Packet API

netX Dual-Port Memory

Packet-based services (netX 90)

Hilscher Gesellschaft für Systemautomation mbH

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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.

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
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.
6	2021-09-13	ALM, RMA, BME	Section *Error Log information*: Correction in confirmation packet.
			Section *Downloading / Uploading Files*: Multi packet example ulId handling updated.
			Description of HIL_RESET_FLAG_VERIFY_INSTALLATION_MSK added.
			Section *Use cases A/B/C*, *Plain Flash area*, *File Download*: Added information/diagram about usecase B and note that file download is not supported
			Section *File Download Data*: Download Data Confirmation always returns 4 byte (ulLen = 4)
			Section *Device Data Provider (DDP)* reworked.
			Boot and chip type definitions from HIL_SharedDefinitions.h added.
			Description of the volume information request added.
			Sections *White list for DDP State* passive, *Communication Channel Logbook added.*
			Removed some unsupported legacy services from the document.
			Several clarifications in sections *Device Data Provider (DDP)*, *Delete Protocol Stack Configuration*, *Read I/O Process Data Image Size*, and *Perform a Bus Scan*.
7	2022-08-24	HHE, ALM	Section *Modify Configuration Settings*: inibatch removed, Communication Studio added.
			Section *Exception handler*: Make it obvious that packet services in the exception handler might behave different to services in a running/functional firmware.

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 17, 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
HIL_SharedDefinitios.h	Provides global hardware specific definitions

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`
`ulDestId`
`ulSrc`
`ulSrcId`
	Destination Address / Handle
	Destination Identifier
	Source Address / Handle
	Source Identifier
	These elements are used to address the receiver and sender of a packet.

`ulLen`	**Packet Data Length** `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** `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** `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. 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** `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. Example: Reading the hardware identification of a netX-based device ▪ `HIL_HW_IDENTIFY_REQ` (`0x00001EB8`) Command to read general hardware information like device number / serial number etc. ▪ `HIL_HW_IDENTIFY_CNF` (`0x00001EB9`) Answer to the `HIL_HW_IDENTIFY_REQ` command.
`ulExt`	**Packet Extension** `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)** This is reserved for further use (shall not be changed by the receiver of a packet).
`abData`	**Packet Data** `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
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Read the device-specific hardware information	`HIL_HW_HARDWARE_INFO_REQ`	20
Read the name and version or firmware, operating system or protocol stack running on a communication channel	`HIL_FIRMWARE_IDENTIFY_REQ`	22
System Channel Information Blocks		
Read the system channel: *System Information Block*	`HIL_SYSTEM_INFORMATION_BLOCK_REQ`	27
Read the system channel: *Channel Information Block*	`HIL_CHANNEL_INFORMATION_BLOCK_REQ`	28
Read the system channel: *System Control Block*	`HIL_SYSTEM_CONTROL_BLOCK_REQ`	31
Read the system channel: *System Status Block*	`HIL_SYSTEM_STATUS_BLOCK_REQ`	32
Files and folders		
List directories and files from the file system	`HIL_DIR_LIST_REQ`	38
Download a file (start, send file data, abort)	`HIL_FILE_DOWNLOAD_REQ`	42
	`HIL_FILE_DOWNLOAD_DATA_REQ`	45
	`HIL_FILE_DOWNLOAD_ABORT_REQ`	47
File Upload (start, read file data, abort)	`HIL_FILE_UPLOAD_REQ`	49
	`HIL_FILE_UPLOAD_DATA_REQ`	51
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Create a CRC32 checksum	(example code)	58
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Error log information		
Read startup error log information	`HIL_SYSTEM_ERRORLOG_REQ_T`	74
Exception Handler		
For a description of the services of the exception handler, see section *Exception handler*.		91

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] Fix: 500 ms (not changeable)
`ulResetMode`	uint32_t	0	Reset Mode & Parameter 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..10	reserved
9	**Verify installable firmware files:** `HIL_RESET_FLAG_VERIFY_INSTALLATION_MSK`
	This flag activates a verification of the available and installable firmware files, without installing it. The option is only available in reset mode HIL_RESET_MODE_UPDATESTART `1` = Run a file verification without an installation `0` = Run a normal update start handling **Reset Mode:** `HIL_RESET_MODE_UPDATESTART` If this bit is set (1) when executing a HIL_RESET_MODE_UPDATESTART, the Maintenance firmware (MFW) starts and processes all verifications normally done for the firmware file, but does not install any files.The MFW automatically restarts to the firmware (LFW) afterwards. The confirmation of this request will not return any processing errors because the functionality is activated by an internal system reset. The MFW or LFW will signal a *System Error* if the verification fails.
8	**Delete remanent area:** `HIL_RESET_FLAG_CLEAR_REMANENT_MSK`
	This parameter definies if the Maintenance firmware (MFW) should also delete an existing remanent data area located in the system FLASH. This option is only available in reset mode `HIL_RESET_MODE_UPDATESTART` or `HIL_RESET_MODE_BOOTSTART`. `1` = Remanent data area will be deleted `0` = Remanent data area will not be deleted **Reset Mode:** `HIL_RESET_MODE_UPDATESTART` If this bit is set (1) when executing a HIL_RESET_MODE_UPDATESTART, the MFW will process a fimrware update. If this was successful, it deletes the remanent data area too. The MFW automatically restarts to the firmware (LFW) afterwards. **Reset Mode:** `HIL_RESET_MODE_BOOTSTART` If this bit is set (1) when executing a `HIL_RESET_MODE_BOOTSTART`, the MFW deletes the complete remanent data area during startup processing and remains active. No reset to the LFW is executed.

7..4	**Reset Parameter**
	The reset parameter defines additional functionalities in combination with a *Reset Mode* **Reset Mode:** `HIL_RESET_MODE_UPDATESTART` In case of a multi protocol firmware ZIP/NXS file, this parameter specifies the firmware variant to install from such a file. `0 … 15 =` Select firmware variant VAR0 to VAR15 (if a ZIP/NXS files is used). **Reset Mode:** `HIL_RESET_MODE_CONSOLESTART` Specify which physical interface the console program should use for communication. `0x0 = HIL_RESET_PARAM_CONSOLE_ETH` - Use Ethernet interface `0x1 = HIL_RESET_PARAM_CONSOLE_UART` - Use UART interface `0x2 = HIL_RESET_PARAM_CONSOLE_USB` – Use USB interface `0x3 = HIL_RESET_PARAM_CONSOLE_DPM` - Use DPM interface (Reserved/Unused) `0xF = HIL_RESET_PARAM_CONSOLE_DEFAULT` - Use default interface (normally UART) Note: On netX90 devices, the default interface is configureable in the hardware configuration (HWC/MWC).
3..0	**Reset Mode**
	`0 = HIL_RESET_MODE_COLDSTART` A cold start will perform a device reset and a following start of an installed firmware.
	`1 = HIL_RESET_MODE_WARMSTART` This mode not supported.
	`2 = HIL_RESET_MODE_BOOTSTART` A boot start will perform a device reset and a start of the Maintenance firmware (MFW) in idle mode. (*System LED*: green/yellow flashing)
	`3 = HIL_RESET_MODE_UPDATESTART` An update start will perform a reset of the device and starts the Maintenance firmware. If a valid update file is available, it will be automatically processed and installed. After a successfull completition, the MFW executes a reset (`HIL_RESET_MODE_COLDSTART`) to start the installed LFW. If the MFW becomes active again, because of no or invalid files or an update error, it changes into an error state. (*System LED*: solid yellow / *System Error*: show an error code (e.g.ERR_HIL_NOT_AVAILABLE).
	`4 = HIL_RESET_MODE_CONSOLESTART` A console start will perform a device reset and starts the intenal ROM loader in console mode. The *Reset Parameter* (see above) defines the physical interface used by the ROM loader for communication. The firmware will not started and all communication takes place with the ROM loader. (*System LED*: yellow flashing)
Other values are reserved	

Note: The *System LED* state and the *System Error* are described in netX DPM manual

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_FIRMWARE_RESET_CNF

Table 8: HIL_FIRMWARE_RESET_CNF_T – Firmware Reset confirmation

Packet structure reference

```
/* FIRMWARE RESET CONFIRMATION */
#define HIL_FIRMWARE_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 Communication Studio 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	 36 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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;
```

Note: The following definitions are located in *HIL_SharedDefinitions.h*

Boot Type

This field indicates from which resource the system was started.

Value	Description	Definition
0x00000000	ROM Loader: PARALLEL FLASH (SRAM Bus)	HIL_DEV_BOOT_TYPE_PFLASH_SRAMBUS
0x00000001	ROM Loader: PARALLEL FLASH (Extension Bus)	HIL_DEV_BOOT_TYPE_PFLASH_EXTBUS
0x00000002	ROM Loader: DUAL-PORT MEMORY	HIL_DEV_BOOT_TYPE_DUALPORT
0x00000003	ROM Loader: PCI INTERFACE	HIL_DEV_BOOT_TYPE_PCI
0x00000004	ROM Loader: MULTIMEDIA CARD	HIL_DEV_BOOT_TYPE_MMC
0x00000005	ROM Loader: I2C BUS	HIL_DEV_BOOT_TYPE_I2C
0x00000006	ROM Loader: SERIAL FLASH	HIL_DEV_BOOT_TYPE_SFLASH
0x00000007	Second Stage Boot Loader: SERIAL FLASH	HIL_DEV_BOOT_TYPE_2ND_STAGE_FLASH_BASED
0x00000008	Second Stage Boot Loader: RAM	HIL_DEV_BOOT_TYPE_2ND_STAGE_RAM_BASED
0x00000009	ROM Loader: Internal Flash	HIL_DEV_BOOT_TYPE_IFLASH
Other values are reserved		-

Table 11: Boot Type

Chip Type

This field indicates the type of chip that is used.

Value	Chip Namen	Definition
0x00000000	Unknown	HIL_DEV_CHIP_TYPE_UNKNOWN
0x00000001	netX 500	HIL_DEV_CHIP_TYPE_NETX500
0x00000002	netX 100	HIL_DEV_CHIP_TYPE_NETX100
0x00000003	netX 50	HIL_DEV_CHIP_TYPE_NETX50
0x00000004	netX 10	HIL_DEV_CHIP_TYPE_NETX10
0x00000005	netX 51	HIL_DEV_CHIP_TYPE_NETX51
0x00000006	netX 52	HIL_DEV_CHIP_TYPE_NETX52
0x00000007	netX 4000	HIL_DEV_CHIP_TYPE_NETX4000
0x00000008	netX 4100	HIL_DEV_CHIP_TYPE_NETX4100
0x00000009	netX 90	HIL_DEV_CHIP_TYPE_NETX90
0x0000000A	netIOL	HIL_DEV_CHIP_TYPE_NETIOL
0x0000000B	netX XXL MPW	HIL_DEV_CHIP_TYPE_NETXXXL_MPW
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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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
`ulHardwareFeatures1`	uint32_t	0	Hardware Features 1 (not used, set to 0)
`ulHardwareFeatures2`	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 0x00000020	HIL_PACKET_DEST_SYSTEM 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	 76 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 Communication Studio, 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 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 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	 16 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See Below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001E37	HIL_SYSTEM_CONTROL_BLOCK_CNF
Data			
`tSystemControl`	Structure		System Control Block 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 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-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 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 with internal Flash only	**Plain Flash areas** -> in the internal netX Flash
B	netX 90 system with internal and external Flash	**Plain Flash areas** -> in the internal netX Flash -> and an external connected Flash chip (used by the APP CPU only)
C	netX 90 system with external Flash	**Flash-file system** -> in the external Flash, using a predefined folder structure

Table 25: Use cases definition

"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 for use case A

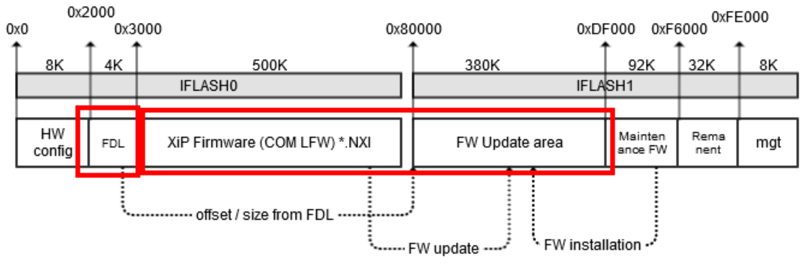


Figure 1: Example Flash layout for use case A

Example Flash layout for use case B

In this case the COM firmware has no direct access to the SQI FLASH, which means that e.g. a download using HIL_DOWNLOAD_REQ will fail.

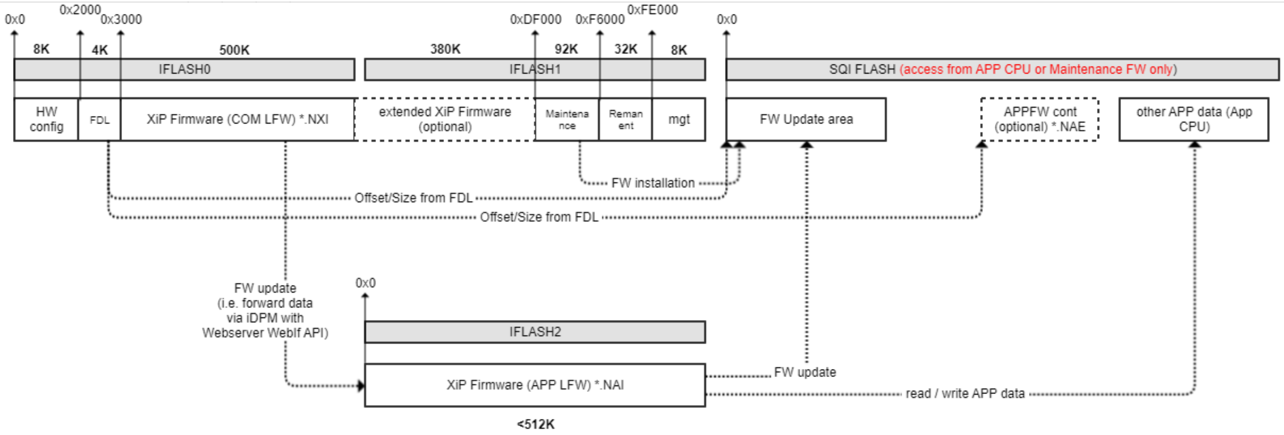


Figure 2: Example Flash layout for use case B

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

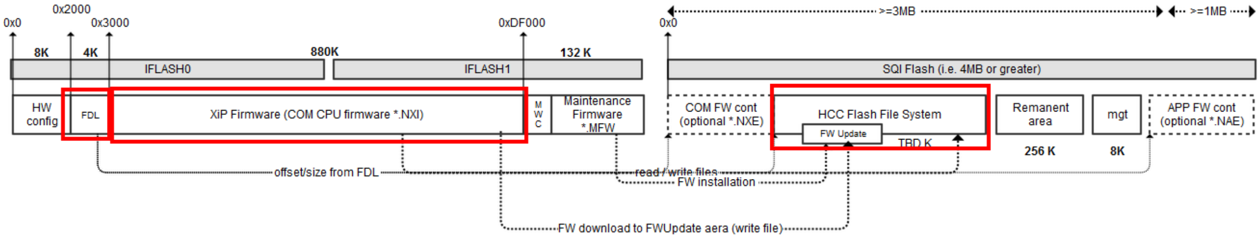

0x0
0x2000
0x3000
0xDF000
0x0
>=3MB
>=1MB
8K
4K
880K
132 K
IFLASH0
IFLASH1
SQI Flash (i.e. 4MB or greater)
HW config
FDL
XiP Firmware (COM CPU firmware *.NXI)
M W C
Maintenance Firmware *.MFW
COM FW cont (optional *.NXE)
HCC Flash File System
FW Update
TBD K
Remanent area
mgt
APP FW cont (optional *.NAE)
256 K
8K
offset/size from FDL
read / write files
FW installation
FW download to FWUpdate aera (write file)

Figure 3: 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

Table 26: Folder layout of file system

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
FWUPDATE	.NXS	Signed file container to update multiple system files at once

Table 27: File names

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 36) 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, FWUPDATE.NXS`). 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_5 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 Remark: 0 can be used for the second, third, etc. packet.
`ulCmd`	uint32_t	0x00001E70	HIL_DIR_LIST_REQ
`ulExt`	uint32_t	0x00, 0xC0	0x00: for the first packet. 0xC0: for the next packets.
Data			
`ulChannelNo`	uint32_t	 0 … 3 4 … 5 0xFFFFFFFF	Channel number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if the file name contains a path information
`usDirNameLength`	uint16_t	n	Name length Length of the Directory Name (in Bytes) strlen("DirName")+1
	uint8_t	ASCII	Directory Name ASCII string, zero terminated

Table 28: 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	 24 0 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` If `ulSta` = `SUCCESS_HIL_OK` and `ulExt = 0x40` (last packet) Otherwise
`ulSta`	uint32_t	See Below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001E71	HIL_DIR_LIST_CNF
`ulExt`	uint32_t	0x80, 0xC0, 0x40	0x80 for the first packet. 0xC0 for the following packets. 0x40 for the last packet.
Data			
`szName[16]`	uint8_t		File Name
`ulFileSize`	uint32_t	m	File Size in Bytes
`bFileType`	uint8_t	 0x00000001 0x00000002	File Type HIL_DIR_LIST_CNF_FILE_TYPE_DIRECTORY HIL_DIR_LIST_CNF_FILE_TYPE_FILE
`bReserved`	uint8_t	0	Reserved, unused
`usReserved2`	uint16_t	0	Reserved, unused

Table 29: 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 (split into e.g. 50 data packets)		
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	......	HIL_PACKET_SEQ_MIDDLE
HIL_FILE_DOWNLOAD_DATA_REQ	n+5	HIL_PACKET_SEQ_MIDDLE
HIL_FILE_DOWNLOAD_DATA_REQ	n+6	HIL_PACKET_SEQ_MIDDLE
HIL_FILE_DOWNLOAD_DATA_REQ	......	HIL_PACKET_SEQ_MIDDLE
HIL_FILE_DOWNLOAD_DATA_REQ	n+50	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

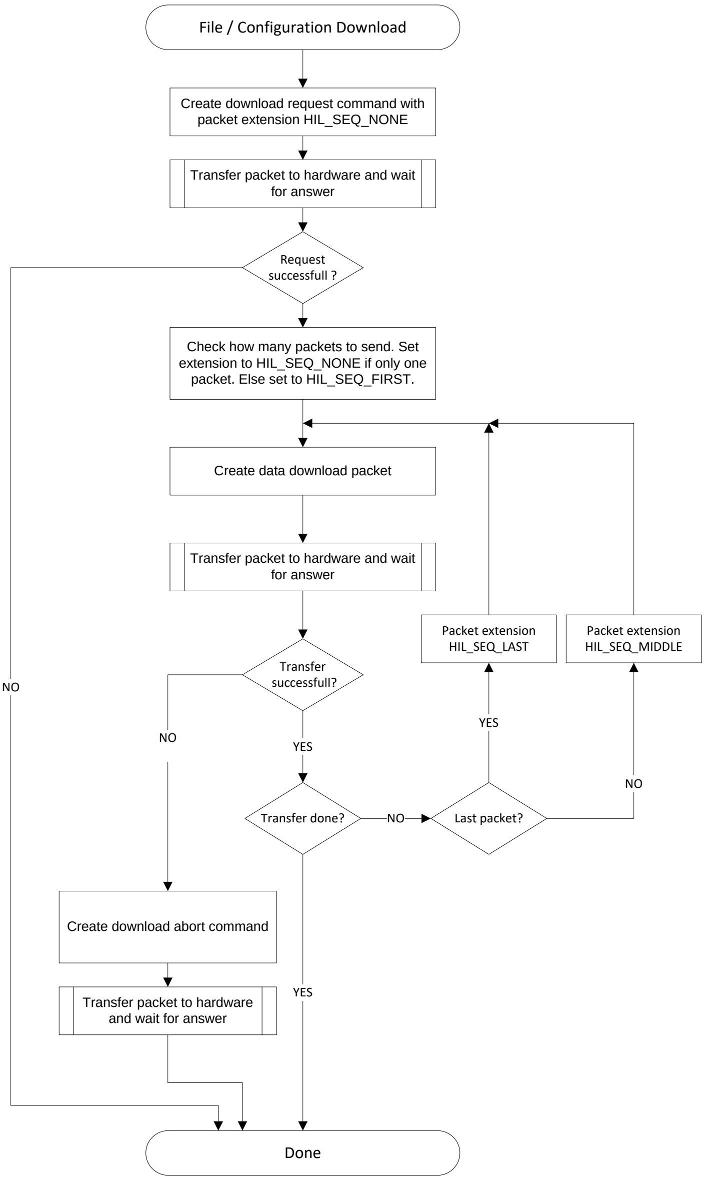

File / Configuration Download
Create download request command with packet extension HIL_SEQ_NONE
Transfer packet to hardware and wait for answer
Request successfull ?
Check how many packets to send. Set extension to HIL_SEQ_NONE if only one packet. Else set to HIL_SEQ_FIRST.
Create data download packet
Transfer packet to hardware and wait for answer
Packet extension HIL_SEQ_LAST
Packet extension HIL_SEQ_MIDDLE
NO
Transfer successfull?
NO
YES
YES
NO
Transfer done?
NO
Last packet?
Create download abort command
Transfer packet to hardware and wait for answer
YES
Done

Figure 4: 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.

Note: In netX90 usecase B a file download using this service is not supported, because there is no direct access to the SQI FLASH.

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 HIL_PACKET_SEQ_NONE
Data			
`ulXferType`	uint32_t	0x00000001	Download Transfer Type HIL_FILE_XFER_FILE
`ulMaxBlockSize`	uint32_t	1 … m	Max Block Size Maximum Size of Block per Packet
`ulFileLength`	uint32_t	n	File size to be downloaded in bytes
`ulChannelNo`	uint32_t	0 … 3 4 … 5 0xFFFFFFFF	Destination Channel Number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if file name contains a path information
`usFileNameLength`	uint16_t	n	Length of Name Length of the following file name (in Bytes)
`(file name)`	uint8_t	ASCII	File Name ASCII string, zero terminated

Table 30: 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	 4 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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	 1 … n	Max Block Size Maximum Size of Block per Packet

Table 31: 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 47) 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 **Note:** Should be incremented for each request: `ulId` (this request) = `ulId` (previous request) + 1
`ulCmd`	uint32_t	0x00001E64	HIL_FILE_DOWNLOAD_DATA_REQ
`ulExt`	uint32_t	 0x00000000 0x00000080 0x000000C0 0x00000040	Extension HIL_PACKET_SEQ_NONE (if data fits into one packet) HIL_PACKET_SEQ_FIRST HIL_PACKET_SEQ_MIDDLE HIL_PACKET_SEQ_LAST
Data			
`ulBlockNo`	uint32_t	0 ... m	Block Number Block or Sequence Number
`ulChksum`	uint32_t	S	Checksum CRC32 Polynomial
	uint8_t	0 … 0xFF	File Data Block (length given in *ulLen*)

Table 32: 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 and contains the expected CRC32 checksum of the data block, if available.

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	0x00001E65	HIL_FILE_DOWNLOAD_DATA_CNF
`ulId`	uint32_t	From Request	Packet Identifer
Data			
`ulExpectedCrc32`	uint32_t	S	Checksum Expected CRC32 polynomial Note: If the functions fails, `ulExpectedCrc32` contains the latest created CRC32 until detecting an error (could also be 0 if no CRC32 was created at all).

Table 33: 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 34: 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 35: 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

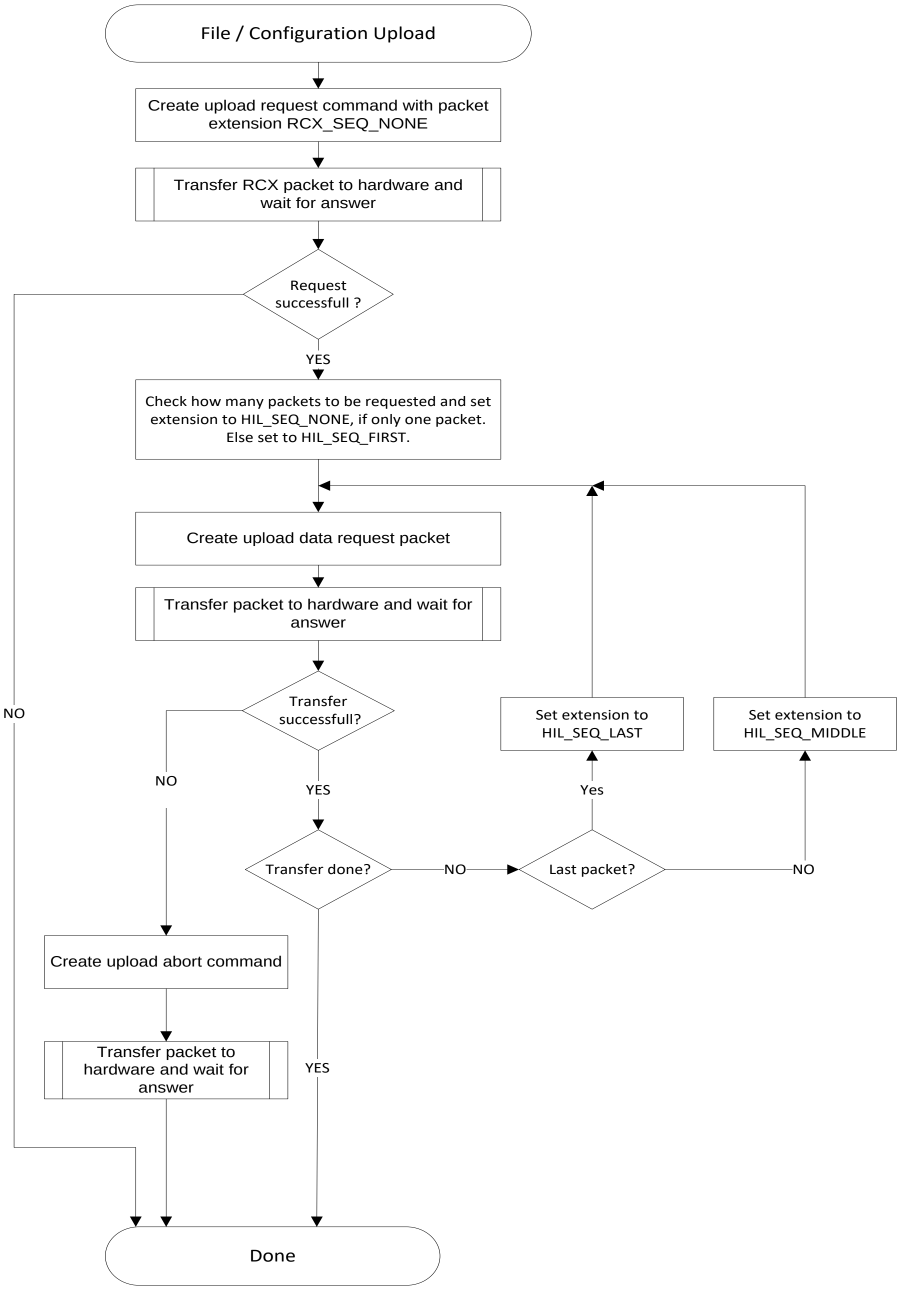

File / Configuration Upload
Create upload request command with packet extension RCX_SEQ_NONE
Transfer RCX packet to hardware and wait for answer
Request successfull ?
YES
NO
Check how many packets to be requested and set extension to HIL_SEQ_NONE, if only one packet. Else set to HIL_SEQ_FIRST.
Create upload data request packet
Transfer packet to hardware and wait for answer
Transfer successfull?
NO
YES
Set extension to HIL_SEQ_LAST
Set extension to HIL_SEQ_MIDDLE
Yes
Transfer done?
NO
Last packet?
NO
Create upload abort command
Transfer packet to hardware and wait for answer
YES
Done

Figure 5: 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 HIL_PACKET_SEQ_NONE
Data			
`ulXferType`	uint32_t	0x00000001	Transfer Type: HIL_FILE_XFER_FILE
`ulMaxBlockSize`	uint32_t	1 … m	Max Block Size Maximum Size of Block per Packet
`ulChannelNo`	uint32_t	0 … 3 4 … 5 0xFFFFFFFF	Channel Number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if file name contains a path information
`usFileNameLength`	uint16_t	n	Length of Name Length of Following File Name (in Bytes)
	uint8_t	ASCII	File Name ASCII string, zero terminated

Table 36: 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	 8 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 Maximum Size of Block per Packet
`ulFileLength`	uint32_t	n	File Length Total File Length (in Bytes)

Table 37: 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 **Note:** Should be incremented for each request
`ulExt`	uint32_t	 0x00000000 0x00000080 0x000000C0 0x00000040	Extension HIL_PACKET_SEQ_NONE (if data fits into one packet) HIL_PACKET_SEQ_FIRST HIL_PACKET_SEQ_MIDDLE HIL_PACKET_SEQ_LAST

Table 38: 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 Block or Sequence Number
`ulChksum`	uint32_t	 S	Checksum CRC32 Polynomial
	uint8_t		File Data Block (Size is n given in *`ulLen`*)

Table 39: 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 40: 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 41: 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 4 … 5 0xFFFFFFFF	Channel Number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if file name contains a path information
`usFileNameLength`	uint16_t	n	Length of Name Length of the Following File Name (in Bytes)
	uint8_t	ASCII	File Name ASCII string, zero terminated

Table 42: 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 43: 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 4 … 5 0xFFFFFFFF	Channel Number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if file name contains a path information
`usOldNameLength`	uint16_t	m	Length of Old File Name Length of following NULL terminated old File Name (in Bytes)
`usNewNameLength`	uint16_t	n	Length of New File Name Length of following NULL terminated new File Name (in Bytes)
	uint8_t	 ASCII	Old File Name ASCII string, zero terminated
	uint8_t	 ASCII	New File Name ASCII string, zero terminated

Table 44: 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 45: 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 4 … 5 0xFFFFFFFF	Channel Number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if file name contains a path information
`usFileNameLength`	uint16_t	n	Length of Name Length of the Following File Name (in Bytes)
	uint8_t	ASCII	File Name ASCII string, zero terminated

Table 46: 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	 16 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 47: 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 4 … 5 0xFFFFFFFF	Channel Number Communication Channel 0 … 3 Application Channel 0 … 1 System Channel **Note:** ignored if file name contains a path information
`usFileNameLength`	uint16_t	 n	Length of Name Length of the Following File Name (in Bytes)
	uint8_t	 ASCII	File Name ASCII string, zero terminated

Table 48: 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 49: 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
```

3.7.11 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 0x00000001	Type of format operation HIL_FORMAT_REQ_DATA_FLAGS_QUICKFORMAT HIL_FORMAT_REQ_DATA_FLAGS_FULLFORMAT
`ulReserved`	uint32_t	0	Reserved, unsed

Table 50: 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) Always
`ulSta`	uint32_t	See below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001ED7	HIL_FORMAT_CNF
Data			
`ulExtendedErrorInfo`	uint32_t		Set if full format failed during a verify operation. Last byte verified at offset *ulErrorOffset* (if failed during verify operation).
`ulErrorOffset`	uint32_t		Offset the error was encountered on

Table 51: 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;
```

3.7.12 Read Volume Information

This request delivers information about existing volumens in the file system.

Volume 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	0x00001E6C	HIL_VOLUME_GET_ENTRY_REQ
Data			
`ulVolumeIndex`	uint32_t	0..n	Index of the volume to be queried

Table 52: HIL_VOLUME_GET_ENTRY_REQ_T – Voulume request

Packet structure reference

```
/* VOLUME REQUEST */
#define HIL_VOLUME_GET_ENTRY_REQ           0x00001E6C

typedef struct HIL_VOLUME_GET_ENTRY_REQ_DATA_Ttag
{
  uint32_t  ulVolumeIndex;          /* volume entry table index */
} HIL_VOLUME_GET_ENTRY_REQ_DATA_T;

typedef struct HIL_VOLUME_GET_ENTRY_REQ_Ttag
{
  HIL_PACKET_HEADER_T                     tHead;                  /* packet header */
  HIL_VOLUME_GET_ENTRY_REQ_DATA_T         tData;                  /* packet data */
} HIL_VOLUME_GET_ENTRY_REQ_T;
```

Volume confirmation

Variable	Type	Value / Range	Description
`ulLen`	uint32_t	 20 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001E6D	HIL_VOLUME_GET_ENTRY_CNF
Data			
`ulVolumeCount`	uint32_t	0..n	Number of available volumes
`szName`	uint8_t[16]	ASCII	Volume name ASCII string, zero terminated

Table 53: HIL_VOLUME_GET_ENTRY_CNF_T – Volume confirmation

Packet structure reference

```
/* VOLUME CONFIRMATION */
#define HIL_VOLUME_GET_ENTRY_CNF_DATA_Ttag  HIL_VOLUME_GET_ENTRY_REQ+1

typedef struct HIL_FORMAT_CNF_DATA_Ttag
{
  uint32_t  ulVolumeCount;          /* count of volumes */
  uint8_t   szName[16];             /* name of currently requested volume entry */
} HIL_VOLUME_GET_ENTRY_CNF_DATA_T;

typedef struct HIL_VOLUME_GET_ENTRY_CNF_Ttag
{
  HIL_PACKET_HEADER                      tHead;                  /* packet header */
  HIL_VOLUME_GET_ENTRY_CNF_DATA_T        tData;                  /* packet data */
} HIL_VOLUME_GET_ENTRY_CNF_T;
```

3.8 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 54: 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	 28 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 55: 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 56: 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 0 UNDEFINED 1 IN (netX to Host System) 2 OUT (Host System to netX) 3 IN – OUT (Bi-Directional) Other values are reserved
4-7	Transmission Type 0 UNDEFINED 1 DPM (Dual-Port Memory) 2 DMA (Direct Memory Access) Other values are reserved
8-15	Reserved, set to 0

Table 57: 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 58: 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.

3.9 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 *DDP OEM Data Area* (page 86).

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.

Table 59: Flash Device Label: Header

Basic Device Data

Offset	Type	Name	Description
16	uint16_t	`usManufacturer`	Manufacturer ID managed and assigned by Hilscher GmbH. 0 = Undefined; 1 - 255 = Hilscher GmbH; 256 - x = OEM
18	uint16_t	`usDeviceClass`	Device classification number
20	uint32_t	`ulDeviceNumber`	Device number. 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:
			Year = ((usProductionDate >> 8) & 0x00ff) + 2000
			Week = ((usProductionDate >> 0) & 0x00ff)
			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

Table 60: Flash Device Label: Basic Device Data

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.

Table 61: Flash Device Label: MAC addresses (COM)

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.

Table 62: Flash Device Label: MAC addresses (APP)

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.

Table 63: Flash Device Label: Product identification information

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

Table 64: Flash Device Label: OEM identification

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)

Table 65: Flash Device Label: Flash layout

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”

Table 66: Flash Device Label: Footer

3.10 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 67: 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 68: 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;
```

3.11 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 0x00000002 0x00000004	HIL_SYSTEM_ERRORLOG_CMD_READINDEX ▪ Return error log entry with index ulParameter. HIL_SYSTEM_ERRORLOG_CMD_READCOUNT ▪ Return number of logged errors. This value may be larger than the number of errors that can be read. HIL_SYSTEM_ERRORLOG_CMD_CLEARBUFFERS ▪ Clear the error log.
`ulParameter`	uint32_t		Supplied parameter of ulCommand: For HIL_SYSTEM_ERRORLOG_CMD_READINDEX ▪ Index of error log entry to return

Table 69: 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001E13	HIL_SYSTEM_ERRORLOG_CNF
Data			
`ulCommand`	uint32_t		Requested command (same as in error log request)
`ulResult`	uint32_t		For HIL_SYSTEM_ERRORLOG_CMD_READINDEX ▪ Index of returned error log entry. For HIL_SYSTEM_ERRORLOG_CMD_READCOUNT ▪ Number of logged errors For HIL_SYSTEM_ERRORLOG_CMD_CLEARBUFFERS ▪ 0 on success
	HIL_SYSTEM_ERRORLOG_CNF_DATA_ELEMENT_T		For HIL_SYSTEM_ERRORLOG_CMD_READINDEX ▪ The requested error log entry, consists of error code, timestamp and textual description

Table 70: 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;
```

3.12 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 71: 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	 32 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 72: HIL_MALLINFO_CNF_T – Memory usage confirmation

Packet structure reference

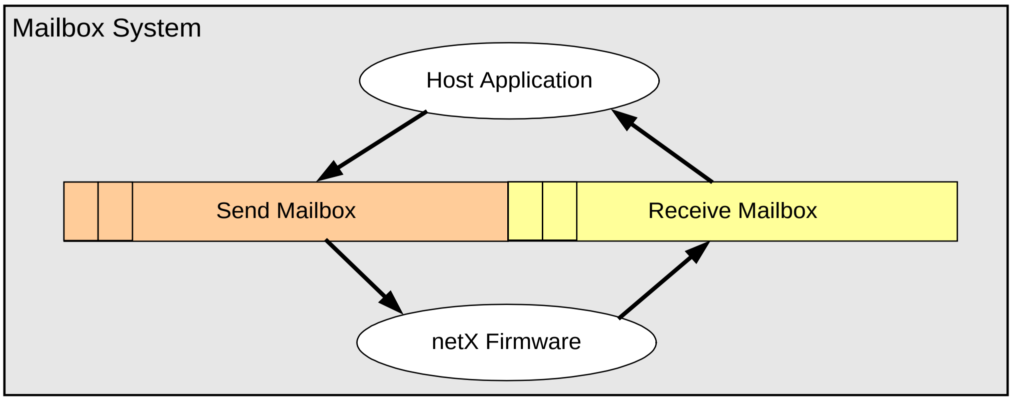
```
#define HIL_MALLINFO_CNF                     HIL_MALLINFO_REQ+1

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;
```

3.13 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, **General packet fragmentation** is used as described in this section.	For the communication channel, **Communication channel packet fragmentation** is used. For a basic description, see section *Communication channel packet fragmentation* on page 118, for a detailed description see reference [2].

Table 73: 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 0x00000000 = HIL_PACKET_SEQ_NONE None sequenced (default) 0x00000080 = HIL_PACKET_SEQ_FIRST First packet of a sequence 0x000000C0 = HIL_PACKET_SEQ_MIDDLE Packet inside a sequence 0x00000040 = HIL_PACKET_SEQ_LAST Last packet of a sequence
`ulId`	Packet number within a sequence ▪ Start value ▪ Incremented by one for each packet in a sequence

Table 74: 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 75: 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 76: 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 Last Packet of Sequence
	`ulRout`	UINT32	0x00000000	Reserved (routing information)

Table 77: 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 SUCCESS_HIL_OK (always)
	`ulCmd`	UINT32	**CMD+1**	Packet Command / Confirmation
	`ulExt`	UINT32	**0x00000040**	Packet Extension Last Packet of Sequence
	`ulRout`	UINT32		Reserved (routing information)

Table 78: Packet Fragmentation: Abort Confirmation

3.14 Device Data Provider (DDP)

The *Device Data Provider* (DDP) offeres device-specific data, e.g. serial number, hardware revision or MAC addresses of the device to all components inside a device firmware in a uniform manner. The DDP reads the device data from underlying data sources, e.g. Flash Device Label (FDL) and stores these data in internal RAM. Some of the the data is read-only while other data can be read and written.

Applications can use the *DDP Service Get Data* (page 86) and *DDP Service Set Data* (see page 90) functions to read and write data. These services using a maximum payload of 80 byte in order to fit into the smallest available mailbox (e.g. the system mailbox) offered by a device.

Writeable data is only stored in a **temporary** buffer and never written back to the underlying data source.

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. Firmware components can register at the DDP and the DDP will inform the components if the state changes.

The following table lists the available data, provided by the DDP service, and shows if the data is only readable or also writeable.

Note: Values marked as ***R/W = Yes***, can be chanded by an application.

Code	System Data Definition	R/W	Data Structure / Data Type
0x00	HIL_DDP_SERVICE_DATATYPE_BASE_DEVICE_DATA	No	HIL_DDP_SERVICE_BASE_DEVICE_DATA_T
0x10	HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_APP	Yes	HIL_DDP_SERVICE_MAC_ADDRESS_T[8] Number of structures = 8
0x20	HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_COM	Yes	HIL_DDP_SERVICE_MAC_ADDRESS_T[4] Number of structuers = 4
0x30	HIL_DDP_SERVICE_DATATYPE_USB_INFORMATION	No	HIL_DDP_SERVICE_USB_INFO_T
0x41 .. 0x4A	HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_0 … HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_9	No	HIL_DDP_SERVICE_LIBSTORAGE_AREA_T
0x51 .. 0x53	HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_0 … HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_3	No	HIL_DDP_SERVICE_LIBSTORAGE_CHIP_T
Code	**OEM Data Definitions**		
0x60	HIL_DDP_SERVICE_DATATYPE_OEM_OPTIONS	Yes	32-bit value
0x61	HIL_DDP_SERVICE_DATATYPE_OEM_SERIALNUMBER	Yes	String max. 28 including 0 termination
0x62	HIL_DDP_SERVICE_DATATYPE_OEM_ORDERNUMBER	Yes	String max. 32 character including 0 termination
0x63	HIL_DDP_SERVICE_DATATYPE_OEM_HARDWAREREVISION	Yes	String max. 16 character including 0 termination
0x64	HIL_DDP_SERVICE_DATATYPE_OEM_PRODUCTIONDATE	Yes	String max. 32 character including 0 termination
0x65 0x66	HIL_DDP_SERVICE_DATATYPE_OEM_VEDORDATA_0 HIL_DDP_SERVICE_DATATYPE_OEM_VEDORDATA_1	Yes	Byte array, size 80 Byte Byte array, size 32 Byte
Code	**General DDP State**		
0x67	HIL_DDP_SERVICE_DATATYPE_STATE	Yes	32-bit value

Table 79: Device data identification (Device Data Provider)

3.14.1 DDP State Definition

The Device Data Provider supports two states:

- HIL_DDP_SERVICE_STATE_PASSIVE (0)
  - In ***passive*** state, the information marked as "***writeable***" (see *Table 79*), can be changed by an application.
  - The information is not used for the firmware configuration.
  - The `HIL_DDP_SERVICE_GET_REQ` returns error `ERR_HIL_DDP_STATE_INVALID` in the `ulSta` field to inform the requester about the current passive state. However, the requested data is delivered in the confirmation as it is (e.g. the content read from the FDL).
  - The `ulSta` field must be evaluated to verify if the information can be considered as valid.
  - All software components integrated in the firmware will reject component-specific services in ***passive*** DDP state (except those from the white list, see *White list for DDP State* passive).
- HIL_DDP_SERVICE_STATE_ACTIVE (1)
  - Once, an application switches the state to ***active***, parameters are considered as valid.
  - Parameters are not changeable anymore.
  - Parameters are now usable by the firmware for configuration.
  - A state change is executed by the HIL_DDP_SERVICE_SET_REQ service when setting:
ulDataType= HIL_DDP_SERVICE_DATATYPE_STATE
ulValue = HIL_DDP_SERVICE_STATE_ACTIVE
  - The DDP informs all registered firmware components about a state change.
  - The confirmation to the state change request is send back after all registered component functions are processed.
  - Switching back to passive mode is not possible.

Note: A state change from ***passive*** to ***active*** mode may require a certain time until all firmware components recognizes and changes into the new (active) state.
During this time, requests to a firmware component will possibly be answered with `ulSta = ERR_HIL_DDP_STATE_INVALID.` In this case, the application can continue to send the request again, until `ulSta` returns without an error.

Note: The firmware must not be used in the mode ***passive*** if the device is using the firmware to fulfill the requirement "fast bootup time" (e.g. Ethernet/IP QuickConnect or PROFINET FastStartUp).

The current state of the DDP can be read by using the `HIL_DDP_SERVICE_GET_REQ` request with `ulDataType` = `HIL_DDP_SERVICE_DATATYPE_STATE`.

3.14.2 DDP Definitions and Data Structures

The following defines and structures used by the DDP 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)
```

HIL_DDP_SERVICE_BASE_DEVICE_DATA_T

```
typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST 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_DDP_SERVICE_BASE_DEVICE_DATA_T;
```

HIL_DDP_SERVICE_MAC_ADDRESS_T

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

HIL_DDP_SERVICE_USB_INFO_T

```
typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST 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 Vendor name (Byte array) */
  uint8_t   abUSBProductName[HIL_DDP_SERVICE_DEFAULT_NAME_SIZE];/*!< USB Product name (string) */
} HIL_DDP_SERVICE_USB_INFO_T;
```

HIL_DDP_SERVICE_LIBSTORAGE_AREA_T

```
typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST 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_DDP_SERVICE_LIBSTORAGE_AREA_T;
```

HIL_DDP_SERVICE_LIBSTORAGE_CHIP_T

```
typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST 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_DDP_SERVICE_LIBSTORAGE_CHIP_T;
```

3.14.3 DDP OEM Data Area

Inside the Flash Device Lable (FDL) an OEM data area is available, which can be used by device vendors to add their specific information into the device.

The OEM data consists of predefined values (e.g. serial number / order number) and a 112 byte freely usable data area. The only limitation of the data area is that it is only read and writeable in two fix portitions of 80 bytes and 32 byte.

OEM data are also read and writeable by the DDP `HIL_DDP_SERVICE_GET_REQ / HIL_DDP_SERVICE_SET_REQ` services and OEM data specific data type definitions (see Table 80) are available to select the data in the services.

Like other DDP data, the OEM data also have a fix data size corresponding to the data type, also defined in Table 81.

Definition of HIL_DDP_SERVICE_DATATYPE_OEM_OPTIONS

This value has a special meaning in the OEM data and the DDP evaluates this value too.

The lowest 4 bits (3:0) of the parameter are intended to ensure that the four predefined OEM parameters belonging together and are inherently consistent. This is necessary because each parameter can individually be written but only useable in conjunction with the OEM other parameters.

Note: The DDP only accepts the bits (3:0) either cleared or set in the OEM option value.
Any attempts to write another value for these bits will be reject with `ulSta` set to `HIL_ERROR_INVALID_DDP_CONTENT` in the confirmation to the request.
Other bits are not evaluated.

- HIL_DDP_SERVICE_DATATYPE_OEM_OPTIONS (0x0 / bits (3:0) = 0)
  - OEM parameters are **not valid** / **not consistent**
    HIL_DDP_SERVICE_DATATYPE_OEM_SERIALNUMBER
    HIL_DDP_SERVICE_DATATYPE_OEM_ORDERNUMBER
    HIL_DDP_SERVICE_DATATYPE_OEM_HARDWAREREVISION
    HIL_DDP_SERVICE_DATATYPE_OEM_PRODUCTIONDATE
  - The firmware evaluates the OEM option value and does not use these values.
- HIL_DDP_SERVICE_DATATYPE_OEM_OPTIONS (0xF / bits (3:0) = 1)
  - OEM parameters are **valid** / **consistent**
    HIL_DDP_SERVICE_DATATYPE_OEM_SERIALNUMBER
    HIL_DDP_SERVICE_DATATYPE_OEM_ORDERNUMBER
    HIL_DDP_SERVICE_DATATYPE_OEM_HARDWAREREVISION
    HIL_DDP_SERVICE_DATATYPE_OEM_PRODUCTIONDATE
  - An OEM application hast to set the value to 0xF before the firmware will use the values.

3.14.4 DDP Service Get Data

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

DDP Service Get Data 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	see Table 82	One of the HIL_DDP_SERVICE_DATATYPE_* defines described above.

Table 83: HIL_DDP_SERVICE_GET_REQ_T – Device Data Provider Get request

Packet structure reference

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

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

DDP Service Get Data Confirmation

Changeable parameter (see *Table 79*) 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 4 + n 0	Packet Data Length (in Bytes / see example below)) If `ulSta` = `SUCCESS_HIL_OK` If `ulSta` = `ERR_HIL_DDP_STATE_INVALID` 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	from request	The HIL_DDP_SERVICE_DATATYPE_* define sent in the request packet.
`uDataType`	see ulDataType	0..n	Data corresponding to the requested data type (see examples below)

Table 84: HIL_DDP_SERVICE_GET_CNF_T – Device Data Provider Get confirmation

Note: The confirmation packet length (`ulLen`) depends on the requested / returned data type (`ulDataType`).

Example on how to determine the confirmation data length (n)

```
ulDataType = HIL_DDP_SERVICE_DATATYPE_BASE_DEVICE_DATA
n          = sizeof(HIL_DDP_SERVICE_BASE_DEVICE_DATA_T
ulLen      = 4 + n
```

```
ulDataType = HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_APP
n          = sizeof(HIL_DDP_SERVICE_MAC_ADDRESS_T) * HIL_DDP_SERVICE_MAC_APP_NUM
ulLen      = 4 + n
```

```
ulDataType = HIL_DDP_SERVICE_DATATYPE_OEM_VENDORDATA_0
n          = 80 (Byte array of 80 Byte)
ulLen      = 4 + n
```

```
ulDataType = HIL_DDP_SERVICE_DATATYPE_OEM_VENDORDATA_1
n          = 32 (Byte array of 32 Byte)
ulLen      = 4 + n
```

Packet structure reference

HIL_DDP_SERVICE_GET_CNF_T

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

HIL_DDP_SERVICE_GET_CNF_DATA_T

Note: The confrmation data structure contains the `ulDataType` return value and the resulting data structured in the `uDataType` union.
The union should help to simplify the access to the necessary data depending on the data type.

```
typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST HIL_DDP_SERVICE_GET_CNF_DATA_Ttag
{
  /*!< DDP_SERVICE_DATATYPE_* definitions */
  uint32_t ulDataType;

  union HIL_DDP_SERVICE_GET_DATATYPE_U
  {
    /* Fixed structures for specific ulDataType */
    HIL_DDP_SERVICE_BASE_DEVICE_DATA_T    tBaseDeviceData;

    /*!< HIL_DDP_SERVICE_DATATYPE_USB_INFORMATION */
    HIL_DDP_SERVICE_USB_INFO_T            tUSBInfo;

   /*!< HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_AREA_* */
    HIL_DDP_SERVICE_LIBSTORAGE_AREA_T     tFlashArea;

    /*!< HIL_DDP_SERVICE_DATATYPE_STORAGE_FLASH_CHIP_* */
    HIL_DDP_SERVICE_LIBSTORAGE_CHIP_T     tFlashChip;

    /* Members for multiple keys (ulDataType) */

    /*!< Keys with 32bit values, e.g. OEM Option Flags */
    uint32_t                              ulValue;

    /* The following values are defined with maximum value sizes.
       Actual valid or used length/sizes dependent on DataType and maybe smaller.*/

    /*!< Strings, e.g. OEM Serial Number; maximum 80 bytes (including NULL termination) */
    int8_t                                szString[80];

    /*!< Binary data, e.g. OEM Vendor Data; maximum 80 bytes */
    uint8_t                            abData[80];

    /*!< HIL_DDP_SERVICE_DATATYPE_MAC_ADDRESSES_*; maximum 13 addresses (6bytes*13=78) */
    HIL_DDP_SERVICE_MAC_ADDRESS_T         atMacAddress[13];

  } uDataType;

} HIL_DDP_SERVICE_GET_CNF_DATA_T;
```

3.14.5 DDP Service Set Data

The application can use this service to change the writable device data in the DDP (Table 85) before configuring the firmware to setup any necessary information for the field bus protocol, the hardware or OEM data.

Once the device data is set, the application has to switch the DDP state to **active**.

This is done by sending HIL_DDP_SERVICE_SET_REQ with
`ulDataType` set to `HIL_DDP_SERVICE_DATATYPE_STATE` and the data value
`HIL_DDP_SERVICE_STATE_ACTIVE`
The firmware will consider the information valid and configure its resources.

Note: Changed device data is only stored in a **temporary** buffer and not written to the underlying data source (e.g. Flash Device Label).
After a system reset or power cycle, the application must repeat this service.

DDP Service 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	see Table 86	One of the HIL_DDP_SERVICE_DATATYPE_* defines described above.
`uDataType`	see ulDataType	0..n	Data, depending on `ulDataType`

Table 87: HIL_DDP_SERVICE_SET_REQ_T – Device Data Provider Set request

HIL_DDP_SERVICE_SET_REQ_T

```
/* Set data structure equal to data structure of Get confirmation */
typedef HIL_DDP_SERVICE_GET_CNF_DATA_T HIL_DDP_SERVICE_SET_REQ_DATA_T;

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

DDP Service Set Data 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 88: HIL_DDP_SERVICE_SET_CNF_T – Device Data Provider Set confirmation

DDP SERVICE SET CONFIRMATION

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

3.15 Exception handler

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

Note: The exception handler runs as an "emergency mode" in case a firmware has crashed. It has only a limited number of packet services that can behave different to the services in a functional standard firmware. Since at this point, the firmware already crashed, some parameter checks might be omitted or behave differently e.g. services might only support 0x00000000 for *ulDest* and returned data might be zero or random. There is no guarantee that services in the exception handler behave the same way as in a functional standard firmware.

The execution of the exception handler can be identified by following points:

- The blink pattern of the `SYS-LED` (3x yellow, 3x green)
- The DPM entries `ulSystemError` and `ulCommunicationError` are set to error code `ERR_HIL_FIRMWARE_CRASHED`
- The `HIL_FIRMWARE_IDENTIFY_REQ` packet command returns the name of the handler
  Note:
  => the command only accepts `ulChannelID` = `0xFFFFFFFF` (other IDs are rejected)
  => the command only delivers the name "`ExceptionHandler`" (other fields are set to 0)
- Unsupported packet commands returned with *`ulSta`* set to error code `ERR_HIL_FIRMWARE_CRASHED`

The exception handler supports following services:

Exception handler service	Command	Page
Read the name of the exception handler	`HIL_FIRMWARE_IDENTIFY_REQ` (see note above)	22
Firmware and system reset	`HIL_FIRMWARE_RESET_REQ`	13
Get exception context from crashed firmware	`HIL_EXCEPTION_INFO_REQ`	92
Read physical memory from crashed firmware	`HIL_PHYSMEM_READ_REQ`	94

Table 89: Exception handler service overview

3.15.1 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 90: 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	 84 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001E15	HIL_EXCEPTION_INFO_CNF
Data			
`ulType`	uint32_t	 1 2 3	Exception type HIL_EXCEPTION_TYPE_EXCEPTION HIL_EXCEPTION_TYPE_THREAD 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 Cortex-M: ulXLR
`ulDFAR/ulBASEPRI`	uint32_t		Cortex-R: ulDFAR Cortex-M: ulBASEPRI

Table 91: 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;
```

3.15.2 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	0x00000000 … 0xFFFFFFFF	Memory read address. Depending on access type, address needs to be 8, 16, or 32-bit aligned.
`ulAccessType`	uint32_t	 0 1 2 3	Type of memory access HIL_PHYSMEM_ACCESSTYPE_8BIT HIL_PHYSMEM_ACCESSTYPE_16BIT HIL_PHYSMEM_ACCESSTYPE_32BIT HIL_PHYSMEM_ACCESSTYPE_TASK (not supported)
`ulReadLength`	uint32_t		Length to be read (limited by mailbox size).

Table 92: 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	 n 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00001EA9	HIL_PHYSMEM_READ_CNF
Data			
	uint8_t	0x00 … 0xFF	Data read from netX

Table 93: 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	97
Read the Common Status Block of a channel	HIL_DPM_GET_COMMON_STATE_REQ	99
Read the Extended Status Block of a channel	HIL_DPM_GET_EXTENDED_STATE_REQ	101
Read Communication Flag States		
Read the communication flags of a specified communication channel	HIL_DPM_GET_COMFLAG_INFO_REQ	103
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	105
Channel Initialization		
Re-initialize / re-configure a protocol stack	HIL_CHANNEL_INIT_REQ	108
Delete Protocol Stack Configuration		
Delete a actual configuration of a protocol stack	HIL_DELETE_CONFIG_REQ	110
Lock / Unlock Configuration		
Lock or unlock a configuration against changes	HIL_LOCK_UNLOCK_CONFIG_REQ	112
Start / Stop Communication		
Start or stop network communication	HIL_START_STOP_COMM_REQ	113
Channel Watchdog Time		
Read the actual watchdog time of a communication channel	HIL_GET_WATCHDOG_TIME_REQ	114
Set the watchdog time of a communication channel	HIL_SET_WATCHDOG_TIME_REQ	115
Channel Component Information		
Read information about all components of one channel	GENAP_GET_COMPONENT_IDS_REQ	116

Table 94: 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 Communication Studio 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 78.

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 4 … 5	Communication Channel Number Application Channel Number

Table 95: 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	 8 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 96: 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 4 … 5	Communication Channel Number Application Channel Number

Table 97: 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	 64 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 98: 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
`ulChannelIndex`	uint32_t	0 … 3 4 … 5	Communication Channel Number Application Channel Number

Table 99: 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 100: 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 101: 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 102: Area Index

DPM Get ComFlag Info confirmation

Variable	Type	Value / Range	Description
`ulLen`	uint32_t	 12 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 103: 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 101) 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.

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 104: 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.

Variable	Type	Value / Range	Description
`ulLen`	uint32_t	 44 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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
Data			
`ulNumIOBlockInfo`	uint32_t	2	Number of Block Definitions in this packet
`atIoBlockInfo[2]`	Array of Structure		I/O Block definition structure(s) `HIL_DPM_IO_BLOCK_INFO`

Table 105: 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 The value identifies the index of the sub block. This field is only informative and shall not be used by an application. Value 5 for standard output image. Value 6 for standard input image.
`ulType`	uint32_t		Type of sub block HIL_BLOCK_* type definitions, see Hil_DualPortMemory.h.
`usFlags`	uint16_t		Flags of the sub block HIL_DIRECTION_* and HIL_TRANSMISSION_TYPE_* type definitions, see Hil_DualPortMemory.h
`usReserved`	uint16_t		Reserved
`ulOffset`	uint32_t	0	Offset 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

Table 106: 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.

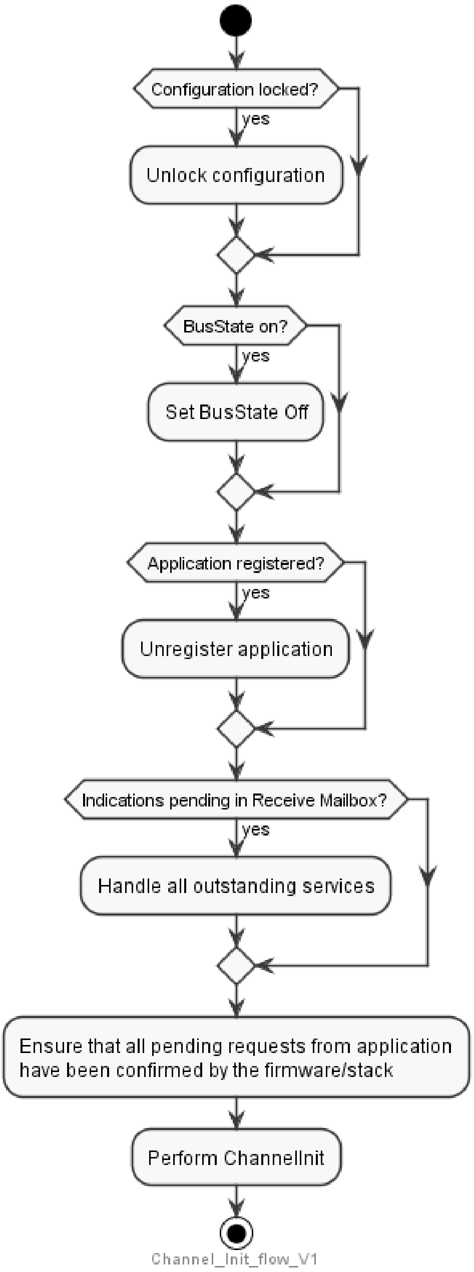


Figure 6: Flow chart ChannelInit (Best practise pattern for the host application)

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 107: 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 108: 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.

Consequence for	Configured via packets	Configured via configuration database
Configuration	The configuration stored in RAM will be deleted. The application has to use the Set Configuration service again. Otherwise (after a channel initialization) the protocol stack will not startup properly due to the missing configuration.	This service has no effect to the configuration file itself, 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 54.
Remanent Data	The remanent data will be reset to default values.	The remanent data will be reset to default values.

Table 109: 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 110: 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 111: 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 0x00000002	Parameter Lock Configuration Unlock Configuration

Table 112: 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 113: 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 0x00000002	Parameter HIL_START_STOP_COMM_PARAM_START HIL_START_STOP_COMM_PARAM_STOP

Table 114: 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 115: 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 116: 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 0	Packet Data Length (in Bytes) If `ulSta` = SUCCESS_HIL_OK 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 20 … 0xFFFF	Watchdog Time in milliseconds [ms] = not set 20 > WDT < 0xFFFF

Table 117: 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 20 … 65535	Watchdog Time Watchdog inactive Watchdog time in milliseconds

Table 118: 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 119: 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 155.

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 120: 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. See file `Hil_ComponentID.h` for details.
`ulRemanentDataSize`	uint32_t		The size of this components remanent data. 0: component has no remanent data. >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 121: 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 78) 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 7 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.

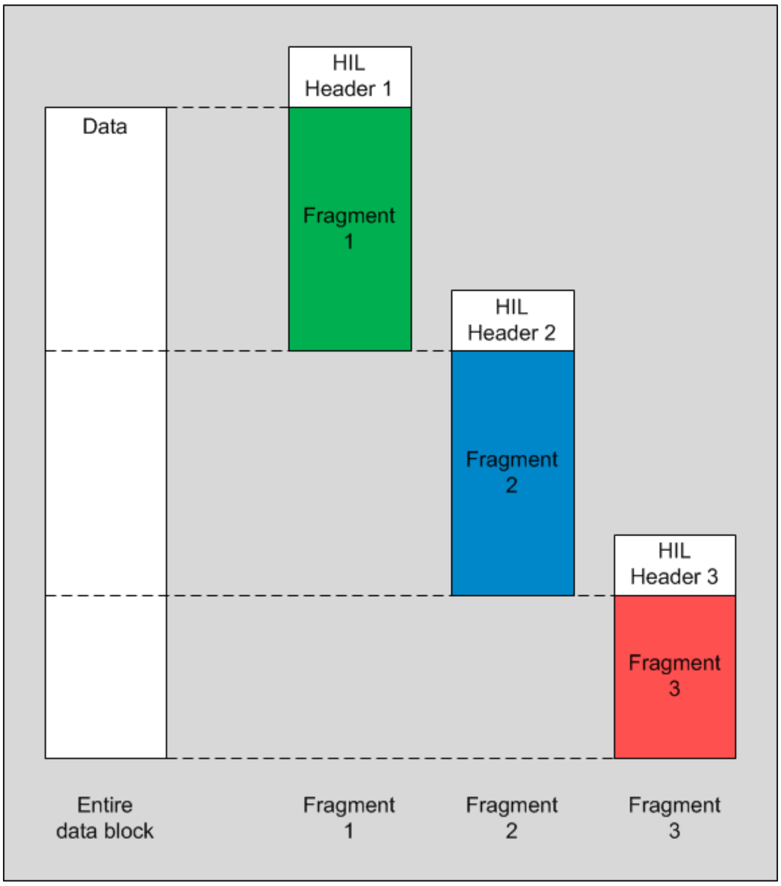


Figure 7: Packet fragmentation principle (splitting the entire data block into fragments)

Handling of packet reassembly

The host application or the protocol stack can rebuild the entire data block as shown in Figure 9. Each packet has a unique sequence number and states whether more packet fragments will follow.

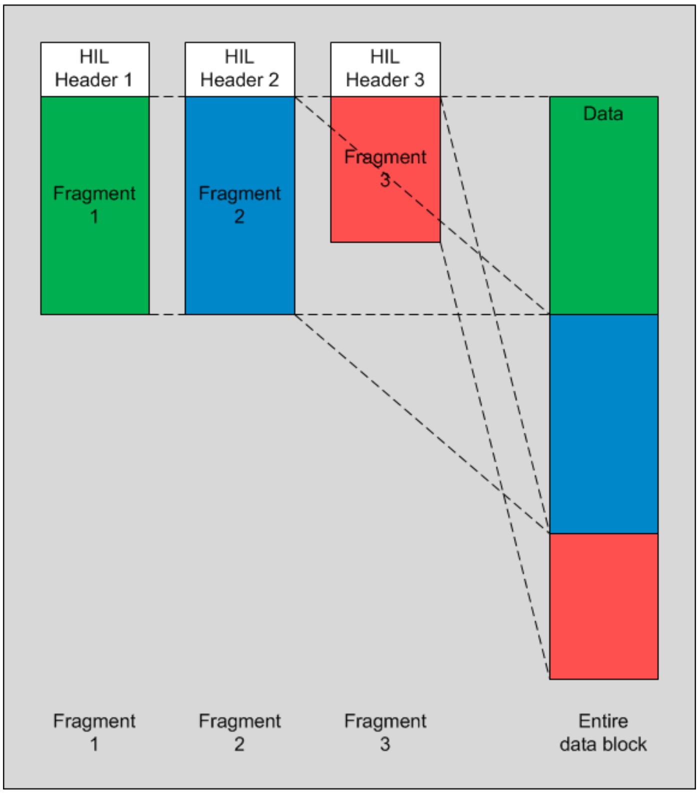


Figure 8: Packet fragmentation principle (rebuild entire data block)

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

Variable	Used for	Remark

ulExt	▪ indicate fragmented transfer
	▪ indicate whether more fragments will follow: first fragment, middle fragment
	▪ indicate whether the service is complete: last fragment
		ulExt:SEQ_MASK is used (Hil_Packet.h)
		`HIL_PACKET_SEQ_NONE (0x00000000)`
		`HIL_PACKET_SEQ_LAST (0x00000040)`
		`HIL_PACKET_SEQ_FIRST (0x00000080)`
		`HIL_PACKET_SEQ_MIDDLE (0x000000C0)`

	▪ indicate the sequence number of fragmented packet ▪ the first fragment starts with 0 ▪ wrap around to 0 after 63 was reached	ulExt:SEQ_NR_MASK is used (Hil_Packet.h) `HIL_PACKET_SEQ_NR_MASK (0x0000003F)`
ulDestId	▪ the service requester uses value 0 for the first fragment ▪ the service provider defines the value for ulDestId in the first answer ▪ 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 ▪ 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 ▪ the service requester and service provider must use this value for all other packets (middle and last) of this fragmentation sequence	-

Table 122: 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].

4.12 White list for DDP State passive

By default, all services addressing a functionality of a communication channel will be rejected in DDP state passive. This section lists services that can be used on a communication channel even if the DDP state is passive.

Protocol stack services

Service	Command definition	Page
Read available components of the Communication Channel	GENAP_GET_COMPONENT_IDS_REQ	116
Register an application to be able to receive notifications from a protocol stack	HIL_REGISTER_APP_REQ	147
Unregister an application from receiving notifications	HIL_UNREGISTER_APP_REQ	148
Activate a link status change notification	HIL_LINK_STATUS_CHANGE_IND	149
Hand over the remanent data to the application to be stored	HIL_SET_REMANENT_DATA_REQ	156
Delete configuration and remanent data	HIL_DELETE_CONFIG_REQ	110
Read entry of Communication Channel logbook	HIL_READ_LOG_BOOK_ENTRIES_REQ	124
Read layout of Communication Channel logbook	HIL_GET_LOG_BOOK_LAYOUT_REQ	122
Clear Communication Channel logbook	HIL_CLEAR_LOG_BOOK_REQ	127
Set severity level for Communication Channel logbook	HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ	128

Table 123: White list for DDP State “passive” (Protocol stack services)

4.13 Communication Channel Logbook

A communication channel may provide a logbook which gives hints in case of a failure. The logbook functionality is an optional feature and thus the services listed here are not always supported by a specific Communication Channel.

The logbook consists of two parts

- a permanent part whose entries will not be overwritten, and
- a ringbuffer part whose oldest entries will be overwritten with newer ones once the ringbuffer is full

4.13.1 Get logbook layout

This service provides information about the layout and structure of the Communication Channel logbook.

Get logbook layout request

The application can use the following packet to read the logbook layout.

Variable	Type	Value / Range	Description
`ulDest`	uint32_t	0x00000020	HIL_PACKET_DEST_DEFAULT_CHANNEL
`ulCmd`	uint32_t	0x00002F96	HIL_GET_LOG_BOOK_LAYOUT_REQ

Table 124: HIL_GET_LOG_BOOK_LAYOUT_REQ_T – Get logbook layout request

Packet structure reference

```
/* Get logbook layout request */
#define HIL_GET_LOG_BOOK_LAYOUT_REQ                   0x00002F96

typedef HIL_EMPTY_PACKET_T      HIL_GET_LOG_BOOK_LAYOUT_REQ_T;
```

Get logbook layout confirmation

The communication channel returns the following packet to indicate the logbook layout.

Variable	**Type**	**Value / Range**	**Description**
`ulLen`	uint32_t	 8 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See Below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00002F97	HIL_GET_LOG_BOOK_LAYOUT_CNF
Data			
`ulNumberOfEntries`	uint32_t		Total number of entries the logbook can hold
`ulPermanentEntries`	uint32_t		Number of entries which will no be overwritten by new ones

Table 125: HIL_GET_LOG_BOOK_LAYOUT_CNF_T – Get logbook layout confirmation

Packet structure reference

```
/* Get logbook layout confirmation */
#define HIL_GET_LOG_BOOK_LAYOUT_CNF                    0x00002F97

typedef struct HIL_GET_LOG_BOOK_LAYOUT_CNF_DATA_Ttag
{
  /*! Total number of entries the logbook can hold */
  uint32_t ulNumberOfEntries;
  /*! Number of entries which will no be overwritten by new ones */
  uint32_t ulPermanentEntries;
} HIL_GET_LOG_BOOK_LAYOUT_CNF_DATA_T;

typedef struct HIL_GET_LOG_BOOK_LAYOUT_CNF_Ttag
{
  HIL_PACKET_HEADER                  tHead;     /* packet header           */
  HIL_GET_LOG_BOOK_LAYOUT_CNF_DATA_T tData;     /* packet data             */
} HIL_GET_LOG_BOOK_LAYOUT_CNF_T;
```

4.13.2 Read logbook entries

Using this service the application can read (multiple) entries of the Communication Channel logbook.

Note that up to 64 entries can be transferred in unfragmented manner. If more entries are requested, the confirmation packet will be fragmented.

Get logbook entries request

The application can use the following packet to read entries of the logbook.

Variable	Type	Value / Range	Description
`ulLen`	uint32_t	8	Request packet length
`ulDest`	uint32_t	0x00000020	HIL_PACKET_DEST_DEFAULT_CHANNEL
`ulCmd`	uint32_t	0x00002F94	HIL_READ_LOG_BOOK_ENTRIES_REQ
Data			
`ulSkipRecentEntries`	uint32_t		How many of the recent made entries shall be skipped
`ulNumberOfEntriesToRead`	uint32_t		Number of entries to read

Table 126: HIL_GET_LOG_BOOK_LAYOUT_REQ_T – Get logbook layout request

Packet structure reference

```
/* Get logbook entries request */
#define HIL_READ_LOG_BOOK_ENTRIES_REQ                   0x00002F94

typedef struct HIL_READ_LOG_BOOK_ENTRIES_REQ_DATA_Ttag
{
  /*! Total number of entries the logbook can hold */
  uint32_t ulNumberOfEntries;
  /*! Number of entries which will no be overwritten by new ones */
  uint32_t ulPermanentEntries;
} HIL_READ_LOG_BOOK_ENTRIES_REQ_DATA_T;

typedef struct HIL_READ_LOG_BOOK_ENTRIES_REQ_Ttag
{
  HIL_PACKET_HEADER                    tHead;   /* packet header          */
  HIL_READ_LOG_BOOK_ENTRIES_REQ_DATA_T tData;   /* packet data            */
} HIL_READ_LOG_BOOK_ENTRIES_REQ_T;
```

Get logbook entries confirmation

The communication channel returns the following packet containing the requested logbook entries.

Variable	Type	Value / Range	Description
`ulLen`	uint32_t	 8 + n 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See Below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00002F95	HIL_READ_LOG_BOOK_ENTRIES_CNF
Data			
`ulSkipRecentEntries`	uint32_t		Number of skipped entries
`ulNumberOfReadEntries`	uint32_t		Number of entries in the following dynamic array
`atEntries`	HIL_READ_LOG_BOOK_ENTRY_DATA_T		

Table 127: HIL_READ_LOG_BOOK_ENTRIES_CNF_T – Read logbook entries confirmation

A single logbook entry has the follogin structure.

Variable	Type	Value / Range	Description
`ulSystemTicks`	uint32_t		Timestamp (in milliseconds) of operating system when entry was made. Note that this timestamp overruns every ~47 days.
`bLevel`	uint8_t	 2 4 6	Severity Level: Critical Warning Informational
`bReserved`	uint8_t	0	Reserved, do not check content
`usType`	uint16_t		Type of entry in `abData`. This gives a hint how to decode the next 16 byte. See header file *Hil_Logbook.h* provided together with the used firmware for possible values.
`abData`	uint8_t[16]		Logbook entry detailed data. Needs to be interpreted depending on value of `usType`.

Table 128: HIL_READ_LOG_BOOK_ENTRY_DATA_T – A single logbook entry

Packet structure reference

```
/* Read logbook entries confirmation */
#define HIL_READ_LOG_BOOK_ENTRIES_CNF                   0x00002F95

/* logbook entry */
typedef __HIL_PACKED_PRE struct __HIL_PACKED_POST {
  /*! Time stamp of the OS in Millisecond when the entry was made */
  uint32_t  ulSystemTicks;
  /*! Severity level of this entry. Levels are defined in the Hil_Logbook.h */
  uint8_t   bLevel;
  /*! This field is reserved for later use, will be set to 0. */
  uint8_t   bReserved;
  /*! The type is used to determine how the following abData filed must be
   * interpreted. Types and related structures are defined in the Hil_Logbook.h */
  uint16_t  usType;
  /*! Data length and format depends on usType */
  uint8_t   abData[16];
} HIL_READ_LOG_BOOK_ENTRY_DATA_T;


typedef struct HIL_READ_LOG_BOOK_ENTRIES_CNF_DATA_Ttag
{
  /*! Requested amount of skipped entries */
  uint32_t ulSkipRecentEntries;
  /*! Successfully read entries. Valid as index in atEntries[] array */
  uint32_t ulNumberOfReadEntries;} HIL_GET_LOG_BOOK_LAYOUT_CNF_DATA_T;
  /*! Array of read entries, size is defined by ulNumberOfReadEntries */
  HIL_READ_LOG_BOOK_ENTRY_DATA_T atEntries[__HIL_VARIABLE_LENGTH_ARRAY];
} HIL_READ_LOG_BOOK_ENTRIES_CNF_DATA_T;

typedef struct HIL_READ_LOG_BOOK_ENTRIES_CNF_Ttag
{
  HIL_PACKET_HEADER                    tHead;  /* packet header          */
  HIL_READ_LOG_BOOK_ENTRIES_CNF_DATA_T tData;  /* packet data            */
} HIL_READ_LOG_BOOK_ENTRIES_CNF_T;
```

4.13.3 Clear logbook content

This service allows to clear the whole content of Communication Channel logbook. This includes the permanent entries as well.

Clear logbook content request

The application can use the following packet to clear the logbook content.

Variable	Type	Value / Range	Description
`ulDest`	uint32_t	0x00000020	HIL_PACKET_DEST_DEFAULT_CHANNEL
`ulCmd`	uint32_t	0x00002F98	HIL_CLEAR_LOG_BOOK_REQ

Table 129: HIL_CLEAR_LOG_BOOK_REQ_T – Clear logbook request

Packet structure reference

```
/* Clear logbook content request */
#define HIL_CLEAR_LOG_BOOK_REQ                   0x00002F98

typedef HIL_EMPTY_PACKET_T      HIL_CLEAR_LOG_BOOK_REQ_T;
```

Clear logbook content confirmation

The communication channel returns the following packet as 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	0x00002F99	HIL_CLEAR_LOG_BOOK_CNF

Table 130: HIL_CLEAR_LOG_BOOK_CNF_T – Clear logbook confirmation

Packet structure reference

```
/* Get logbook layout confirmation */
#define HIL_CLEAR_LOG_BOOK_ CNF                  0x00002F99

typedef HIL_EMPTY_PACKET_T     HIL_CLEAR_LOG_BOOK_CNF_T;
```

4.13.4 Set logbook severity level

This service allows to set the severity level of the Communication Channel logbook. This may be helpful to reduce the amount of entries if logbook contains many entries that are currently not of interest.

Set logbook severity level request

The application can use the following packet to set the logbook severity level.

Variable	Type	Value / Range	Description
`ulDest`	uint32_t	0x00000020	HIL_PACKET_DEST_DEFAULT_CHANNEL
`ulCmd`	uint32_t	0x00002F9A	HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ
Data			
`ulLevelsToBeLogged`	uint32_t	 0x00000040 0x00000010 0x00000004	Bitlist controlling which severity level shall be added to the logbook. (Bits can be combined e.g. to activate all use 0x54) enable informational entries enable warning entries enable critical entries

Table 131: HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ_T – Set logbook severity level request

Packet structure reference

```
/* Set logbook severity level request */
#define HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ                   0x00002F9A

typedef struct HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ_DATA_Ttag
{
  /*! Bit list of severity levels which shall be logged.
   * Set related bit position to 1 to enable logging of level, or set to 0
   * to disable related level.
   * e.g. ulLevelsToBeLogged = (1<<HIL_LOGBOOK_SEVERITY_LEVEL_CRITICAL) |
   *                           (1<<HIL_LOGBOOK_SEVERITY_LEVEL_WARNING) */
  uint32_t ulLevelsToBeLogged;
} HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ_DATA_T;

typedef struct HIL_READ_LOG_BOOK_ENTRIES_REQ_Ttag
{
  HIL_PACKET_HEADER                          tHead; /* packet header      */
  HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ_DATA_T tData; /* packet data        */
} HIL_SET_LOG_BOOK_SEVERITY_LEVEL_REQ_T;
```

Set logbook severity level confirmation

The communication channel returns the following packet as 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	0x00002F9B	HIL_SET_LOG_BOOK_SEVERITY_LEVEL_CNF

Table 132: HIL_SET_LOG_BOOK_SEVERITY_LEVEL_CNF_T – Get logbook severity level confirmation

Packet structure reference

```
/* Set logbook severity level confirmation */
#define HIL_SET_LOG_BOOK_SEVERITY_LEVEL_CNF                   0x00002F9B

typedef HIL_EMPTY_PACKET_T     HIL_SET_LOG_BOOK_SEVERITY_LEVEL_CNF_T;
```

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	130
Modify Configuration Settings		
Set protocol stack configuration parameters to new values	HIL_SET_FW_PARAMETER_REQ	138
Network Connection State		
Obtain a list of slave which are configured, active or faulted	HIL_GET_SLAVE_HANDLE_REQ	142
Obtain a slave connection information	HIL_GET_SLAVE_CONN_INFO_REQ	144
Protocol Stack Notifications / Indications		
Register an application to be able to receive notifications from a protocol stack	HIL_REGISTER_APP_REQ	147
Unregister an application from receiving notifications	HIL_UNREGISTER_APP_REQ	148
Link Status Changed Service		
Activate a link status change notification	HIL_LINK_STATUS_CHANGE_IND	149
Perform a Bus Scan		
Scan for available devices on the fieldbus devices	HIL_BUSSCAN_REQ	151
Get Information about a Fieldbus Device		
Read the fieldbus depending information of a device	HIL_GET_DEVICE_INFO_REQ	153
Remanent Data		
Hand over the remanent data to the application to be stored	HIL_SET_REMANENT_DATA_REQ	156
Hand over the remanent data to the firmware/stack	HIL_STORE_REMAMENT_DATA_IND	159

Table 133: 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-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 134: 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 135: 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 136: 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 137: 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 2 ways.

- With configuration software: Configuration database file
  (Created with Communication Studio)
- Via API: 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

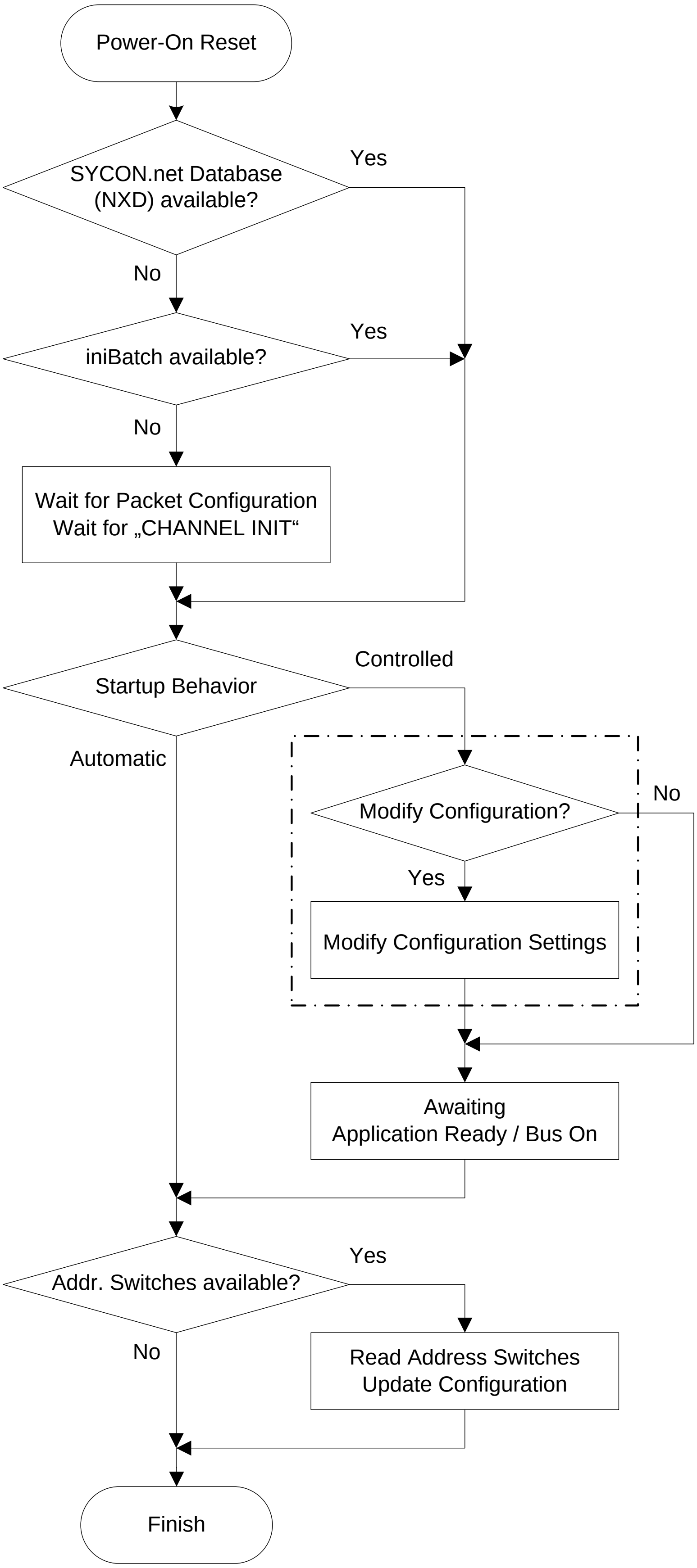


Figure 9: Flowchart Modify Configuration Settings

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 112).

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 139 and Table 140
`ulParameterLen`	uint32_t	n	Length of abParameter in byte
`abParameter[4]`	uint8_t	m	Parameter value, byte array

Table 138: 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 139: 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 140: 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 141: 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	 0x00000001 0x00000002 0x00000003	Parameter HIL_LIST_CONF_SLAVES HIL_LIST_ACTV_SLAVES HIL_LIST_FAULTED_SLAVES

Table 142: 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) 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 0x00000002 0x00000003	Parameter HIL_LIST_CONF_SLAVES HIL_LIST_ACTV_SLAVES HIL_LIST_FAULTED_SLAVES
`aulHandle[1]`	uint32_t	0 … 0xFFFFFFFF	Slave Handle, Number of Handles is **n**

Table 143: 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 144: 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*) 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 (Refer to Fieldbus Documentation)

Table 145: 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 149) 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 146: 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 147: 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 148: 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 149: 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 147).

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	 0 10 100	Speed of the link No link 10MBit 100Mbit

Table 150: 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 151: 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 0x02 0x03	Action to perform HIL_BUSSCAN_CMD_START HIL_BUSSCAN_CMD_STATUS HIL_BUSSCAN_CMD_ABORT

Table 152: 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	 12 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` Otherwise
`ulSta`	uint32_t	See below	Status / Error Code, see Section 6
`ulCmd`	uint32_t	0x00002F23	HIL_BUSSCAN_CNF
Data			
`ulMaxProgress`	uint32_t		Maximum time (in milliseconds) application has to wait for scan to complete
`ulActProgress`	uint32_t		Already elapsed time (in milliseconds)
`abDeviceList[4]`	uint8_t		List of available devices on the fieldbus system

Table 153: 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 154: 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 0	Packet Data Length (in Bytes) If `ulSta` = `SUCCESS_HIL_OK` 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 155: 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 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 116) 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.

5.9.1 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 10 shows the sequence for the application during start-up phase.

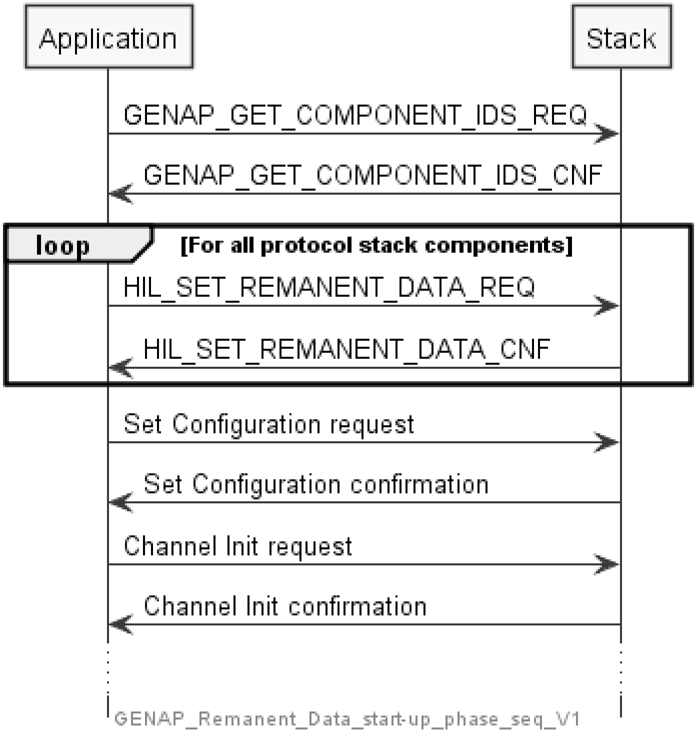

Application
Stack
GENAP_GET_COMPONENT_IDS_REQ
GENAP_GET_COMPONENT_IDS_CNF
loop
[For all protocol stack components]
HIL_SET_REMANENT_DATA_REQ
HIL_SET_REMANENT_DATA_CNF
Set Configuration request
Set Configuration confirmation
Channel Init request
Channel Init confirmation
GENAP_Remanent_Data_start-up_phase_seq_V1

Figure 10: Set Remanent Data (during configuration phase)

This service supports packet fragmentation (see section *Communication channel packet fragmentation* on page 118).

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) 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 156: 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 157: 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;
```

5.9.2 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) 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. For values, see file `Hil_ComponentID.h`
`abData[]`	uint8_t		The remanent data as byte array.

Table 158: 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 159: 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 Success, Status Okay
0xC0000001	ERR_HIL_FAIL Fail
0xC0000002	ERR_HIL_UNEXPECTED Unexpected
0xC0000003	ERR_HIL_OUTOFMEMORY Out Of Memory
0xC0000004	ERR_HIL_UNKNOWN_COMMAND Unknown Command
0xC0000005	ERR_HIL_UNKNOWN_DESTINATION Unknown Destination
0xC0000006	ERR_HIL_UNKNOWN_DESTINATION_ID Unknown Destination ID
0xC0000007	ERR_HIL_INVALID_PACKET_LEN Invalid Packet Length
0xC0000008	ERR_HIL_INVALID_EXTENSION Invalid Extension
0xC0000009	ERR_HIL_INVALID_PARAMETER Invalid Parameter
0xC000000C	ERR_HIL_WATCHDOG_TIMEOUT Watchdog Timeout
0xC000000D	ERR_HIL_INVALID_LIST_TYPE Invalid List Type
0xC000000E	ERR_HIL_UNKNOWN_HANDLE Unknown Handle
0xC000000F	ERR_HIL_PACKET_OUT_OF_SEQ Out Of Sequence
0xC0000010	ERR_HIL_PACKET_OUT_OF_MEMORY Out Of Memory
0xC0000011	ERR_HIL_QUE_PACKETDONE Queue Packet Done
0xC0000012	ERR_HIL_QUE_SENDPACKET Queue Send Packet
0xC0000013	ERR_HIL_POOL_PACKET_GET Pool Packet Get
0xC0000015	ERR_HIL_POOL_GET_LOAD Pool Get Load
0xC000001A	ERR_HIL_REQUEST_RUNNING Request Already Running
0xC0000100	ERR_HIL_INIT_FAULT Initialization Fault
0xC0000101	ERR_HIL_DATABASE_ACCESS_FAILED Database Access Failed
0xC0000119	ERR_HIL_NOT_CONFIGURED Not Configured

Value	Definition / Description
0xC0000120	ERR_HIL_CONFIGURATION_FAULT Configuration Fault
0xC0000121	ERR_HIL_INCONSISTENT_DATA_SET Inconsistent Data Set
0xC0000122	ERR_HIL_DATA_SET_MISMATCH Data Set Mismatch
0xC0000123	ERR_HIL_INSUFFICIENT_LICENSE Insufficient License
0xC0000124	ERR_HIL_PARAMETER_ERROR Parameter Error
0xC0000125	ERR_HIL_INVALID_NETWORK_ADDRESS Invalid Network Address
0xC0000126	ERR_HIL_NO_SECURITY_MEMORY No Security Memory
0xC0000140	ERR_HIL_NETWORK_FAULT Network Fault
0xC0000141	ERR_HIL_CONNECTION_CLOSED Connection Closed
0xC0000142	ERR_HIL_CONNECTION_TIMEOUT Connection Timeout
0xC0000143	ERR_HIL_LONELY_NETWORK Lonely Network
0xC0000144	ERR_HIL_DUPLICATE_NODE Duplicate Node
0xC0000145	ERR_HIL_CABLE_DISCONNECT Cable Disconnected
0xC0000180	ERR_HIL_BUS_OFF Network Node Bus Off
0xC0000181	ERR_HIL_CONFIG_LOCKED Configuration Locked
0xC0000182	ERR_HIL_APPLICATION_NOT_READY Application Not Ready
0xC0000204	ERR_HIL_INVALID_DATA_LENGTH 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 Failed to read from file/area
0xC0001154	ERR_HIL_WRITE Failed to write from file/area
0xC0001157	ERR_HIL_VERIFICATION Error during verification of firmware
0xC0001166	ERR_HIL_ERASE Failed to erase file/directory/flash
0xC0001167	ERR_HIL_OPEN Failed to open file/directory

Value	Definition / Description
0xC0001168	ERR_HIL_CLOSE Failed to close file/directory
0xC0001169	ERR_HIL_CREATE Failed to create file/directory
0xC0001170	ERR_HIL_MODIFY Failed to modify file/directory
0xC000DEAD	ERR_HIL_FIRMWARE_CRASHED The firmware has crashed and the exception handler is running
0xC002000C	ERR_HIL_TIMER_APPL_PACKET_SENT Timer App Packet Sent
0xC02B0001	ERR_HIL_QUE_UNKNOWN Unknown Queue
0xC02B0002	ERR_HIL_QUE_INDEX_UNKNOWN Unknown Queue Index
0xC02B0003	ERR_HIL_TASK_UNKNOWN Unknown Task
0xC02B0004	ERR_HIL_TASK_INDEX_UNKNOWN Unknown Task Index
0xC02B0005	ERR_HIL_TASK_HANDLE_INVALID Invalid Task Handle
0xC02B0006	ERR_HIL_TASK_INFO_IDX_UNKNOWN Unknown Index
0xC02B0007	ERR_HIL_FILE_XFR_TYPE_INVALID Invalid Transfer Type
0xC02B0008	ERR_HIL_FILE_REQUEST_INCORRECT Invalid File Request
0xC02B000E	ERR_HIL_TASK_INVALID Invalid Task
0xC02B001D	ERR_HIL_SEC_FAILED Security EEPROM Access Failed
0xC02B001E	ERR_HIL_EEPROM_DISABLED EEPROM Disabled
0xC02B001F	ERR_HIL_INVALID_EXT Invalid Extension
0xC02B0020	ERR_HIL_SIZE_OUT_OF_RANGE Block Size Out Of Range
0xC02B0021	ERR_HIL_INVALID_CHANNEL Invalid Channel
0xC02B0022	ERR_HIL_INVALID_FILE_LEN Invalid File Length
0xC02B0023	ERR_HIL_INVALID_CHAR_FOUND Invalid Character Found
0xC02B0024	ERR_HIL_PACKET_OUT_OF_SEQ Packet Out Of Sequence
0xC02B0025	ERR_HIL_SEC_NOT_ALLOWED Not Allowed In Current State
0xC02B0026	ERR_HIL_SEC_INVALID_ZONE Security EEPROM Invalid Zone
0xC02B0028	ERR_HIL_SEC_EEPROM_NOT_AVAIL Security EEPROM Not Available
0xC02B0029	ERR_HIL_SEC_INVALID_CHECKSUM Security EEPROM Invalid Checksum
0xC02B002A	ERR_HIL_SEC_ZONE_NOT_WRITEABLE Security EEPROM Zone Not Writeable

Value	Definition / Description
0xC02B002B	ERR_HIL_SEC_READ_FAILED Security EEPROM Read Failed
0xC02B002C	ERR_HIL_SEC_WRITE_FAILED Security EEPROM Write Failed
0xC02B002D	ERR_HIL_SEC_ACCESS_DENIED Security EEPROM Access Denied
0xC02B002E	ERR_HIL_SEC_EEPROM_EMULATED Security EEPROM Emulated
0xC02B0038	ERR_HIL_INVALID_BLOCK Invalid Block
0xC02B0039	ERR_HIL_INVALID_STRUCT_NUMBER Invalid Structure Number
0xC02B4352	ERR_HIL_INVALID_CHECKSUM Invalid Checksum
0xC02B4B54	ERR_HIL_CONFIG_LOCKED Configuration Locked
0xC02B4D52	ERR_HIL_SEC_ZONE_NOT_READABLE Security EEPROM Zone Not Readable

Table 160: Status and error codes

7 Appendix

7.1 List of figures

7.2 List of tables

7.3 Legal notes

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