FW_PARAMETER_REQ | 124 |
| **Network Connection State** | | |
| Obtain a list of slave which are configured, active or faulted | HIL_GET_SLAVE_HANDLE_REQ | 128 |
| Obtain a slave connection information | HIL_GET_SLAVE_CONN_INFO_REQ | 130 |
| **Protocol Stack Notifications / Indications** | | |
| Register an application to be able to receive notifications from a protocol stack | HIL_REGISTER_APP_REQ | 133 |
| Unregister an application from receiving notifications | HIL_UNREGISTER_APP_REQ | 134 |
| **Link Status Changed Service** | | |
| Activate a link status change notification | HIL_LINK_STATUS_CHANGE_IND | 135 |
| **Perform a Bus Scan** | | |
| Scan for available devices on the fieldbus devices | HIL_BUSSCAN_REQ | 137 |
| **Get Information about a Fieldbus Device** | | |
| Read the fieldbus depending information of a device | HIL_GET_DEVICE_INFO_REQ | 139 |
| **Configuration in Run** | | |
| Verify a modified configuration database file | HIL_VERIFY_DATABASE_REQ | 141 |
| Activate the modified configuration | HIL_ACTIVATE_DATABASE_REQ | 143 |
| **Remanent Data** | | |
| Hand over the remanent data to the application to be stored | HIL_SET_REMANENT_DATA_REQ | 145 |
| Hand over the remanent data to the firmware/stack | HIL_STORE_REMAMENT_DATA_IND | 148 |

*Table 104: Protocol stack services (function overview)*

## 5.2 DPM Handshake Configuration

The host application has the option between two services to modify the netX firmware specific behavior of the IO handshake and the Sync handshake. Depending on the protocol stack this service is or is not implemented.

For a description of the handshake modes and the handling in general, see reference [1].

**Note:** To protect the netX CPU from unexpected overload scenarios, a firmware may have implemented a protection mechanism. This mechanism will only allow a specific amount of IO data exchanges per time. If too many IO exchange requests are detected by the firmware, the firmware will not handle a request directly but instead wait for a specific amount of time until the request will be handled. This is especially (but not exclusively) the case for netX 90 and netX 4000-based firmware.

### 5.2.1 Set Trigger Type

Using this service, the application can configure the data exchange trigger mode for IO handshake and Sync handshake.

The trigger mode defines the network-specific event when the protocol stack will finish the synchronization or the provider/consumer data update.

**Consumer Data (DPM Input)**

The protocol stack finishes the synchronization or the consumer data update:

- immediately in free-run mode: `HIL_TRIGGER_TYPE_*_NONE`
- in case a new network connection is opened and new data is received (bus cycle synchronous): `HIL_TRIGGER_TYPE_*_RX_DATA_RECEIVED`
- in case a defined point of time is reached (time isochronous). The point of time is protocol stack specific: `HIL_TRIGGER_TYPE_*_TIMED_ACTIVATION`

**Provider Data (DPM Output)**

The protocol stack finishes the synchronization or the provider data update:

- immediately in free-run mode: `HIL_TRIGGER_TYPE_*_NONE`
- in case new data on the bus is required. E.g. the protocol stack will delay the update process until a new network connection is established (bus cycle synchronous): `HIL_TRIGGER_TYPE_*_READY_FOR_TX_DATA`
- in case a defined point of time is reached (time isochronous). The point of time is protocol stack specific: `HIL_TRIGGER_TYPE_*_TIMED_LATCH`

The configuration of the consumer and provider data update trigger mode are independent from each other and can be used individually or combined. However, the synchronization trigger mode can only be configured unequal to `HIL_TRIGGER_TYPE_SYNC_NONE` in case both, the consumer and provider, trigger modes are configured in free-run mode `HIL_TRIGGER_TYPE_*_NONE`.

In case the application does not use the service, the protocol stack will start in default trigger mode. The default trigger mode is free-run: `HIL_TRIGGER_TYPE_*_NONE`.

In case the protocol stack does not support the trigger mode, an error code in the response will be set to signal an invalid configuration.

**Notes**

- In case the protocol stack is configured with a trigger mode unequal to free-run, it is protocol stack specific at which point of time the synchronization or provider/consumer data update is finished. E.g. the protocol stack will wait for a network connection to be established.
- If supported, the protocol stack accepts the service in bus off mode. It is protocol stack specific if the service is accepted in bus on mode.
- On channel initialization, the protocol stack keeps the previously configured trigger mode until active change or device reset.
- In case of a deleted config, the firmware uses the default exchange trigger mode.
- The protocol stack monitors (for the configured data exchange mode) if the host application handles the handshake as expected. Every time an error symptom occurs, the respective handshake error counter is incremented. The error counter counts up to the maximal possible value and saturates.
- In case the trigger mode is configured in default mode, the handshake error counters are set to 0 and do not count.
- The protocol stack resets the handshake error counter to initial value (zero) after each channel init.

### Set Trigger Type request

This request packet is used by the application to modify the trigger mode of the protocol stack.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 6 | Packet Data Length (in Bytes) |
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F90 | HIL_SET_TRIGGER_TYPE_REQ |
| Data | | | |
| usPdInHskTriggerType | uint16_t | | The Input Handshake Trigger mode to be used. |
| usPdOutHskTriggerType | uint16_t | | The Output Handshake Trigger mode to be used. |
| usSyncHskTriggerType | uint16_t | | The Sync Handshake Trigger mode to be used. |

*Table 105: HIL_SET_TRIGGER_TYPE_REQ_T – Set Trigger Type request*

### Packet structure reference

```
#define HIL_SET_TRIGGER_TYPE_REQ           0x00002F90

/*!< No input data synchronization (free-run). */
#define HIL_TRIGGER_TYPE_PDIN_NONE                      0x0010
/*!< Input data will be updated when new data was received. (bus cycle synchronous). */
#define HIL_TRIGGER_TYPE_PDIN_RX_DATA_RECEIVED          0x0011
/*!< Input data will be updated on time event (time isochronous). */
#define HIL_TRIGGER_TYPE_PDIN_TIMED_ACTIVATION          0x0012

/*!< No output data synchronization (free-run). */
#define HIL_TRIGGER_TYPE_PDOUT_NONE                     0x0010
/*!< Output data will be send in next bus cycle. (bus cycle synchronous). */
#define HIL_TRIGGER_TYPE_PDOUT_READY_FOR_TX_DATA        0x0011
/*!< Output data will be delayed until next time event (time isochronous). */
#define HIL_TRIGGER_TYPE_PDOUT_TIMED_LATCH              0x0012

/*!< No sync signal generation */
#define HIL_TRIGGER_TYPE_SYNC_NONE                      0x0010
/*!< Generate Sync event when new data was received. */
#define HIL_TRIGGER_TYPE_SYNC_RX_DATA_RECEIVED          0x0011
/*!< Generate Sync event when new data will be send. */
#define HIL_TRIGGER_TYPE_SYNC_READY_FOR_TX_DATA         0x0012
/*!< Generate Sync event when data shall be latched. */
#define HIL_TRIGGER_TYPE_SYNC_TIMED_LATCH               0x0013
/*!< Generate Sync event when data shall be applied. */
#define HIL_TRIGGER_TYPE_SYNC_TIMED_ACTIVATION          0x0014


/*! Set data exchange trigger data. */
typedef __HIL_PACKED_PRE struct HIL_SET_TRIGGER_TYPE_REQ_DATA_Ttag
{
  /*! Consumer data trigger type HIL_TRIGGER_TYPE_PDIN_*. */
  uint16_t usPdInHskTriggerType;
  /*! Provider data trigger type HIL_TRIGGER_TYPE_PDOUT_*. */
  uint16_t usPdOutHskTriggerType;
  /*! Synchronization trigger type HIL_TRIGGER_TYPE_SYNC_*. */
  uint16_t usSyncHskTriggerType;
} __HIL_PACKED_POST HIL_SET_TRIGGER_TYPE_REQ_DATA_T;

/*! Set data exchange trigger request. */
typedef __HIL_PACKED_PRE struct HIL_SET_TRIGGER_TYPE_REQ_Ttag
{
  HIL_PACKET_HEADER_T               tHead;  /*!< Packet header. */
  HIL_SET_TRIGGER_TYPE_REQ_DATA_T   tData;  /*!< Packet data. */
} __HIL_PACKED_POST HIL_SET_TRIGGER_TYPE_REQ_T;
```

### Set Trigger Type confirmation

The protocol stack will respond to the request with the following confirmation.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 0 | Packet Data Length (in Bytes) |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F91 | HIL_SET_TRIGGER_TYPE_CNF |

*Table 106: HIL_SET_TRIGGER_TYPE_CNF_T – Set Trigger Type confirmation*

### Packet structure reference

```
#define HIL_SET_TRIGGER_TYPE_CNF           0x2F91

/*! Set data exchange trigger confirmation structure. */
typedef HIL_EMPTY_PACKET_T      HIL_SET_TRIGGER_TYPE_CNF_T;
```

## 5.2.2 Get Trigger Type

Using this service the application can read out

- the trigger mode (handshake behavior) for IO handshake and Sync handshake
- the fastest allowed DPM update time

of a protocol stack related to a specific DPM Communication Channel.

### Get Trigger Type request

This service is used by the application to read the current handshake trigger type configured in the protocol stack.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 0 | Packet Data Length (in Bytes) |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F92 | HIL_GET_TRIGGER_TYPE_REQ |

*Table 107: HIL_GET_TRIGGER_TYPE_REQ_T – Get Trigger Type request*

### Packet structure reference

```
#define HIL_GET_TRIGGER_TYPE_REQ           0x2F92

/*! Get data exchange trigger request. */
typedef HIL_EMPTY_PACKET_T      HIL_GET_TRIGGER_TYPE_REQ_T;
```

### Get Trigger Type confirmation

The protocol stack will respond to the request with the following confirmation.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 8 | Packet Data Length (in Bytes) |
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F93 | HIL_GET_TRIGGER_TYPE_CNF |
| Data | | | |
| usPdInHskTriggerType | uint16_t | | The Input Handshake Trigger mode to be used. |
| usPdOutHskTriggerType | uint16_t | | The Output Handshake Trigger mode to be used. |
| usSyncHskTriggerType | uint16_t | | The Sync Handshake Trigger mode to be used. |
| usMinFreeRunUpdateInterval | uint16_t | | The fastest possible update time in case FreeRun mode is active (in microseconds). |

*Table 108: HIL_GET_TRIGGER_TYPE_CNF_T – Get Trigger Type confirmation*

### Packet structure reference

```
#define HIL_GET_TRIGGER_TYPE_CNF           0x00002F93

/*! Get data exchange trigger data. */
typedef struct HIL_GET_TRIGGER_TYPE_CNF_DATA_Ttag
{
  /*! Input process data trigger type.
   * Value is a type of HIL_TRIGGER_TYPE_PDIN_*. */
  uint16_t usPdInHskTriggerType;
  /*! Output process data trigger type.
   * Value is a type of HIL_TRIGGER_TYPE_PDOUT_*. */
  uint16_t usPdOutHskTriggerType;
  /*! Synchronization trigger type.
   * Value is a type of HIL_TRIGGER_TYPE_SYNC_*. */
  uint16_t usSyncHskTriggerType;
  /*! Minimal provide/consumer data update interval in free-run mode.
   * The application shall ensure in free-run mode to not request faster
   * provider/consumer data update than this interval.
   * Unit of microseconds, default value is 1000us, value 0-31 is not valid. */
  uint16_t usMinFreeRunUpdateInterval;
} HIL_GET_TRIGGER_TYPE_CNF_DATA_T;

/*! Get data exchange trigger confirmation structure. */
typedef struct HIL_GET_TRIGGER_TYPE_CNF_Ttag
{
  HIL_PACKET_HEADER_T               tHead;  /*!< Packet header. */
  HIL_GET_TRIGGER_TYPE_CNF_DATA_T   tData;  /*!< Packet data. */
} HIL_GET_TRIGGER_TYPE_CNF_T;
```

# 5.3 Modify Configuration Settings

The *Modify Configuration Settings* functionality allows to selectively changing configuration parameters or settings of a slave protocol stacks which is already configured by a configuration database file (e.g. config.nxd).

The subsequent modification of configuration settings is particularly useful if the same configuration database file is used for a number of identical slave devices where each of the devices needs some individual settings like a unique network address or station name.

**Note:** Modifying configuration settings is only possible if the protocol stack is configured by a configuration database file (e.g. config.nxd) and the network startup behavior, given by the configuration database, is set to ***Controlled Start of Communication***.

Example of parameters which usually have to be modified:

- Station / Network Address
- Baud rate
- Name of Station (PROFINET Device only)
- Device Identification (EtherCAT Slave only)
- Second Station Address (EtherCAT Slave only)

### General Configuration Handling

In general, a protocol stack can be configured in 3 different ways.

- SYCON.net configuration database file
- iniBatch database file (via netX Configuration Tool)
- Configuration via *Set Configuration Request* packets

After power-on reset, a protocol stack first checks if a configuration database file (e.g. config.nxd) is available. If so, the configuration will be evaluated and no other configuration will be accepted from this point (see *Set Configuration* packets). In case a configuration database file could not be found, the firmware checks next if an *iniBatch* database file is available and if so, it proceeds in the same way. If none of the two database files are available, the protocol stack will remain in unconfigured state and waits until an application starts to send configuration packets to the stack.

To be able to use the modification service, the protocol stack must be in a specific state. It must be configured by a configuration database file and the network startup behavior in the configuration database must be set to *Controlled Start of Communication.* Only in this state, where the protocol stack waits on a BUS-ON command, he will accept modification commands.

### Flowchart

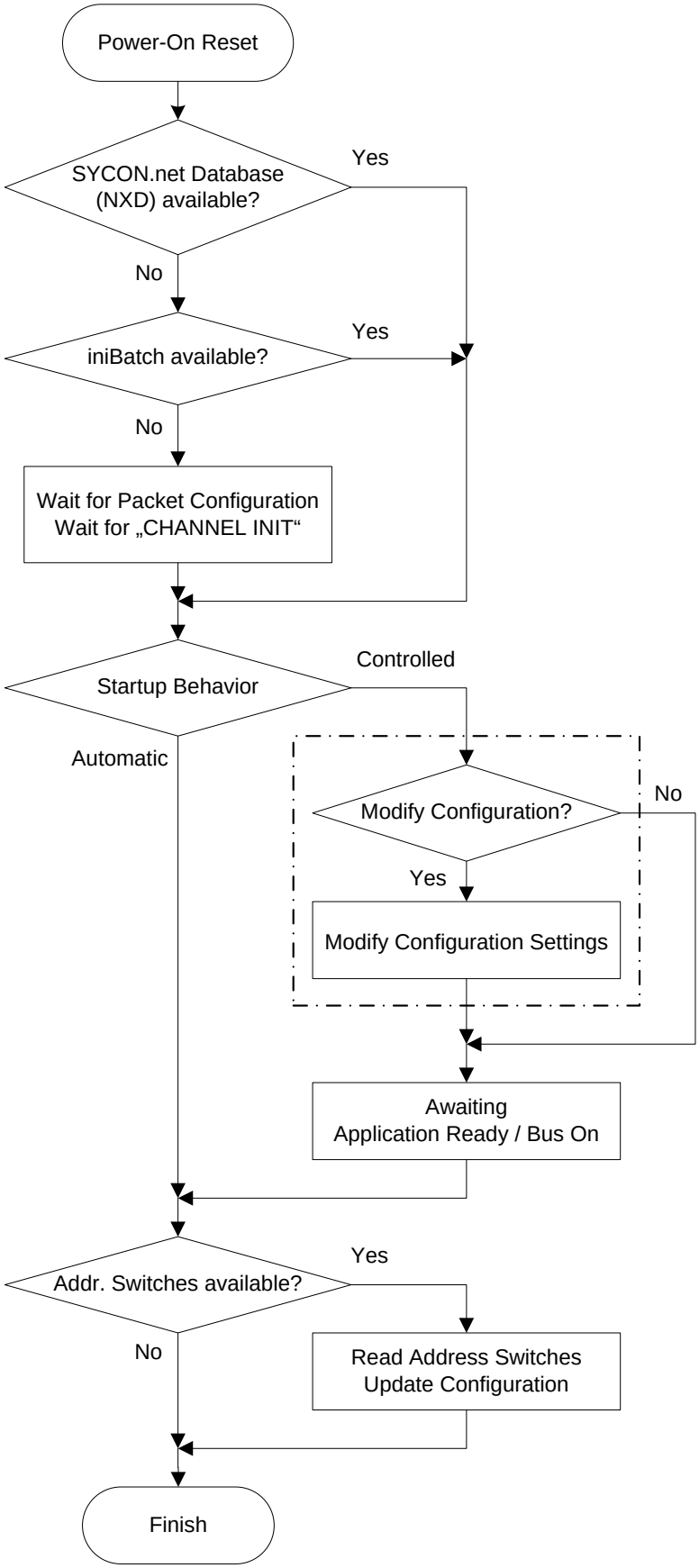



*Figure 6: Flowchart Modify Configuration Settings*

**Behavior when configuration is locked**

The protocol stack returns no error code when the host application tries to modify the configuration settings while the configuration is locked (see section *Lock / Unlock Configuration* on page 106).

**Behavior while network communication / bus on is set**

The protocol stack returns no error code when the host application tries to modify the configuration settings during network communication or if BUS_ON is set. The new parameter value is not applied to the current configuration. This behavior is necessary because some fieldbus systems are required to react when certain configuration parameters change during runtime.

For example, the DeviceNet firmware shall indicate an error status via its LED if a new network address was assigned during runtime.

**Note:** During network communication, the *Get Parameter* command can be used to read the currently used parameter.

**Behavior during channel initialization**

During channel initialization (see *netX Dual-Port Memory Interface Manual* for more details) all parameters set by the *Set Parameter* command are discarded and the original from the configuration database are used again.

### 5.3.1 Set Parameter Data

This service allows a host application to modify certain protocol stack parameters from the current configuration. This requires that *Controlled Start of Communication* is set in the configuration database file and the protocol stack is waiting for the *BUS ON / APPLICATION READY* command.

#### Set Parameter request

Depending on the stack implementation the service allows the application to set one or more parameters in one request. Please consult the protocol stack manual which parameters are changeable. The packet is send through the channel mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulDest` | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| `ulLen` | uint32_t | 8 + n | Packet Data Length (in Bytes) |
| `ulCmd` | uint32_t | 0x00002F86 | HIL_SET_FW_PARAMETER_REQ |
| Data | | | |
| `ulParameterID` | uint32_t | 0 … 0xFFFFFFFF | Parameter identifier, see Table 110 and Table 111 |
| `ulParameterLen` | uint32_t | n | Length of abParameter in byte |
| `abParameter[4]` | uint8_t | m | Parameter value, byte array |

*Table 109: HIL_SET_FW_PARAMETER_REQ_T – Set Parameter request*

#### Packet structure reference

```
/* SET FIRMWARE PARAMETER REQUEST */
#define HIL_SET_FW_PARAMETER_REQ           0x00002F86

typedef struct HIL_SET_FW_PARAMETER_REQ_DATA_Ttag
{
  uint32_t ulParameterID;                  /* parameter identifier       */
  uint32_t ulParameterLen;                 /* parameter length           */
  uint8_t  abParameter[4];                 /* parameter                  */
} HIL_SET_FW_PARAMETER_REQ_DATA_Ttag;

typedef struct HIL_SET_FW_PARAMETER_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header              */
  HIL_SET_FW_PARAMETER_REQ_DATA_T  tData;   /* packet data                */
} HIL_SET_FW_PARAMETER_REQ_T;
```

#### Parameter Identifier *ulParameterID*

The Parameter Identifier is encoded as outlined below (0xPCCCCNNN).

| 31 | … | 28 | 27 | 26 | 25 | … | 14 | 13 | 12 | 11 | 10 | … | 2 | 1 | 0 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | NNN = unique number | | | | | | |
| | | | CCCC = protocol class (see *usProtocolClass* in the *netX Dual-Port Memory Interface Manual*) | | | | | | | | | | | | | |
| P = prefix (always 0x3) | | | | | | | | | | | | | | | | |

*Table 110: Encoding Parameter Identifier*

The following parameter identifiers are defined.

| Name | Code | Type | Size | Description of Parameter |
|---|---|---|---|---|
| PID_STATION_ADDRESS | 0x30000001 | uint32_t | 4 Byte | Station Address |
| PID_BAUDRATE | 0x30000002 | uint32_t | 4 Byte | Baud Rate |
| PID_PN_NAME_OF_STATION | 0x30015001 | uint8_t | 240 Byte | PROFINET: Name of Station |
| PID_ECS_DEVICE_IDENTIFICATION | 0x30009001 | uint16_t | 4 Byte | EtherCAT: Value for Explicit Device Identification |
| PID_ECS_SCND_STATION_ADDRESS | 0x30009002 | uint16_t | 4 Byte | EtherCAT: Second Station Address |
| All other codes are reserved for future use. | | | | |

*Table 111: Defined Parameter Identifier*

### Set Parameter confirmation

The following packet describes the answer of the *Set Parameter Request.*

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F87 | HIL_SET_FW_PARAMETER_CNF |

*Table 112: HIL_SET_FW_PARAMETER_CNF_T – Set Parameter confirmation*

### Packet structure reference

```
/* SET FIRMWARE PARAMETER CONFIRMATION */
#define HIL_SET_FW_PARAMETER_CNF           HIL_SET_FW_PARAMETER_REQ+1

typedef struct HIL_SET_FW_PARAMETER_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_SET_FW_PARAMETER_CNF_T;
```

# 5.4 Network Connection State

This section explains how an application can obtain connection status information about slave devices from a master protocol stack. Hence the packets below are only supported by master protocol stacks. Slave stacks do not support this function and will rejects the request with an error code.

## 5.4.1 Mechanism

The application can request information about the status of network slaves in regards of their cyclic connection (Non-cyclic connections are not handled in here).

The protocol stack returns a list of handles where each handle represents one slave device.

**Note:** A handle of a slave is not its MAC ID, station or node address nor an IP address.

The following lists are available.

- **List of Configured Slaves**
  This list represents all network nodes that are configured via a configuration database file or via packet services.
- **List of Active Slaves**
  This list holds network nodes that are configured (see above) and actively communicating to the network master.

  **Note:** This is not a ‘Life List’! The list contains only nodes included in the configuration.
- **List of Faulted Slaves**
  This list contains handles of all configured nodes that currently encounter some sort of connection problem (e.g. disconnected, hardware or configuration problems).

### Handling procedure

At first an application has to send a *Get Slave Handle Request* to obtain the list of slaves.

**Note:** Handles may change after reconfiguration or power-on reset.

With the handles returned by *Get Slave Handle Request*, the application can use the *Get Slave Connection Information Request* to read the slave’s current network status.

The network status information is always fieldbus specific and to be able to evaluate the slave information data, the returned information also contains the unique identification number `ulStructID`. By using `ulStructID` the application is able to identify the delivered data structured.

Identification numbers and structures are described in the corresponding protocol stack interface manual and corresponding structure definitions can be found in the protocol-specific header files.

In a flawless network (all configured slaves are working properly) the list of configured slaves is identical to the list of activated slaves and both list containing the same handles. In case of a slave failure, the corresponding slave handle will be removed from the active slave list and moved to the faulty slave list while the list of configured slaves remains always constant.

If an application want to check, if the fieldbus system (all slaves) workings correctly, it has to compare the *List of Configured Slaves* against the *List of Active Slaves*. If both lists are identical, all slaves are active on the bus.

Faulty slaves are always shown in the *List of Faulted Slaves* which contains the corresponding slave handle. Depending on the fieldbus system a faulty slave may or may not appear in the *List of Active Slaves*.

The reason why slaves are not working correctly could differ between fieldbus systems. Obvious causes are:

- Inconsistent configuration between master and slave
- Slave parameter data faults
- Disconnected network cable

**Note:** Diagnostic functionalities and diagnostic information details are heavily depending on the fieldbus system. Therefore only the handling to get the information is specified. The data evaluation must be done by the application using the fieldbus specific documentations and definitions.

## 5.4.2 Obtain List of Slave Handles

### Get Slave Handle request

The host application uses the packet below in order to request a list of slaves depending on the requested type:

- *List of Configured Slaves* (*HIL_LIST_CONF_SLAVES*)
- *List of Activated Slaves* (*HIL_LIST_ACTV_SLAVES*)
- *List of Faulted Slaves* (*HIL_LIST_FAULTED_SLAVES*)

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F08 | HIL_GET_SLAVE_HANDLE_REQ |
| Data | | | |
| ulParam | uint32_t | <br>0x00000001<br>0x00000002<br>0x00000003 | Parameter<br>HIL_LIST_CONF_SLAVES<br>HIL_LIST_ACTV_SLAVES<br>HIL_LIST_FAULTED_SLAVES |

*Table 113: HIL_PACKET_GET_SLAVE_HANDLE_REQ_T – Get Slave Handle request*

### Packet structure reference

```
/* GET SLAVE HANDLE REQUEST */
#define HIL_GET_SLAVE_HANDLE_REQ             0x00002F08

/* LIST OF SLAVES */
#define HIL_LIST_CONF_SLAVES                 0x00000001
#define HIL_LIST_ACTV_SLAVES                 0x00000002
#define HIL_LIST_FAULTED_SLAVES              0x00000003

typedef struct HIL_PACKET_GET_SLAVE_HANDLE_REQ_DATA_Ttag
{
  uint32_t ulParam;                          /* type of list               */
} HIL_PACKET_GET_SLAVE_HANDLE_REQ_DATA_T;

typedef struct HIL_PACKET_GET_SLAVE_HANDLE_REQ_Ttag
{
  HIL_PACKET_HEADER                        tHead;     /* packet header     */
  HIL_PACKET_GET_SLAVE_HANDLE_REQ_DATA_T  tData;     /* packet data       */
} HIL_PACKET_GET_SLAVE_HANDLE_REQ_T;
```

### Get Slave Handle confirmation

This is the answer to the *HIL_GET_SLAVE_HANDLE_REQ* command. The answer packet contains a list of slave handles. Each handle in the returned list describes a slave device where the slave state corresponds to the requested list type (*configured*, *activated* or *faulted*).

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 * (1 + n)<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F09 | HIL_GET_SLAVE_HANDLE_CNF |
| Data | | | |
| ulParam | uint32_t | 0x00000001<br>0x00000002<br>0x00000003 | Parameter<br>HIL_LIST_CONF_SLAVES<br>HIL_LIST_ACTV_SLAVES<br>HIL_LIST_FAULTED_SLAVES |
| aulHandle[1] | uint32_t | 0 … 0xFFFFFFFF | Slave Handle, Number of Handles is **n** |

*Table 114: HIL_PACKET_GET_SLAVE_HANDLE_CNF_T – Get Slave Handle confirmation*

### Packet structure reference

```
/* GET SLAVE HANDLE CONFIRMATION */
#define HIL_GET_SLAVE_HANDLE_CNF             HIL_GET_SLAVE_HANDLE_REQ+1

typedef struct HIL_PACKET_GET_SLAVE_HANDLE_CNF_DATA_Ttag
{
  uint32_t ulParam;                          /* type of list               */
  /* list of handles follows here                                          */
  uint32_t aulHandle[1];
} HIL_PACKET_GET_SLAVE_HANDLE_CNF_DATA_T

typedef struct HIL_PACKET_GET_SLAVE_HANDLE_CNF_Ttag
{
  HIL_PACKET_HEADER                       tHead;     /* packer header     */
  HIL_PACKET_GET_SLAVE_HANDLE_CNF_DATA_T  tData;     /* packet data       */
} HIL_PACKET_GET_SLAVE_HANDLE_CNF_T;
```

## 5.4.3 Obtain Slave Connection Information

### Get Slave Connection Information request

Using the handles from section 5.4.2, the application can request network status information for each of the configured network slaves.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F0A | HIL_GET_SLAVE_CONN_INFO_REQ |
| Data | | | |
| ulHandle | uint32_t | 0 … 0xFFFFFFFF | Slave Handle |

*Table 115: HIL_PACKET_GET_SLAVE_CONN_INFO_REQ_T – Get Slave Connection Information request*

### Packet structure reference

```
/* SLAVE CONNECTION INFORMATION REQUEST */
#define HIL_GET_SLAVE_CONN_INFO_REQ          0x00002F0A

typedef struct HIL_PACKET_GET_SLAVE_CONN_INFO_REQ_DATA_Ttag
{
  uint32_t ulHandle;                                    /* slave handle  */
} HIL_PACKET_GET_SLAVE_CONN_INFO_REQ_DATA_T;

typedef struct HIL_PACKET_GET_SLAVE_CONN_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER                             tHead;   /* packer header */
  HIL_PACKET_GET_SLAVE_CONN_INFO_REQ_DATA_T     tData;   /* packet data   */
} HIL_PACKET_GET_SLAVE_CONN_INFO_REQ_T;
```

### Get Slave Connection Information confirmation

The confirmation contains the fieldbus specific state information of the requested slave defined in *ulHandle*.

The identification number *ulStructID* defines the fieldbus specific information data structure following the *ulStructID* element in the packet.

The identification numbers and structures are described in the fieldbus related documentation and the fieldbus specific C header file.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 8+sizeof(*slave data*)<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br><br>Otherwise |
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F0B | HIL_GET_SLAVE_CONN_INFO_CNF |
| Data | | | |
| ulHandle | uint32_t | 0 … 0xFFFFFFFF | Slave Handle |
| ulStructID | uint32_t | 0 … 0xFFFFFFFF | Structure Identification Number |
| *slave data* | Structure | n | Fieldbus Specific Slave Status Information<br>(Refer to Fieldbus Documentation) |

*Table 116: HIL_PACKET_GET_SLAVE_CONN_INFO_CNF_T – Get Slave Connection Information conformation*

### Packet structure reference

```
/* GET SLAVE CONNECTION INFORMATION CONFIRMATION */
#define HIL_GET_SLAVE_CONN_INFO_CNF          HIL_GET_SLAVE_CONN_INFO_REQ+1

typedef struct HIL_PACKET_GET_SLAVE_CONN_INFO_CNF_DATA_Ttag
{
  uint32_t ulHandle;                /* slave handle                      */
  uint32_t ulStructID;              /* structure identification number   */
  /* fieldbus specific slave status information follows here             */
} HIL_PACKET_GET_SLAVE_CONN_INFO_CNF_DATA_T;

typedef struct HIL_PACKET_GET_SLAVE_CONN_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER                             tHead;    /* packet header     */
  HIL_PACKET_GET_SLAVE_CONN_INFO_CNF_DATA_T     tData;    /* packet data  */
} HIL_PACKET_GET_SLAVE_CONN_INFO_CNF_T;
```

### Fieldbus Specific Slave Status Information

The structure returned in the confirmation contains at least a field that helps to unambiguously identify the node. Usually it's a network address, like MAC ID, IP address or station address. If applicable, the structure may hold a name string.

For details consult the corresponding protocol stack interface manual.

## 5.5 Protocol Stack Notifications / Indications

Protocol stacks are able to create notifications / indications (in form of “unsolicited data telegrams”) exchanged via the mailbox system. These notifications / indications are used to inform the application about state changes and other protocol stack relevant information.

This section describes the method on how to register / unregister an application to the protocol stack in order to activate and receive notifications / indications via the mailbox system.

**Note:** Available information (as notifications / indications) depends on the protocol stack. Please consult the corresponding Protocol API manual.

During the registration of the application, notifications will be automatically activated. From this point of time, the application **must process incoming notification / indication packets**. If an application does not process the notification / indication after registration, the protocol stack internal service will time-out which can result into network failures.

If an application registers, `ulSrc` (the *Source Queue Handle*) of the register command is used to identify the host application. It is also stored to verify if further registration / unregistration attempts are valid and `ulSrc` is copied into every notification / indication packet send to the host application to help identifying the intended receiver.

Ethernet-based protocol stacks will automatically issue the *Link Status Changed Service* (see page 135) after the application has registered.

**Note:** Only one application is able to register with the protocol stack at a time. Further register attempts in parallel will be rejected by the protocol stack.

## 5.5.1 Register Application

### Register Application request

The application uses the following packet in order to register itself to a protocol stack. The packet is send through the channel mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulSrc | uint32_t | n | Unique application identifier |
| ulCmd | uint32_t | 0x00002F10 | HIL_REGISTER_APP_REQ |

*Table 117: HIL_REGISTER_APP_REQ_T – Register Application request*

### Packet structure reference

```
/* REGISTER APPLICATION REQUEST */
#define HIL_REGISTER_APP_REQ                0x00002F10

typedef struct HIL_REGISTER_APP_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_REGISTER_APP_REQ_T;
```

### Register Application confirmation

The system channel returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F11 | HIL_REGISTER_APP_CNF |

*Table 118: HIL_REGISTER_APP_CNF_T – Register Application confirmation*

### Packet structure reference

```
/* REGISTER APPLICATION CONFIRMATION */
#define HIL_REGISTER_APP_CNF                HIL_REGISTER_APP_REQ+1

typedef struct HIL_REGISTER_APP_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_REGISTER_APP_CNF_T;
```

## 5.5.2 Unregister Application

### Unregister Application request

The application uses the following packet in order to undo the registration from above. The packet is send through the channel mailbox.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulSrc | uint32_t | n | used during registration |
| ulCmd | uint32_t | 0x00002F12 | HIL_UNREGISTER_APP_REQ |

*Table 119: HIL_UNREGISTER_APP_REQ_T – Unregister Application request*

### Packet structure reference

```
/* UNREGISTER APPLICATION REQUEST */
#define HIL_UNREGISTER_APP_REQ              0x00002F12

typedef struct HIL_UNREGISTER_APP_REQ_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_UNREGISTER_APP_REQ_T;
```

### Unregister Application confirmation

The system channel returns the following packet.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See Below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F13 | HIL_UNREGISTER_APP_CNF |

*Table 120: HIL_UNREGISTER_APP_CNF_T – Unregister Application confirmation*

### Packet structure reference

```
/* UNREGISTER APPLICATION CONFIRMATION */
#define HIL_UNREGISTER_APP_CNF              HIL_UNREGISTER_APP_REQ+1

typedef struct HIL_UNREGISTER_APP_CNF_Ttag
{
  HIL_PACKET_HEADER                tHead;   /* packet header            */
} HIL_UNREGISTER_APP_CNF_T;
```

# 5.6 Link Status Changed Service

This service is used to inform an application about link status changes of a protocol stack. In order to receive the notifications, the application has to register itself at the protocol stack (see *5.5 Protocol Stack Notifications / Indications*).

An Ethernet-based protocol stack will automatically generate this indication after the application has used the *Register Application* service (page 133).

This command depends on the used protocol stack, see corresponding Protocol API manual if this command is supported.

### Link Status Change indication

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 32 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F8A | HIL_LINK_STATUS_CHANGE_IND |
| Data | | | |
| atLinkData[2] | Structure | | Link Status Information |

| **Structure Information:** *HIL_LINK_STATUS_T* | | | |
|---|---|---|---|
| ulPort | uint32_t | | Number of the port |
| fIsFullDuplex | uint32_t | | Non-zero if full duplex is used |
| fIsLinkUp | uint32_t | | Non-zero if link is up |
| ulSpeed | uint32_t | <br>0<br>10<br>100 | Speed of the link<br>No link<br>10MBit<br>100Mbit |

*Table 121: HIL_LINK_STATUS_CHANGE_IND_T – Link Status Change indication*

### Packet structure reference

```
/* LINK STATUS CHANGE INDICATION */
#define HIL_LINK_STATUS_CHANGE_IND         0x00002F8A

typedef struct HIL_LINK_STATUS_Ttag
{
  uint32_t        ulPort;           /*!< Port the link status is for */
  uint32_t        fIsFullDuplex;    /*!< If a full duplex link is available on this port
*/
  uint32_t        fIsLinkUp;        /*!< If a link is available on this port */
  uint32_t        ulSpeed;          /*!< Speed of the link \n\n
                                     \valueRange
                                     0:   No link \n
                                     10:  10MBit  \n
                                     100: 100MBit \n */
} HIL_LINK_STATUS_T;

typedef struct HIL_LINK_STATUS_CHANGE_IND_DATA_Ttag
{
  HIL_LINK_STATUS_T  atLinkData[2];
} HIL_LINK_STATUS_CHANGE_IND_DATA_T;

typedef struct HIL_LINK_STATUS_CHANGE_IND_Ttag
{
  HIL_PACKET_HEADER                tHead;
  HIL_LINK_STATUS_CHANGE_IND_DATA_T tData;
} HIL_LINK_STATUS_CHANGE_IND_T;
```

### Link Status Change response

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F8B | HIL_LINK_STATUS_CHANGE_RES |

*Table 122: HIL_LINK_STATUS_CHANGE_RES_T – Link Status Change response*

### Packet structure reference

```
/* LINK STATUS CHANGE RESPONSE */
#define HIL_LINK_STATUS_CHANGE_RES         HIL_LINK_STATUS_CHANGE_IND+1

typedef HIL_PACKET_HEADER      HIL_LINK_STATUS_CHANGE_RES_T;
```

## 5.7 Perform a Bus Scan

Perform a bus scan and retrieve the scan results. This services in only offered by master protocol stacks.

**Note:** This command depends on the used protocol stack. Consult the corresponding protocol stack interface manual if the command is supported and for more information.

### Bus Scan request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F22 | HIL_BUSSCAN_REQ |
| Data | | | |
| ulAction | uint32_t | 0x01<br>0x02<br>0x03 | Action to perform<br>HIL_BUSSCAN_CMD_START<br>HIL_BUSSCAN_CMD_STATUS<br>HIL_BUSSCAN_CMD_ABORT |

*Table 123: HIL_BUSSCAN_REQ_T – Bus Scan request*

### Packet structure reference

```
/* BUS SCAN REQUEST */
#define HIL_BUSSCAN_REQ                    0x00002F22

#define HIL_BUSSCAN_CMD_START    0x01
#define HIL_BUSSCAN_CMD_STATUS   0x02
#define HIL_BUSSCAN_CMD_ABORT    0x03

typedef struct HIL_BUSSCAN_REQ_DATA_Ttag
{
  uint32_t ulAction;
} HIL_BUSSCAN_REQ_DATA_T;

typedef struct HIL_BUSSCAN_REQ_Ttag
{
  HIL_PACKET_HEADER       tHead;
  HIL_BUSSCAN_REQ_DATA_T  tData;
} HIL_BUSSCAN_REQ_T;
```

### Bus Scan confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>12<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F23 | HIL_BUSSCAN_CNF |
| Data | | | |
| ulMaxProgress | uint32_t | n | Number of devices from the configuration |
| ulActProgress | uint32_t | m | Number of devices found |
| abDevice List[4] | uint8_t | | List of available devices on the fieldbus system |

*Table 124: HIL_BUSSCAN_CNF_T – Bus Scan confirmation*

### Packet structure reference

```
/* BUS SCAN CONFIRMATION */
#define HIL_BUSSCAN_CNF                    HIL_BUSSCAN_REQ+1

typedef struct HIL_BUSSCAN_CNF_DATA_Ttag
{
  uint32_t ulMaxProgress;
  uint32_t ulActProgress;
  uint8_t  abDeviceList[4];
} HIL_BUSSCAN_CNF_DATA_T;

typedef struct HIL_BUSSCAN_CNF_Ttag
{
  HIL_PACKET_HEADER      tHead;
  HIL_BUSSCAN_CNF_DATA_T tData;
} HIL_BUSSCAN_CNF_T;
```

# 5.8 Get Information about a Fieldbus Device

Read the available information about a specific node on the fieldbus system. This services in only offered by master protocol stacks.

**Note:** This command depends on the used protocol stack. Consult the corresponding protocol stack interface manual if the command is supported and for more information.

### Get Device Info request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulCmd | uint32_t | 0x00002F24 | HIL_GET_DEVICE_INFO_REQ |
| Data | | | |
| ulDeviceIdx | uint32_t | n | Fieldbus specific device identifier |

*Table 125: HIL_GET_DEVICE_INFO_REQ_T – Get Device Info request*

### Packet structure reference

```
/* GET DEVICE INFO REQUEST */
#define HIL_GET_DEVICE_INFO_REQ            0x00002F24

typedef struct HIL_GET_DEVICE_INFO_REQ_DATA_Ttag
{
  uint32_t ulDeviceIdx;
} HIL_GET_DEVICE_INFO_REQ_DATA_T;

typedef struct HIL_GET_DEVICE_INFO_REQ_Ttag
{
  HIL_PACKET_HEADER              tHead;
  HIL_GET_DEVICE_INFO_REQ_DATA_T tData;
} HIL_GET_DEVICE_INFO_REQ_T;
```

### Get Device Info confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 8 + n<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F25 | HIL_GET_DEVICE_INFO_CNF |
| Data | | | |
| ulDeviceIdx | uint32_t | n | Identifier of device |
| ulStructId | uint32_t | m | Identifier of structure type |
| | Structure | | Fieldbus specific data structure |

*Table 126: HIL_GET_DEVICE_INFO_CNF_T – Get Device Info confirmation*

### Packet structure reference

```
/* GET DEVICE INFO CONFIRMATION */
#define HIL_GET_DEVICE_INFO_CNF            HIL_GET_DEVICE_INFO_REQ+1

typedef struct HIL_GET_DEVICE_INFO_CNF_DATA_Ttag
{
  uint32_t ulDeviceIdx;
  uint32_t ulStructId;
  /* uint8_t  tStruct; Fieldbus specific structure */
} HIL_GET_DEVICE_INFO_CNF_DATA_T;

typedef struct HIL_GET_DEVICE_INFO_CNF_Ttag
{
  HIL_PACKET_HEADER              tHead;
  HIL_GET_DEVICE_INFO_CNF_DATA_T tData;
} HIL_GET_DEVICE_INFO_CNF_T;
```

# 5.9 Configuration in Run

*Configuration in Run* is a fieldbus and protocol stack specific function which should allow the modification of the master fieldbus configuration while the configuration is active and without stopping the already active bus communication. The functions only works if a configuration database file is used to configure the master device.

The modification of configuration data during run-time has some specific limitations. Therefore the modified configuration database must first be downloaded to the master device. Afterwards the master is requested to check if the new configuration database can be used without disturbing the current active devices on the fieldbus system (e.g. adding a new device online).

**Note:** This command depends on the used protocol stack and not all fieldbus systems are supporting *Configuration in Run*.
Consult the corresponding protocol stack interface manual if this function is supported and about additional information on how to use the function.

## 5.9.1 Verify Configuration Database

This packet informs the master, that a new configuration database file was downloaded and available to be verified.

### Verify Database request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F82 | HIL_VERIFY_DATABASE_REQ |

*Table 127: HIL_VERIFY_DATABASE_REQ_T – Verify Database request*

### Packet structure reference

```
/* VERIFY DATABASE REQUEST */
#define HIL_VERIFY_DATABASE_REQ            0x00002F82

typedef struct HIL_VERIFY_DATABASE_REQ_Ttag
{
  HIL_PACKET_HEADER tHead;                    /* packet header */
} HIL_VERIFY_DATABASE_REQ_T;
```

### Verify Database confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | <br>116<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F83 | HIL_VERIFY_DATABASE_CNF |
| Data | | | |
| tNewSlaves | Structure | n | Addresses of new slaves which have to be configured. |
| tDeactivated Slaves | Structure | n | Addresses of slaves which are deactivated or cannot be configured. |
| tChanged Slaves | Structure | n | Addresses of slaves whose configuration has been changed. |
| tUnchanged Slaves | Structure | n | Addresses of slaves whose configuration has not been changed. |
| tImpossible SlaveChanges | Structure | n | Addresses of slaves whose configuration is not valid. |
| tMaster Changes | Structure | n | Field bus changes and status. |

*Table 128: HIL_VERIFY_DATABASE_CNF_T – Verify Database confirmation*

### Packet structure reference

```
/* VERIFY DATABASE CONFIRMATION */
#define HIL_VERIFY_DATABASE_CNF            HIL_VERIFY_DATABASE_REQ+1

typedef struct HIL_VERIFY_SLAVE_DATABASE_LIST_Ttag
{
    uint32_t  ulLen;
    uint8_t   abData[16];
} HIL_VERIFY_SLAVE_DATABASE_LIST_T;

typedef struct HIL_VERIFY_MASTER_DATABASE_Ttag
{
  uint32_t  ulMasterSettings;   /* field bus independent changes */
  uint32_t  ulMasterStatus;     /* field bus specific status */
  uint32_t  ulReserved[2];
} HIL_VERIFY_MASTER_DATABASE_T;

#define HIL_CIR_MST_SET_STARTUP       0x00000001
#define HIL_CIR_MST_SET_WATCHDOG      0x00000002
#define HIL_CIR_MST_SET_STATUSOFFSET  0x00000004
#define HIL_CIR_MST_SET_BUSPARAMETER  0x00000008

typedef struct HIL_VERIFY_DATABASE_CNF_DATA_Ttag
{
    HIL_VERIFY_SLAVE_DATABASE_LIST_T               tNewSlaves;
    HIL_VERIFY_SLAVE_DATABASE_LIST_T               tDeactivatedSlaves;
    HIL_VERIFY_SLAVE_DATABASE_LIST_T               tChangedSlaves;
    HIL_VERIFY_SLAVE_DATABASE_LIST_T               tUnchangedSlaves;
    HIL_VERIFY_SLAVE_DATABASE_LIST_T               tImpossibleSlaveChanges;
    HIL_VERIFY_MASTER_DATABASE_T                   tMasterChanges;
} HIL_VERIFY_DATABASE_CNF_DATA_T;

typedef struct HIL_VERIFY_DATABASE_CNF_Ttag
{
  HIL_PACKET_HEADER                        tHead;    /* packet header  */
  HIL_VERIFY_DATABASE_CNF_DATA_T           tData;    /* packet data    */
} HIL_VERIFY_DATABASE_CNF_T;
```

## 5.9.2 Activate Configuration Database

This packet indicates the master to activate the new configuration.

### Activate Database request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F84 | HIL_ACTIVATE_DATABASE_REQ |

*Table 129: HIL_ACTIVATE_DATABASE_REQ_T – Activate Database request*

### Packet structure reference

```
/* ACTIVATE DATABASE REQUEST */
#define HIL_ACTIVATE_DATABASE_REQ          0x00002F84

typedef struct HIL_ACTIVATE_DATABASE_REQ_Ttag
{
  HIL_PACKET_HEADER tHead;                    /* packet header */
} HIL_ACTIVATE_DATABASE_REQ_T;
```

### Activate Database confirmation

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 16<br>0 | Packet Data Length (in Bytes)<br>If ulSta = SUCCESS_HIL_OK<br>Otherwise |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F85 | HIL_ACTIVATE_DATABASE_CNF |
| Data | | | |
| abSlvSt[16] | uint8_t | n | State of the Slaves after Configuration |

*Table 130: HIL_ACTIVATE_DATABASE_CNF_T – Activate Database confirmation*

### Packet structure reference

```
/* ACTIVATE DATABASE CONFIRMATION */
#define HIL_ACTIVATE_DATABASE_CNF          HIL_ACTIVATE_DATABASE_REQ+1

typedef struct HIL_ACTIVATE_DATABASE_CNF_DATA_Ttag
{
  uint8_t                abSlvSt[16];  /* State of the slaves after configuration */
} HIL_ACTIVATE_DATABASE_CNF_DATA_T;

typedef struct HIL_ACTIVATE_DATABASE_CNF_Ttag
{
  HIL_PACKET_HEADER                        tHead;  /* packet header */
  HIL_ACTIVATE_DATABASE_CNF_DATA_T         tData;
} HIL_ACTIVATE_DATABASE_CNF_T;
```

# 5.10 Remanent Data

*Remanent data* is a term used for configuration and parameterization data that a device must store persistently. This means that the data

- must be stored in a non-volatile memory and
- must be applied / used after a power cycle of the device.

When you design your application, you have to determine whether

- the firmware/stack or
- the application

stores the remanent data.

In case the application store remanent data, this section is relevant for the design of your application.

**Application stores the remanent data**

A protocol stack contains several components. One or more components can require remanent data. The application has to use the *Channel Component Information* service (page 110) to obtain the information whether a component requires remanent data and how many.

The following subsections describe the services:

- Store Remanant Data service: A component uses this service to hand over to the application the remanent data to be stored during runtime.
- Set Remanant Data service: The application has to use this service after power on to hand over the remanent data to the component.

The application has to use these two services for **all** components that need remanat data.

In case the application does not provide remanent data that a component requires, the component will not operate. If this happens during a device certification, the certification will fail.

### 5.10.1 Set Remanent Data

The application has to use this service after power on to hand over the remanent data to all components of a protocol stack. Therefore, the application is required to use this service every time on startup.

If the application cannot provide (valid) remanent data for the specific component of the protocol stack, e.g. in case the system starts up for the very first time, the application must send this service with the correct Component ID but with remanent data size set to zero. Otherwise, it is not ensured that the firmware starts up properly.

The protocol stack will wait for both services

- Set Remanent Data and
- Set Configuration Request

The application then has to activate the configuration using a Channel Init.

Figure 7 shows the sequence for the application during start-up phase.

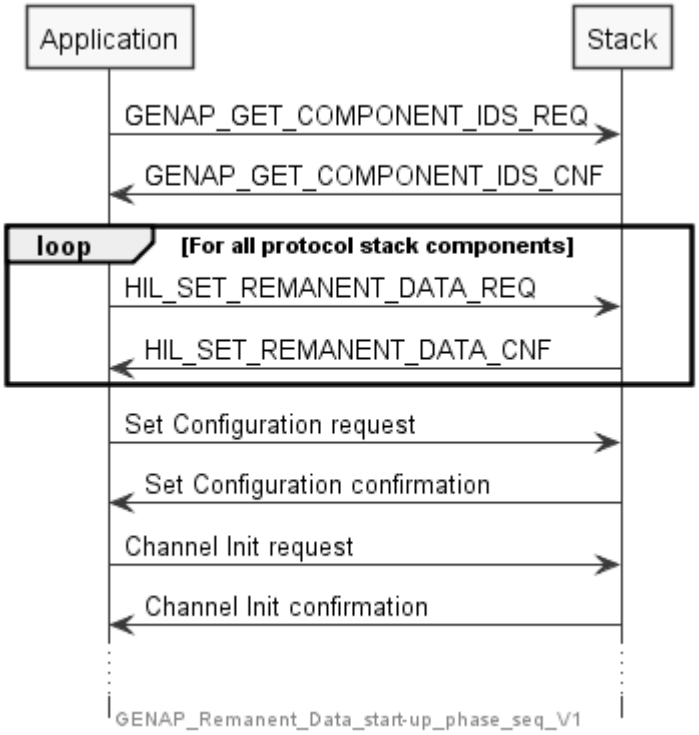



*Figure 7: Set Remanent Data (during configuration phase)*

This service supports packet fragmentation (see section *Communication channel packet fragmentation* on page 112).

The application has to send this request packet on every startup to the protocol stack.

The application must send the last stored remanent a component has reported (without matching the size).

### Set Remanent Data request

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 +n | Packet Data Length (in Bytes)<br>n is the number of bytes of remanent data the application wants to set in protocol stack (n may be 0 in case no data is known by application). |
| ulDest | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| ulCmd | uint32_t | 0x00002F8C | HIL_SET_REMANENT_DATA_REQ |
| Data | | | |
| ulComponentId | uint32_t | | Component ID of the protocol stack component for which the remanent data is set by application. |
| abData[] | uint8_t | | The remanent data as byte array. |

*Table 131: HIL_SET_REMANENT_DATA_REQ_T – Set Remanent Data request*

### Packet structure reference

```
#define HIL_SET_REMANENT_DATA_REQ          0x00002F8C

/*! Set remanent data request data. */
typedef __HIL_PACKED_PRE struct HIL_SET_REMANENT_DATA_REQ_DATA_Ttag
{
  /*! Unique component identifier HIL_COMPONENT_ID_*. */
  uint32_t  ulComponentId;
  /*! Remanent data buffer. */
  uint8_t   abData[__HIL_VARIABLE_LENGTH_ARRAY];
} __HIL_PACKED_POST HIL_SET_REMANENT_DATA_REQ_DATA_T;

/*! Set remanent data request. */
typedef __HIL_PACKED_PRE struct HIL_SET_REMANENT_DATA_REQ_Ttag
{
  HIL_PACKET_HEADER_T               tHead;  /*!< Packet header. */
  HIL_SET_REMANENT_DATA_REQ_DATA_T  tData;  /*!< Packet data. */
} __HIL_PACKED_POST HIL_SET_REMANENT_DATA_REQ_T;
```

### Set Remanent Data confirmation

The protocol stack will respond to the request with the following confirmation.

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulSta | uint32_t | See below | Status / Error Code, see Section 6 |
| ulCmd | uint32_t | 0x00002F8D | HIL_SET_REMANENT_DATA_CNF |
| Data | | | |
| ulComponentId | uint32_t | | Component ID of the protocol stack for which the remanent data was just set by application. |

*Table 132: HIL_SET_REMANENT_DATA_CNF_T – Set Remanent Data configuration*

### Packet structure reference

```
#define HIL_SET_REMANENT_DATA_CNF          0x2F8D

/*! Set remanent data confirmation data. */
typedef __HIL_PACKED_PRE struct HIL_SET_REMANENT_DATA_CNF_DATA_Ttag
{
  /*! Unique component identifier HIL_COMPONENT_ID_*. */
  uint32_t  ulComponentId;
} __HIL_PACKED_POST HIL_SET_REMANENT_DATA_CNF_DATA_T;

/*! Set remanent data confirmation. */
typedef __HIL_PACKED_PRE struct HIL_SET_REMANENT_DATA_CNF_Ttag
{
  HIL_PACKET_HEADER_T              tHead;  /*!< Packet header. */
  HIL_SET_REMANENT_DATA_CNF_DATA_T tData;  /*!< Packet data. */
} __HIL_PACKED_POST HIL_SET_REMANENT_DATA_CNF_T;
```

## 5.10.2 Store Remanent Data

This packet indicates the availability of new remanent data to the application. The application must store the new data **persistently** (related to the protocol stack component).

During runtime and depending on network events, a stack component indicate new remanent data to the application multiple times. The application has to compare the remanent data with the last stored remanent data in order to avoid writing the same data again and again. It is up to the application to consider the wear of the storage device.

Due to update of a component, the application has to be able to store remanent data in case the reported remanent data size has changed. The application has to send the response after the application has stored all data persistently. The response must always contain the Component ID, also in case of an error. Depending on the component, a response to the network may be generated by the component, even if the application has not answered yet.

**Note:** The application has to send the response packet synchronously to remanent data storage, i.e. after all data has been written to the storage device.

### Store Remanent Data indication

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| `ulLen` | uint32_t | 4 + n | Packet Data Length (in Bytes)<br>n = number of remanent data bytes |
| `ulDest` | uint32_t | 0x00000020 | HIL_PACKET_DEST_DEFAULT_CHANNEL |
| `ulCmd` | uint32_t | 0x00002F8E | HIL_STORE_REMAMENT_DATA_IND |
| Data | | | |
| `ulComponentId` | uint32_t | | Component ID of the protocol stack which indicates the remanent data to application.<br>For values, see file `Hil_ComponentID.h` |
| `abData[]` | uint8_t | | The remanent data as byte array. |

*Table 133: HIL_STORE_REMANENT_DATA_IND_T – Store Remanent Data indication*

### Packet structure reference

```
#define HIL_STORE_REMANENT_DATA_IND        0x00002F8E

/*! Store remanent indication data. */
typedef __HIL_PACKED_PRE struct HIL_STORE_REMANENT_DATA_IND_DATA_Ttag
{
  /*! Unique component identifier HIL_COMPONENT_ID_*. */
  uint32_t  ulComponentId;
  /*! Remanent data buffer. */
  uint8_t   abData[__HIL_VARIABLE_LENGTH_ARRAY];
} __HIL_PACKED_POST HIL_STORE_REMANENT_DATA_IND_DATA_T;

/*! Store remanent indication. */
typedef __HIL_PACKED_PRE struct HIL_STORE_REMANENT_DATA_IND_Ttag
{
  HIL_PACKET_HEADER_T                 tHead;  /*!< Packet header. */
  HIL_STORE_REMANENT_DATA_IND_DATA_T  tData;  /*!< Packet data. */
} __HIL_PACKED_POST HIL_STORE_REMANENT_DATA_IND_T;
```

### Store Remenant Data response

| Variable | Type | Value / Range | Description |
|---|---|---|---|
| ulLen | uint32_t | 4 | Packet Data Length (in Bytes) |
| ulSta | uint32_t | | Status / Error Code, see section 6. |
| ulCmd | uint32_t | 0x00002F8F | HIL_STORE_REMANENT_DATA_RES |
| Data | | | |
| ulComponentId | uint32_t | | The application has to use the same value from the indication. |

*Table 134: HIL_STORE_REMANENT_DATA_RES_T – Store Remanent Data response*

### Packet structure reference

```
#define HIL_STORE_REMANENT_DATA_RES        0x2F8F

/*! Store remanent response data. */
typedef __HIL_PACKED_PRE struct HIL_STORE_REMANENT_DATA_RES_DATA_Ttag
{
  /*! Unique component identifier HIL_COMPONENT_ID_*. */
  uint32_t  ulComponentId;
} __HIL_PACKED_POST HIL_STORE_REMANENT_DATA_RES_DATA_T;

/*! Store remanent response. */
typedef __HIL_PACKED_PRE struct HIL_STORE_REMANENT_DATA_RES_Ttag
{
  HIL_PACKET_HEADER_T                tHead; /*!< Packet header. */
  HIL_STORE_REMANENT_DATA_RES_DATA_T  tData; /*!< Packet data. */
} __HIL_PACKED_POST HIL_STORE_REMANENT_DATA_RES_T;
```

# 6 Status and error codes

The following status and error codes may be returned in *ulSta* of the packet. Not all of the codes outlined below are supported by a specific protocol stack.

## 6.1 Packet error codes

| Value | Definition / Description |
|---|---|
| 0x00000000 | SUCCESS_HIL_OK<br>Success, Status Okay |
| 0xC0000001 | ERR_HIL_FAIL<br>Fail |
| 0xC0000002 | ERR_HIL_UNEXPECTED<br>Unexpected |
| 0xC0000003 | ERR_HIL_OUTOFMEMORY<br>Out Of Memory |
| 0xC0000004 | ERR_HIL_UNKNOWN_COMMAND<br>Unknown Command |
| 0xC0000005 | ERR_HIL_UNKNOWN_DESTINATION<br>Unknown Destination |
| 0xC0000006 | ERR_HIL_UNKNOWN_DESTINATION_ID<br>Unknown Destination ID |
| 0xC0000007 | ERR_HIL_INVALID_PACKET_LEN<br>Invalid Packet Length |
| 0xC0000008 | ERR_HIL_INVALID_EXTENSION<br>Invalid Extension |
| 0xC0000009 | ERR_HIL_INVALID_PARAMETER<br>Invalid Parameter |
| 0xC000000C | ERR_HIL_WATCHDOG_TIMEOUT<br>Watchdog Timeout |
| 0xC000000D | ERR_HIL_INVALID_LIST_TYPE<br>Invalid List Type |
| 0xC000000E | ERR_HIL_UNKNOWN_HANDLE<br>Unknown Handle |
| 0xC000000F | ERR_HIL_PACKET_OUT_OF_SEQ<br>Out Of Sequence |
| 0xC0000010 | ERR_HIL_PACKET_OUT_OF_MEMORY<br>Out Of Memory |
| 0xC0000011 | ERR_HIL_QUE_PACKETDONE<br>Queue Packet Done |
| 0xC0000012 | ERR_HIL_QUE_SENDPACKET<br>Queue Send Packet |
| 0xC0000013 | ERR_HIL_POOL_PACKET_GET<br>Pool Packet Get |
| 0xC0000015 | ERR_HIL_POOL_GET_LOAD<br>Pool Get Load |
| 0xC000001A | ERR_HIL_REQUEST_RUNNING<br>Request Already Running |
| 0xC0000100 | ERR_HIL_INIT_FAULT<br>Initialization Fault |
| 0xC0000101 | ERR_HIL_DATABASE_ACCESS_FAILED<br>Database Access Failed |
| 0xC0000119 | ERR_HIL_NOT_CONFIGURED<br>Not Configured |

| Value | Definition / Description |
|---|---|
| 0xC0000120 | ERR_HIL_CONFIGURATION_FAULT<br>Configuration Fault |
| 0xC0000121 | ERR_HIL_INCONSISTENT_DATA_SET<br>Inconsistent Data Set |
| 0xC0000122 | ERR_HIL_DATA_SET_MISMATCH<br>Data Set Mismatch |
| 0xC0000123 | ERR_HIL_INSUFFICIENT_LICENSE<br>Insufficient License |
| 0xC0000124 | ERR_HIL_PARAMETER_ERROR<br>Parameter Error |
| 0xC0000125 | ERR_HIL_INVALID_NETWORK_ADDRESS<br>Invalid Network Address |
| 0xC0000126 | ERR_HIL_NO_SECURITY_MEMORY<br>No Security Memory |
| 0xC0000140 | ERR_HIL_NETWORK_FAULT<br>Network Fault |
| 0xC0000141 | ERR_HIL_CONNECTION_CLOSED<br>Connection Closed |
| 0xC0000142 | ERR_HIL_CONNECTION_TIMEOUT<br>Connection Timeout |
| 0xC0000143 | ERR_HIL_LONELY_NETWORK<br>Lonely Network |
| 0xC0000144 | ERR_HIL_DUPLICATE_NODE<br>Duplicate Node |
| 0xC0000145 | ERR_HIL_CABLE_DISCONNECT<br>Cable Disconnected |
| 0xC0000180 | ERR_HIL_BUS_OFF<br>Network Node Bus Off |
| 0xC0000181 | ERR_HIL_CONFIG_LOCKED<br>Configuration Locked |
| 0xC0000182 | ERR_HIL_APPLICATION_NOT_READY<br>Application Not Ready |
| 0xC0000204 | ERR_HIL_INVALID_DATA_LENGTH<br>Invalid data length |
| 0xC0001002 | ERR_HIL_RESOURCE_IN_USE |
| 0xC0001003 | ERR_HIL_NO_MORE_RESOURCES |
| 0xC0001008 | ERR_HIL_CRC |
| 0xC0001101 | ERR_HIL_DPM_CHANNEL_INVALID |
| 0xC0001010 | ERR_HIL_DRV_INVALID_RESOURCE |
| 0xC0001143 | ERR_HIL_NAME_INVALID |
| 0xC0001144 | ERR_HIL_UNEXPECTED_BLOCK_SIZE |
| 0xC0001153 | ERR_HIL_READ<br>Failed to read from file/area |
| 0xC0001154 | ERR_HIL_WRITE<br>Failed to write from file/area |
| 0xC0001157 | ERR_HIL_VERIFICATION<br>Error during verification of firmware |
| 0xC0001166 | ERR_HIL_ERASE<br>Failed to erase file/directory/flash |
| 0xC0001167 | ERR_HIL_OPEN<br>Failed to open file/directory |

| Value | Definition / Description |
|---|---|
| 0xC0001168 | ERR_HIL_CLOSE<br>Failed to close file/directory |
| 0xC0001169 | ERR_HIL_CREATE<br>Failed to create file/directory |
| 0xC0001170 | ERR_HIL_MODIFY<br>Failed to modify file/directory |
| 0xC000DEAD | ERR_HIL_FIRMWARE_CRASHED<br>The firmware has crashed and the exception handler is running |
| 0xC002000C | ERR_HIL_TIMER_APPL_PACKET_SENT<br>Timer App Packet Sent |
| 0xC02B0001 | ERR_HIL_QUE_UNKNOWN<br>Unknown Queue |
| 0xC02B0002 | ERR_HIL_QUE_INDEX_UNKNOWN<br>Unknown Queue Index |
| 0xC02B0003 | ERR_HIL_TASK_UNKNOWN<br>Unknown Task |
| 0xC02B0004 | ERR_HIL_TASK_INDEX_UNKNOWN<br>Unknown Task Index |
| 0xC02B0005 | ERR_HIL_TASK_HANDLE_INVALID<br>Invalid Task Handle |
| 0xC02B0006 | ERR_HIL_TASK_INFO_IDX_UNKNOWN<br>Unknown Index |
| 0xC02B0007 | ERR_HIL_FILE_XFR_TYPE_INVALID<br>Invalid Transfer Type |
| 0xC02B0008 | ERR_HIL_FILE_REQUEST_INCORRECT<br>Invalid File Request |
| 0xC02B000E | ERR_HIL_TASK_INVALID<br>Invalid Task |
| 0xC02B001D | ERR_HIL_SEC_FAILED<br>Security EEPROM Access Failed |
| 0xC02B001E | ERR_HIL_EEPROM_DISABLED<br>EEPROM Disabled |
| 0xC02B001F | ERR_HIL_INVALID_EXT<br>Invalid Extension |
| 0xC02B0020 | ERR_HIL_SIZE_OUT_OF_RANGE<br>Block Size Out Of Range |
| 0xC02B0021 | ERR_HIL_INVALID_CHANNEL<br>Invalid Channel |
| 0xC02B0022 | ERR_HIL_INVALID_FILE_LEN<br>Invalid File Length |
| 0xC02B0023 | ERR_HIL_INVALID_CHAR_FOUND<br>Invalid Character Found |
| 0xC02B0024 | ERR_HIL_PACKET_OUT_OF_SEQ<br>Packet Out Of Sequence |
| 0xC02B0025 | ERR_HIL_SEC_NOT_ALLOWED<br>Not Allowed In Current State |
| 0xC02B0026 | ERR_HIL_SEC_INVALID_ZONE<br>Security EEPROM Invalid Zone |
| 0xC02B0028 | ERR_HIL_SEC_EEPROM_NOT_AVAIL<br>Security EEPROM Not Available |
| 0xC02B0029 | ERR_HIL_SEC_INVALID_CHECKSUM<br>Security EEPROM Invalid Checksum |
| 0xC02B002A | ERR_HIL_SEC_ZONE_NOT_WRITEABLE<br>Security EEPROM Zone Not Writeable |

| Value | Definition / Description |
|---|---|
| 0xC02B002B | ERR_HIL_SEC_READ_FAILED<br>Security EEPROM Read Failed |
| 0xC02B002C | ERR_HIL_SEC_WRITE_FAILED<br>Security EEPROM Write Failed |
| 0xC02B002D | ERR_HIL_SEC_ACCESS_DENIED<br>Security EEPROM Access Denied |
| 0xC02B002E | ERR_HIL_SEC_EEPROM_EMULATED<br>Security EEPROM Emulated |
| 0xC02B0038 | ERR_HIL_INVALID_BLOCK<br>Invalid Block |
| 0xC02B0039 | ERR_HIL_INVALID_STRUCT_NUMBER<br>Invalid Structure Number |
| 0xC02B4352 | ERR_HIL_INVALID_CHECKSUM<br>Invalid Checksum |
| 0xC02B4B54 | ERR_HIL_CONFIG_LOCKED<br>Configuration Locked |
| 0xC02B4D52 | ERR_HIL_SEC_ZONE_NOT_READABLE<br>Security EEPROM Zone Not Readable |

*Table 135: Status and error codes*

# 7 Appendix

## 7.1 List of figures



## 7.2 List of tables

# 7.3 Legal notes

### Copyright



### Important notes

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