acontis technologies GmbH

SOFTWARE

EC-Monitor

User's Manual

Version 3.1

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Contents

1 Introduction

1.1 What is EtherCAT?

EtherCAT is an IEEE802.3 Ethernet based fieldbus system.

EtherCAT defines a new standard in communication speed and is due to its flexible topology and simple configuration to handle like a conventional Fieldbus. The implementation of EtherCAT is inexpensive to implement which allows the system to use fieldbus technology in applications which had to ommit fieldbus use in the past. EtherCAT is an open technology which is standardized within the IEC (International Electrotechnical Commission). The system itself is supported and powered by the EtherCAT Technology Group, which is an international community of users and vendors where more than 3100 members already joined including acontis technologies GmbH.

Fieldbusses are proved and established in automation and most applications depend on them. The use of PC based control systems in a reasonable way was only made possible by the introduction of fieldbus technology. Since the control CPU's speed is increasing rapidly (especially with IPC's), the conventional fieldbus systems are moreover become the bottle neck and limit the reachable performance of the control systems. Additionaly the control topology becomes multi layered with some subsided cyclic systems: the control task himself, the fieldbus system and propably some local extension busses in the I/O system or simply the local firmware cycle in the peripheral device.

Because of this latency times are generated which are typically a multiple of 3 or 5 of the control cycle time, which is not a satisfying solution in most applications. On top of the fieldbus systems, to interconnect control systems, ethernet is state of the art for a long time. The use of Ethernet to control drives or I/O systems is pretty new and was reserved for the conventional fieldbus systems in the past. In this focus the propability to carry small data, hard real time possibilities and of course low costs are the primary requirements. EtherCAT fulfills those requirements and brings internet technologies to the level of I/O communication.

1.2 What is a EtherCAT protocol?

The EtherCAT protocol is optimized for process data transfer and is transported directly within the Ethernet frame thanks to a special Ethertype. It may consist of several EtherCAT telegrams, each serving a particular memory area of the logical process image which can address up to 4 gigabytes in size. The data sequence is independent of the physical order of the Ethernet terminals in the network; addressing can be in any order. Broadcast, Multicast and communication between slaves are possible. Direct Ethernet frame transfer is used in cases where maximum performance is required and the EtherCAT components are operated in the same subnet as the controller.

However, EtherCAT applications are not limited to a single subnet: EtherCAT UDP packages the EtherCAT protocol into UDP/IP datagrams. This enables any control with Ethernet protocol stack to address EtherCAT systems. Even communication across routers into other subnets is possible. In this variant, system performance obviously depends on the real-time characteristics of the control and its Ethernet protocol implementation. The response times of the EtherCAT network itself are hardly restricted at all: the UDP datagram only has to be unpacked in the first station.

In addition to data exchange according to the master/slave principle, EtherCAT is also very suitable for communication between controllers (master/master). Freely addressable network variables for process data and a variety of services for parameterization, diagnosis, programming and remote control cover a wide range of requirements. The data interfaces for master/slave and master/master communication are identical. For slave to slave communication, two mechanisms are available. Upstream devices can communicate to downstream devices within the same cycle and thus extremely fast. Since this method is topology dependent, it is particularly suitable for slave to slave communication relationships given by machine design - e.g. in printing or packaging applications. For freely configurable slave to slave communication, the second mechanism applies: the data is relayed by the master. Here two cycles are needed, but due to the extraordinary performance of EtherCAT this is still faster than any other approach.

EtherCAT only uses standard frames according to IEEE802.3 - the frames are not shortened. EtherCAT frames can thus be sent from any Ethernet MAC, and standard tools (e.g. monitor) can be used.

1.3 The EC-Monitor - Features

1.4 Protected version

The EC-Monitor software can be delivered in 3 different versions:

- Protected: Binary with MAC protection
- SDK: Binary without MAC protection
- Source: Source code

The protected version will automatically stop after about 10 minutes of continuous operation. In order to remove this restriction a valid runtime license key is required. The runtime license protection is based on the MAC address of the Ethernet controller used for the EtherCAT protocol. With a valid License Key the protected version will automatically become an unrestricted version.

See also:

emSetLicenseKey()

1.4.1 Licensing procedure for Development Licenses

1. Installation of EC-Monitor protected version
2. Determine the MAC Address by calling `emGetSrcMacAddress()` or from a sticker applied on the hardware near the Ethernet controller
3. Send an Email with the subject "Development License Key Request" with the MAC address to sales@acontis.com
4. **Acontis will create the license keys and return them in a License Key Text File (CSV format).**

```
Number;MAC Address;License Key
1;00-00-5A-11-77-FE;DA1099F2-15C249E9-54327FBC
2;64-31-50-80-20-4E;1B7C1F86-D08E40A8-4F96F2BA
```

5. **Activate the License Key by calling *emSetLicenseKey()* with the license key that corresponds to the MAC address on the hardware and check the return code. The license key is 26 characters long.**

```
dwRes = emSetLicenseKey(0, "DA1099F2-15C249E9-54327FBC");
```

1.4.2 Licensing procedure for Runtime Licenses

1. Installation of EC-Monitor protected version
2. Determine the MAC Address by calling `emGetSrcMacAddress()` or from a sticker applied on the hardware near the Ethernet controller
3. **Provide the MAC Addresses and numbers from previously ordered and unused runtime license stickers in a text file to acontis as described in the example below. Please use a separate line for each runtime license sticker number and MAC Address.**

```
S/N; MAC Address
100-105-1-1/1603310001;00-00-5A-11-77-FE
100-105-1-1/1603310002;64-31-50-80-20-4E
```

4. Send an Email with the subject “Runtime License Key Request” with the MAC address to sales@acontis.com
5. **Acontis will create the license keys and return them in a License Key Text File.**

```
Number;MAC Address;License Key
1;00-00-5A-11-77-FE;DA1099F2-15C249E9-54327FBC
2;64-31-50-80-20-4E;1B7C1F86-D08E40A8-4F96F2BA
```

6. **Activate the License Key by calling *emSetLicenseKey()* with the license key that corresponds to the MAC address on the hardware and check the return code.**

```
dwRes = emSetLicenseKey(0, "DA1099F2-15C249E9-54327FBC");
```

1.5 License

1.5.1 EC-Monitor license

According to EC-Monitor Software License Agreement (SLA).

1.5.2 Free Open Source Software contained in EC-Monitor

Expat XML parser license

```
Copyright (c) 1998, 1999, 2000 Thai Open Source Software Center Ltd
and Clark Cooper
Copyright (c) 2001, 2002, 2003, 2004, 2005, 2006 Expat maintainers.

Permission is hereby granted, free of charge, to any person obtaining
a copy of this software and associated documentation files (the
"Software"), to deal in the Software without restriction, including
without limitation the rights to use, copy, modify, merge, publish,
distribute, sublicense, and/or sell copies of the Software, and to
permit persons to whom the Software is furnished to do so, subject to
the following conditions:

The above copyright notice and this permission notice shall be included
in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND,
EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF
MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT.
IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY
CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT,
TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE
SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
```

1.5.3 Free Open Source Software supported by EC-Monitor

The following components are not part of EC-Monitor, but relate to it:

acontis atemsys Linux kernel module

The acontis atemsys is licensed under the GPL:

```
Copyright (c) 2009 - 2020 acontis technologies GmbH, Ravensburg, Germany
All rights reserved.

This program is free software; you can redistribute  it and/or modify it
under  the terms of  the GNU General  Public License as published by the
Free Software Foundation;  either version 2 of the  License, or (at your
option) any later version.
```

WinPCap

The WinPCap library is supported, but not shipped with the EC-Monitor.

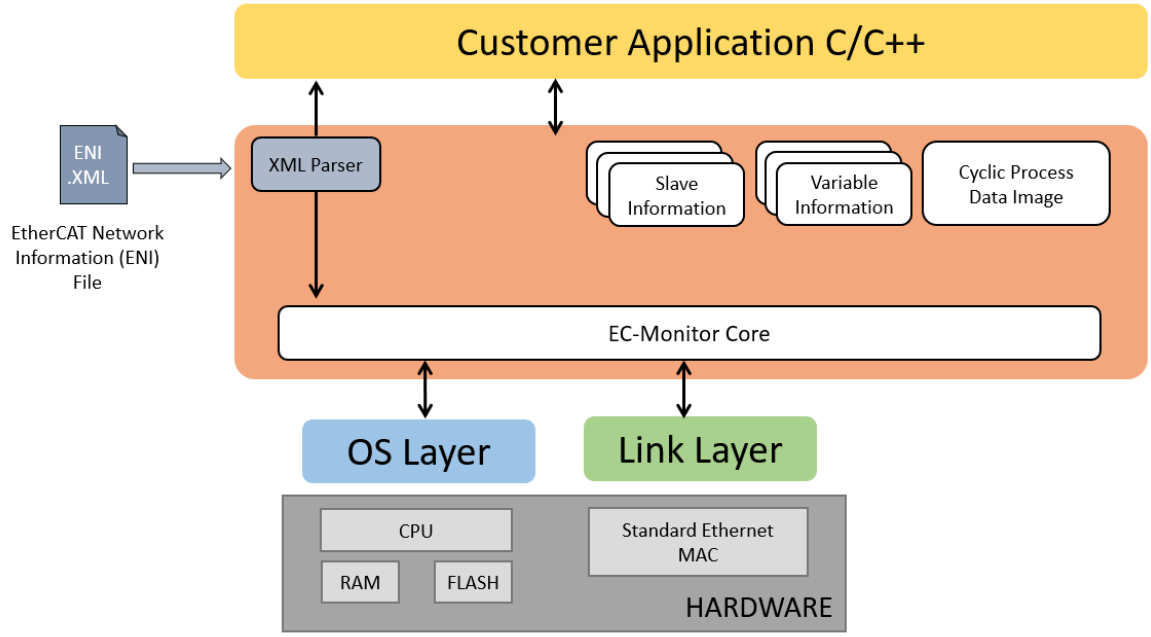
Npcap

The Npcap library is supported, but not shipped with the EC-Monitor.

2 Architecture

The EC-Monitor is implemented in C++ and can be easily ported to any embedded OS platforms using an appropriate C++ compiler. The API interfaces are C language interfaces, thus the EC-Monitor can be used in ANSI-C as well as in C++ environments.

The EC-Monitor is divided into modules, see diagram and descriptions below:



EC-Monitor Core:
In the core module cyclic (process data update) and acyclic (mailbox) EtherCAT commands are received and processed.

Configuration Layer:
The EC-Monitor is configured using a XML file whose format is fixed in the EtherCAT specification ETG.2100. EC-Monitor contains an OS independent XML parser.

Ethernet Link Layer:
This layer receives Ethernet frames from the TAP devices.

OS Layer:
All OS dependent system calls are encapsulated in a small OS layer. Most functions are that easy that they can be implemented using simple C macros.

2.1 EtherCAT Network Configuration (ENI)

The EC-Monitor has to know about the EtherCAT bus topology and the cyclic/acyclic frames which are exchanged by the third party EtherCAT master with the slaves. This configuration is determined in a configuration file which has to be available in the EtherCAT Network Information Format (ENI). This format is completely independent from EtherCAT slave vendors, from EtherCAT master vendors and from EtherCAT configuration tools. Thus interoperability between those vendors is guaranteed.

2.2 Operating system configuration

The main task is to setup the operating system to support the appropriate network adapter for EtherCAT usage and for some systems real-time configuration may be needed.

The operating system-specific settings and configurations are described in *Operating Systems (OS)*.

3 Getting Started

To enable a quick and easy start, every EC-Monitor package comes with a pre-compiled EcMonitorDemo executable. This example application handles the following tasks:

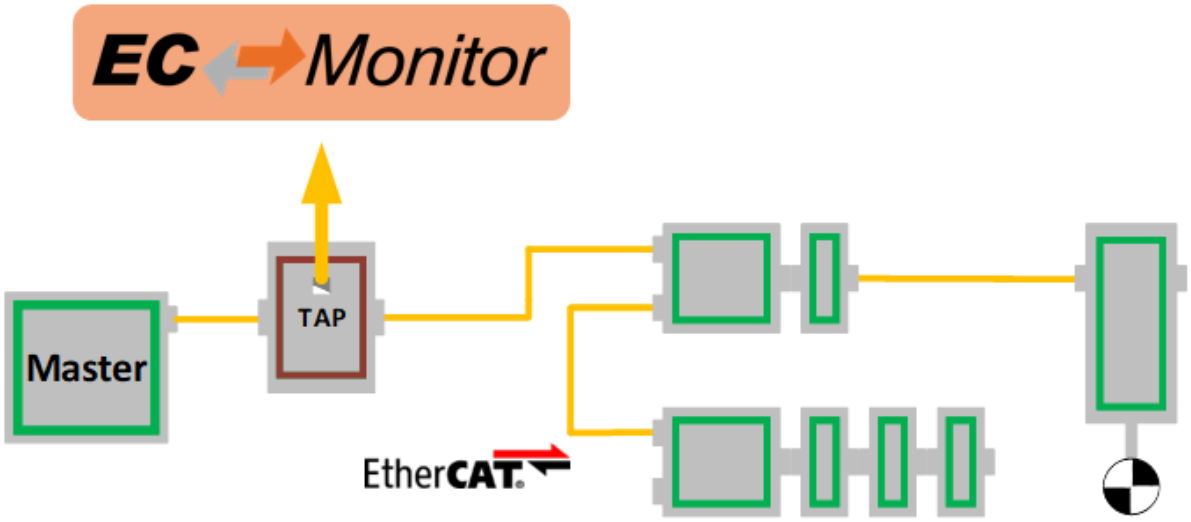
- Showing basic EtherCAT communication
- EC-Monitor initialization
- Process Data acquisition with EC-DAQ
- Periodic diagnosis task
- Periodic Job Task in polling mode
- Logging

See also:

- *Application framework and example application* for detailed explanation

3.1 Running EcMonitorDemo

To capture the EtherCAT traffic insert a TAP device after the Master Controller.



Start the EcMonitorDemo from the command line to process the captured EtherCAT frames. At least a Link Layer and a ENI file must be specified.

```
> EcMonitorDemo -winpcap 192.168.157.2 1 -f MasterENI.xml -t 0 -v 3
```

See also:

Operating Systems (OS) for OS specific additional instructions to run the demo application

3.1.1 Command line parameters

EcMonitorDemo <Link Layer> [-f configFileName] [-t time] [-b time] [-v level] [-a affinity] [-perf] [-auxclk period] [-sp [port] [-log prefix]

The parameters are as follows:

-f <configFileName>
Path to ENI file.

-t <time>
Running duration in msec. When the time expires the demo application exits completely.

<time>
Time in msec, 0 = forever (default = 120000)

-b <cycle time>
Specifies the bus cycle time. Defaults to 1000µs (1ms).

<cycle time>
Bus cycle time in µsec

-v <level>
The verbosity level specifies how much console output messages will be generated by the demo application. A high verbosity level leads to more messages.

<level>
Verbosity level: 0=off (default), 1..n=more messages

-a <affinity>
The CPU affinity specifies which CPU the demo application ought to use.

<affinity>
0 = first CPU, 1 = second, …

-perf
Enable max. and average time measurement in µs for all EtherCAT jobs (e.g. ProcessAllRxFrames).

-sp [port]
If platform has support for IP Sockets, this command line option enables the Remote API Server to be started with the EcMonitorDemo. The Remote API Server is going to listen on TCP Port 6000 (or port parameter if given) and is available for connecting Remote API Clients. This option is included for attaching the EC-Inspector Application to the running monitor.

-log prefix
Use given file name prefix for log files.

Link Layer

Using one of the following demo application Link Layer options, the EC-Monitor will dynamically load the network driver for the specified network adapter card and use the appropriate network driver to access the Ethernet adapter for EtherCAT. ShowSyntaxLinkLayer in `Examples/Common/EcSelectLinkLayer.cpp` is called automatically if the Demo application is started without parameters and lists the possibilities as follows:

-ndis <ipAddress> <mode>

Hardware: Independent, only available for Windows.

<IpAddress>
IP address of network adapter card, e.g. 192.168.157.2

<mode>
0 = Interrupt mode | 1 = Polling mode

-winpcap <ipAddress> <mode>

Hardware: Independent, only available for Windows.

<ipAddress>
IP address of network adapter card, e.g. 192.168.157.2

<mode>
0 = Interrupt mode | 1 = Polling mode

3.2 Compiling the EcMonitorDemo

The following main rules can be used to generate the example applications for all operating systems.

- `<OS>` is a placeholder for the operating system used.
- `<ARCH>` for the architecture. If different architectures are supported.

3.2.1 Software Development Kit (SDK)

The EC-Monitor development kit is needed to write applications based on the EC-Monitor core. The EC-Monitor core is shipped as a library which is linked together with the application.

The following components are supplied together with an SDK:

- `/Bin`: Executables containing the EC-Monitor core
- `/Doc`: Documentation
- `/Examples`: Example applications as source code
- `/SDK`: EtherCAT Software Development Kit containing libraries and header files to build C/C++-applications
- `/SDK/INC`: Header files to be included with the application
- `/SDK/LIB`: Libraries to be linked with the application
- `/SDK/FILES`: Additional files for platform integration
- `/Sources/Common`: Shared source code

3.2.2 Include search path

The header files are located in the following directories:

```
<InstallPath>/SDK/INC/<OS>/<ARCH>
<InstallPath>/SDK/INC
<InstallPath>/Sources/Common
```

3.2.3 Libraries

The libraries that need to be added are in the following directories:

```
<InstallPath>/SDK/LIB/<OS>/<ARCH>
```

3.2.4 Preprocessor definitions

The following preprocessor directives must be set in the build environment or project:

```
EC_MONITOR
```

Exclude the EC-DAQ support in the demo:

```
EXCLUDE_DAQ_SUPPORT
```

4 Software Integration

For the integration of the EC-Monitor, the EcMonitorDemo can be seen as an application framework, serve as a template and be expanded accordingly.

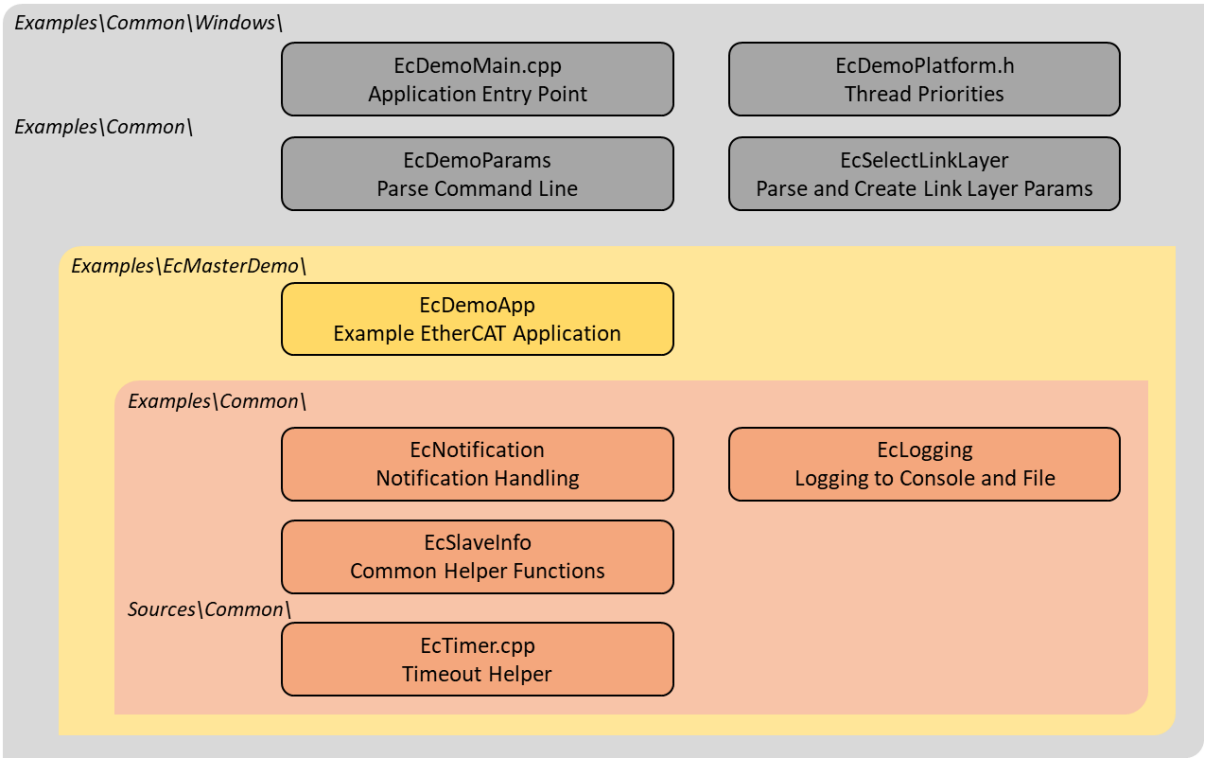
4.1 Application framework and example application

The example application will handle the following tasks:

- EC-Monitor initialization
- Process Data acquisition with EC-DAQ
- Periodic diagnosis task
- Periodic Job Task in polling mode
- Thread with periodic tasks and application thread already implemented
- Logging. The output messages of the demo application will be printed on the console as well as in some files.
- “Out of the box” solution for different operating systems: Windows, Linux …

4.1.1 File reference

The EcMonitorDemo application consists of the following files:



EcDemoMain.cpp	Entrypoint for the different operating systems
EcDemoPlatform.h	Operating system specific settings (task priorities, timer settings)
EcDemoApp.cpp	Initialize, start and terminate EC-Monitor
EcDemoApp.h	Application specific settings for EcDemoApp
EcDemoParms.cpp	Parsing of command line parameters
EcDemoParms.h	Basic configuration parameters
EcSelectLinkLayer.cpp	Common Functions which abstract the command line parsing into Link Layer parameters
EcNotification.cpp	Slave monitoring and error detection (function `emNotify()`)
EcSlaveInfo.cpp	Slave information services
EcLogging.cpp	Message logging functions
EcTimer.cpp	Start and monitor timeouts

4.1.2 EC-Monitor lifecycle

Basically the operation of the EC-Monitor is wrapped between the functions

- *emInitMonitor()*
- *emConfigureNetwork()*

and

- *emDeinitMonitor()*

4.2 EC-Monitor Source Code

In a source code delivery the EC-Monitor sources are divided into 4 parts:

- SDK Header files
- Link layer files (multiple Link Layers may be shipped)
- Link OS layer files (only valid for the Link Layers)
- EC-Monitor files (configuration, core and interface layer)
- OS layer files

The EC-Monitor can be ported to several different operating systems and CPU architectures with different compilers and development environments. Typically no supported build environment files like IDE projects are shipped with the source code.

To build the EC-Monitor the appropriate build environment for the target operating system has to be used. If an integrated development environment (IDE) exists (Visual Studio, Eclipse, etc.) several projects containing all necessary files are needed to build the artefacts. If no integrated development environment is available makefiles and dependency rules may have to be created which contain the necessary EC-Monitor source and header files.

For most platforms three separate independent binaries will have to be generated:

1. Link Layer Binary. The Link Layer binary will be dynamically bound to the application at runtime.
2. EC-Monitor Library
3. Remote API Server Library

4.2.1 Link Layer Binaries

The following files have to be included into an IDE project or makefile:

- Link layer files. Only one single Link Layer must be selected even if multiple Link Layers are shipped. For each Link Layer a separate binary has to be created.
- Link OS layer files
- Windows: a dynamic link library (.dll) has to be created. The name of the DLL has to be emllXxxx.dll where Xxxx shall be replaced by the Link Layer type (e.g. emllI8255x.dll for the I8255x Link Layer).

4.2.2 EC-Monitor Binaries

The following files have to be included into an IDE project or makefile:

- EC-Monitor files
- OS layer files
- For all platforms a static library has to be created. This library will have to be linked together with the application.

4.2.3 Remote API Server Binaries:

The following files have to be included into an IDE project or makefile:

- Remote API server files.
- For all platforms a static library has to be created. This library will have to be linked together with the application.

See also:

Operating Systems (OS) for required tool chain settings

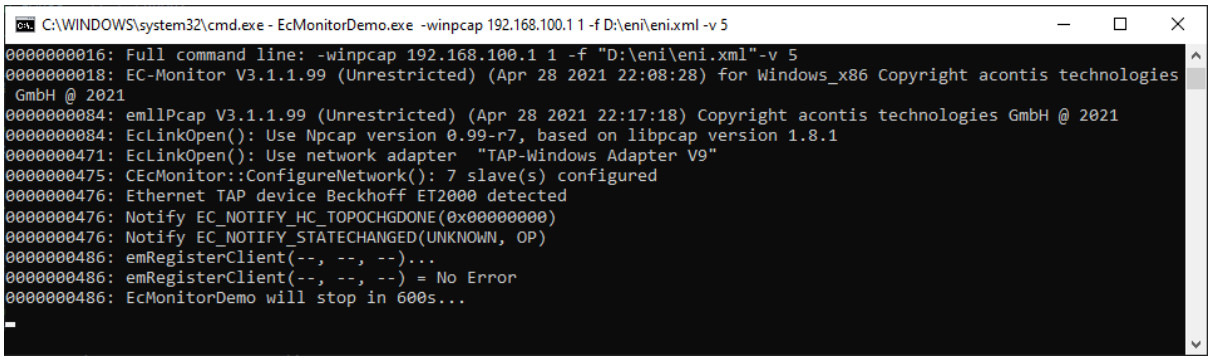
5 Operating Systems (OS)

5.1 Microsoft Windows

5.1.1 EcMonitorDemo

1. **Install EC-Monitor**
   Run `setup.exe` from EC-Monitor package, which will guide you through the installation process.
2. **Determine the network interface**
   For example the option *-winpcap 192.168.1.1 1* will be using the network adapter card with the IP address 192.168.1.1.
3. Insert a TAP device after the Master Controller to capture the EtherCAT traffic and start the EtherCAT master
4. **Run the example application**
   Execute `<InstallPath>/Bin/Windows/<Arch>/EcMonitorDemo.exe`. At least a Link Layer option has to be given.

   ```
   C:
   > EcMonitorDemo -winpcap 192.168.100.1 1 -f eni.xml
   ```



See also:

Running EcMonitorDemo for a detailed description of the demo application.

5.1.2 OS Compiler settings

Besides the general settings from *Compiling the EcMonitorDemo* the following settings are necessary to build the example application for Windows:

Library path:

- `<InstallPath>/SDK/LIB/Windows/<Arch>`

Include path:

- `<InstallPath>/SDK/INC/Windows`

6 Link Layer

6.1 Link Layer selection

The EC-Monitor currently supports a variety of different Link Layer modules, each of which contained in a single library file, which is loaded by the core library dynamically. The EC-Monitor shipment consist of a core library and one (or more) libraries each containing support for one specific Link Layer module (type of hardware card). Which library actually is loaded, is depending on the Link Layer parameters at runtime.

The principle of Link Layer selection is that the name of the Link Layer (Link Layer Identification) is used to determine the location and name of a registration function, which is called by the EC-Monitor and registers function pointers which allow access to the Link Layer functional entries.

The EtherCAT Link Layer will be initialized using a Link Layer specific configuration parameter set. A pointer to this parameter set is part of the EC-Monitor initialization settings.

The EC-Monitor supports two Link Layer operating modes. If the Link Layer operates in interrupt mode all received Ethernet frames will be processed immediately in the context of the Link Layer receiver task. When using the polling mode the EC-Monitor will call the Link Layer receiver polling function prior to processing received frames.

6.1.1 Optimized Link Layer drivers

Optimized means operating directly on the network device's register set instead of using the operating system's native driver.

Note: Link Layer modules not listed here may be available if purchased additionally

6.1.2 Link Layer selection and initialization

The different Link Layer modules are selected and parameterized by a common structure *EC_T_LINK_PARMS* shared by all Link Layers and a Link Layer specific structure, pointed to by an element within the common structure. This parameter set is given to `EC_T_INIT_MONITOR_PARMS::pLinkParms` with the call of *emInitMonitor()*.

struct **EC_T_LINK_PARMS**

Public Members

EC_T_DWORD **dwSignature**
[in] Signature of the adapter specific structure containing the *EC_T_LINK_PARMS* structure

EC_T_DWORD **dwSize**
[in] Size of the adapter specific structure containing the *EC_T_LINK_PARMS* structure

EC_T_LOG_PARMS **LogParms**
[in] Logging parameters

EC_T_CHAR **szDriverIdent**[EC_DRIVER_IDENT_NAMESIZE]
[in] Name of Link Layer module (driver identification) for Link Layer Selection

EC_T_DWORD **dwInstance**
[in] Instance of the adapter. if EC_LINKUNIT_PCILOCATION is set: contains PCI address

EC_T_LINKMODE **eLinkMode**
[in] Mode of operation

EC_T_CPUSET **cpuIstCpuAffinityMask**
[in] Interrupt service thread CPU affinity mask

EC_T_DWORD **dwIstPriority**
[in] Task priority of the interrupt service task (not used in polling mode)

struct **EC_T_LINK_TTS**

Public Members

EC_T_BOOL **bEnabled**
[in] Use Time-Triggered Send

EC_T_DWORD **dwCycleTimeUsec**
[in] Cycle time between 2 pfnStartCycle calls

EC_T_DWORD **dwSendOffsetUsec**
[in] Time between pfnStartCycle call and frame transmition

EC_T_LINK_TTS_CALLBACK **pfnStartCycle**
[in] Callback function called cyclically according dwCycleTimeUsec

EC_T_VOID ***pvStartCycleContext**
[in] Context passed to each pfnTtsStartCycle call

6.1.3 Link Layer instance selection via PCI-Location

For some operating systems it is possible to address the Link Layer instance using its PCI address as an alternative. To do this, EC_LINKUNIT_PCILOCATION (0x01000000) and the PCI location must be set as *EC_T_LINK_PARMS::dwInstance*.

On Linux the PCI address can be shown using e.g.:

```
$ lspci | grep Ethernet
```

```
$ 00:19.0 Ethernet controller: Intel Corporation Ethernet Connection I217-LM (rev 04)
$ 04:00.0 Ethernet controller: Intel Corporation 82574L Gigabit Network Connection
$ 05:00.0 Ethernet controller: Intel Corporation 82574L Gigabit Network Connection
```

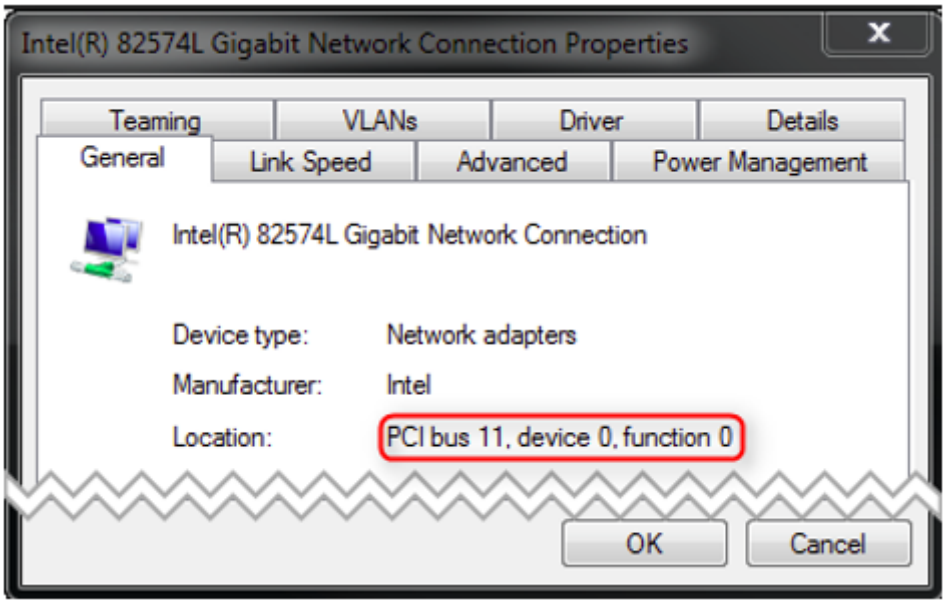
The format of *EC_T_LINK_PARMS::dwInstance* using PCI bus address is:

0x01bbddff

- *bb* Bus Number
- *dd* Device Number
- *ff* Function Number

```
EC_T_LINK_PARMS::dwInstance = 0x01001900; //"0000:00:19.0"
```

On Windows the integer value displayed in properties dialog must be converted to HEX. E.g the number from the following dialog *(PCI bus 11, device 0, function 0)* corresponds to *0x010B0000* (bus *0x0B*).



6.2 Windows NDIS - emllNdis

As default EC-Monitor for Windows contains emllNdis.dll to use a native Windows driver for EtherCAT.

The acontis ECAT Protocol Driver is needed to use the NDIS Link Layer and can be installed from

- `Bin/Windows/x64/EcatNdisSetup-x86_64Bit.msi` or
- `Bin/Windows/x86/EcatNdisSetup-x86_32Bit.msi`

respectively depend on the Windows Operating System Type of 64 Bit or 32 Bit.

IPv4 must be installed for the network adapter as the NDIS Link Layer uses the IP address to identify the network adapter.

The parameters to the NDIS Link Layer are setup-specific. The function “CreateLinkParmsFromCmdLineNDIS” in `EcSelectLinkLayer.cpp` demonstrates how to initialize the Link Layer instance.

struct **`EC_T_LINK_PARMS_NDIS`**

Public Members

EC_T_LINK_PARMS **`linkParms`**
Common link parameters. Signature must be set to EC_LINK_PARMS_SIGNATURE_NDIS

EC_T_CHAR **`szAdapterName`**[EC_NDIS_ADAPTER_NAME_SIZE]
ServiceName of network adapter, see HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\NetworkCards in registry (zero terminated)

EC_T_BYTE **`abyIpAddress`**[4]
IP address of network adapter

6.3 Windows WinPcap - emllpcap

A Link Layer based on the WinPcap library is shipped with the EC-Monitor. This Link Layer is implemented using a network filter driver that enables the software to send and receive raw Ethernet frames. Using this Link Layer any Windows standard network drivers can be used. The Windows network adapter card has to be assigned a unique IP address (private IP address range). This IP address is used by the EtherCAT WinPcap Link Layer driver to select the appropriate adapter.

It is recommended to use a separate network adapter to connect EtherCAT devices. If the main network adapter is used for both EtherCAT devices and the local area network there may be a main impact on the local area network operation. The network adapter card used by EtherCAT has to be set to a fixed private IP address, e.g. 192.168.x.y.

The parameters to the WinPcap Link Layer are setup-specific. The function “CreateLinkParmsFromCmdLineWinPcap” in `EcSelectLinkLayer.cpp` demonstrates how to initialize the Link Layer instance.

struct **EC_T_LINK_PARMS_WINPCAP**

Public Members

EC_T_LINK_PARMS **linkParms**
Common link parameters. Signature must be set to EC_LINK_PARMS_SIGNATURE_WINPCAP

EC_T_BYTE **abyIpAddress**[4]
IP address

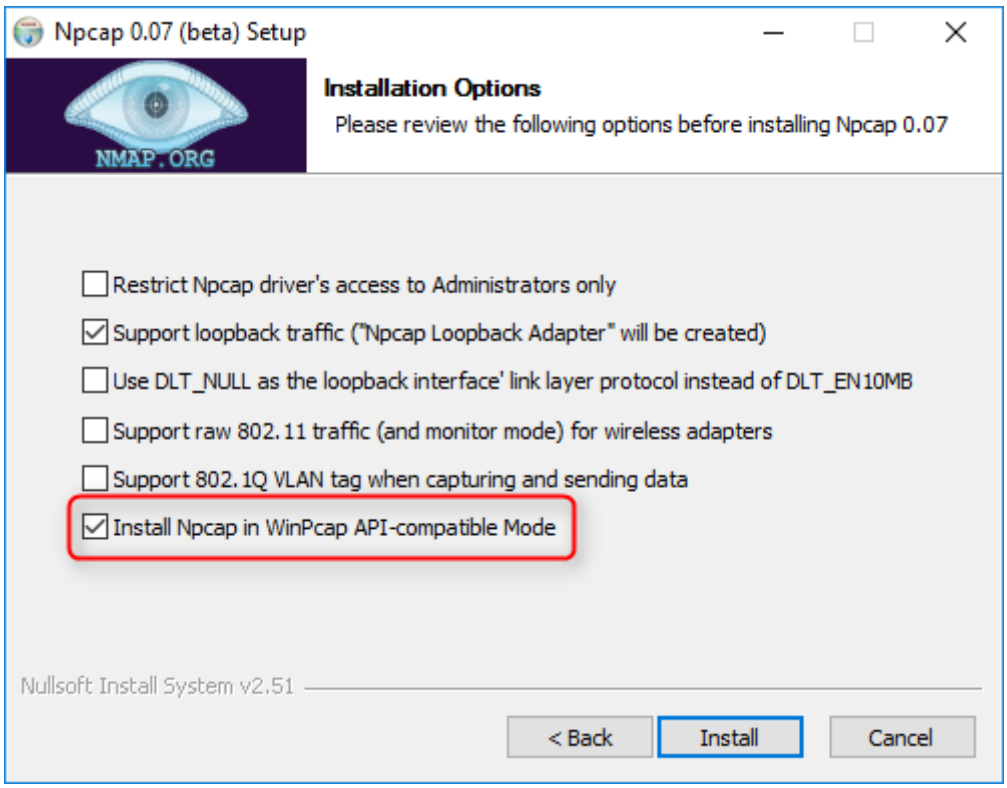
EC_T_CHAR **szAdapterId**[MAX_LEN_WINPCAP_ADAPTER_ID]
Adapter ID, format: {XXXXXXXX-XXXX-XXXX-XXXX-XXXXXXXXXXXX}

EC_T_BOOL **bFilterInput**
Filter input if EC_TRUE. This is needed on some system if the winpcap library notify the sent frames to the network adapter

6.3.1 WinPcap, Npcap support

At least WinPcap version 4.1.2 or Npcap 0.07 r17 must be used. WinPcap version 4.1.2 is the preferred library.

If using Npcap 0.07 r17, the WinPcap API-compatible mode must be chosen:


Npcap 0.07 (beta) Setup
NMAP.ORG
Installation Options
Please review the following options before installing Npcap 0.07
Restrict Npcap driver's access to Administrators only
Support loopback traffic ("Npcap Loopback Adapter" will be created)
Use DLT_NULL as the loopback interface' link layer protocol instead of DLT_EN10MB
Support raw 802.11 traffic (and monitor mode) for wireless adapters
Support 802.1Q VLAN tag when capturing and sending data
Install Npcap in WinPcap API-compatible Mode
Nullsoft Install System v2.51
< Back
Install
Cancel

7 Application programming interface, reference

Function prototypes, definitions etc. of the API can be found in the header file `EcMonitor.h` which is the main header file to include when using EC-Monitor.

Fundamental types

typedef void ***EC_T_PVOID**
Pointer of type void

typedef int **EC_T_BOOL**
Boolean

typedef char **EC_T_CHAR**
Character, 8 bit

typedef unsigned short **EC_T_WCHAR**
Wide-character, 16 bit

typedef unsigned char **EC_T_BYTE**
Byte, unsigned integer 8 bit

typedef unsigned char ***EC_T_PBYTE**
Pointer of type EC_T_BYTE

typedef unsigned short **EC_T_WORD**
Word, unsigned integer 16 bit

typedef unsigned int **EC_T_DWORD**
Double word, unsigned integer 32 bit

typedef signed char **EC_T_SBYTE**
Signed-Byte, signed integer 8 bit

typedef signed short **EC_T_SWORD**
Signed-Word, signed integer 16 bit

typedef signed int **EC_T_SDWORD**
Signed-Double-Word, signed integer 32 bit

typedef int **EC_T_INT**
Integer

typedef unsigned int **EC_T_UINT**
Unsigned-Integer

typedef short **EC_T_SHORT**
Short

typedef unsigned short **EC_T_USHORT**
Unsigned-Short

typedef double **EC_T_REAL**
Real, floating point

typedef unsigned long long **EC_T_UINT64**
Unsigned integer 64 bits

typedef signed long long **EC_T_INT64**
Signed integer 64 bits

EC_T_VOID
Void type

7.1 General functions

7.1.1 emInitMonitor

EC_T_DWORD **emInitMonitor** (
EC_T_DWORD dwInstanceId,
EC_T_MONITOR_INIT_PARMS *pParms
)
Initialize EC-Monitor.

Parameters

- **dwInstanceId** – [in] Instance ID
- **pParms** – [in] Monitor init parameter

Returns
EC_E_NOERROR or error code

struct **EC_T_MONITOR_INIT_PARMS**

Public Members

EC_T_DWORD **dwSignature**
[in] Set to MONITOR_SIGNATURE

EC_T_DWORD **dwSize**
[in] Set to sizeof(EC_T_MONITOR_INIT_PARMS)

EC_T_LOG_PARMS **LogParms**
[in] Logging parameters

EC_T_OS_PARMS ***pOsParms**
[in] Operation system layer parameters

EC_T_LINK_PARMS ***pLinkParms**
[in] Link layer parameters

EC_T_ETHERNET_TAP_TYPE **eEthTapType**
[in] Type of Ethernet TAP

EC_T_DWORD **dwBusCycleTimeUsec**
[in] Bus cycle time [usec]

EC_T_DWORD **dwMaxBusSlaves**
[in] Maximum pre-allocated bus slave objects

EC_T_DWORD **dwBacktraceFrames**
[in] Number of frames held in backtrace buffer. Total memory requirements of the buffer: $2 \times dwBacktraceFrames \times 1536bytes$

EC_T_PERF_MEAS_INTERNAL_PARMS **PerfMeasInternalParms**
[in] Internal performance measurement parameters

EC_T_WORKER_THREAD_PARMS **WorkerThreadParms**
[in] Internal worker thread parameters

enum **EC_T_ETHERNET_TAP_TYPE**
Values:

enumerator **eEthTap_Unknown**
Unknown type

enumerator **eEthTap_AutoDetect**
Auto detect TAP type. If no suitable type is detected, eEthTap_Generic is used

enumerator **eEthTap_Generic**
Generic Ethernet switch

enumerator **eEthTap_Beckhoff_ET2000**
Beckhoff ET2000 Ethernet probe

enumerator **eEthTap_Kunbus_TapCurious**
Kunbus TAP Curious Ethernet probe

enumerator **eEthTap_Dummy**

struct **EC_T_OS_PARMS**

Public Members

EC_T_DWORD **dwSignature**
[in] Set to EC_OS_PARMS_SIGNATURE

EC_T_DWORD **dwSize**
[in] Set to sizeof(EC_T_OS_PARMS)

struct _EC_T_LOG_PARMS ***pLogParms**
[in] Pointer to logging parameters

EC_PF_SYSTIME **pfSystemTimeGet**
[in] Function to get host time in nanoseconds since 1st January 2000. Used as time base for DC Initialization.

EC_T_DWORD **dwSupportedFeatures**
[in/out] reserved

EC_PF_QUERY_MSEC_COUNT **pfSystemQueryMsecCount**
[in] Function to get system's msec count

EC_PF_HW_TIMER_GET_INPUT_FREQUENCY **pfHwTimerGetInputFrequency**
[in] Function to get input frequency of HW timer. This function is needed by some DCM modes described in the Class A manual

EC_PF_HW_TIMER_MODIFY_INITIAL_COUNT **pfHwTimerModifyInitialCount**
[in] Function to modify initial count of HW timer. This function is needed by some DCM modes described in the Class A manual

EC_PF_HW_TIMER_GET_CURRENT_COUNT **pfHwTimerGetCurrentCount**
[in] Function to get current count of HW timer. This function is needed by some DCM modes described in the Class A manual

struct **EC_T_LOG_PARMS**

Public Members

EC_T_DWORD **dwLogLevel**
[in] Log level. See EC_LOG_LEVEL_…

EC_PF_LOGMSGHK **pfLogMsg**
[in] Log callback function called on every message

struct _EC_T_LOG_CONTEXT ***pLogContext**
[in] Log context to be passed to log callback

EC_LOG_LEVEL… The following log levels are defined:

EC_LOG_LEVEL_SILENT

EC_LOG_LEVEL_ANY

EC_LOG_LEVEL_CRITICAL

EC_LOG_LEVEL_ERROR

EC_LOG_LEVEL_WARNING

EC_LOG_LEVEL_INFO

EC_LOG_LEVEL_INFO_API

EC_LOG_LEVEL_VERBOSE

EC_LOG_LEVEL_VERBOSE_ACYC

EC_LOG_LEVEL_VERBOSE_CYC

EC_LOG_LEVEL_UNDEFINED

typedef *EC_T_DWORD* (***EC_PF_LOGMSGHK**)(struct _EC_T_LOG_CONTEXT *pContext, *EC_T_DWORD* dwLogMsgSeverity, const *EC_T_CHAR* *szFormat, ...)

Parameters

- **pContext** – [in] Context pointer. This pointer is used as parameter when the callback function is called
- **dwLogMsgSeverity** – [in] Log message severity, EC_LOG_LEVEL_…

- **szFormat** – [in] String that contains the text to be written. It can optionally contain embedded format specifiers that are replaced by the values specified in subsequent additional arguments and formatted as requested.

Returns
EC_E_NOERROR or error code

Log messages are passed from the EC-Monitor to the callback given at *EC_T_LOG_PARMS::pfLogMsg*. `EcLogging.cpp` demonstrates how messages can be handled by the application. For performance reasons the EC-Monitor automatically filters log messages according to *EC_T_LOG_PARMS::dwLogLevel*. E.g. messages of severity *EC_LOG_LEVEL_WARNING* are not passed to the application if *EC_T_LOG_PARMS::dwLogLevel* is set to *EC_LOG_LEVEL_ERROR*.

The application can provide customized log message handlers of type *EC_PF_LOGMSGHK* if the default handler in `EcLogging.cpp` does not fulfill the application's needs. Note: The callback is typically called from the Job Task's context and should return as fast as possible.

struct **EC_T_PERF_MEAS_INTERNAL_PARMS**

Public Members

EC_T_BOOL **bEnabled**
[in] enable/disable internal performance counters.

EC_T_PERF_MEAS_COUNTER_PARMS **CounterParms**
[in] Timer function settings. When not provided OsMeasGetCounterTicks is used

EC_T_PERF_MEAS_HISTOGRAM_PARMS **HistogramParms**
[in] Histogram settings. When not provided the histogram is disabled.

struct **EC_T_PERF_MEAS_COUNTER_PARMS**

Public Members

EC_PF_PERF_MEAS_GETCOUNTERTICKS **pfGetCounterTicks**
[in] Function returning the current counter ticks

EC_T_VOID ***pvGetCounterTicksContext**
[in] Context passed into GetCounterTicks

EC_T_UINT64 **qwFrequency**
[in] Frequency in Hz used by the timer in GetCounterTicks

typedef *EC_T_UINT64* (***EC_PF_PERF_MEAS_GETCOUNTERTICKS**)(EC_T_VOID *pvContext)

Parameters
pvContext[in] – Context pointer

struct **EC_T_PERF_MEAS_HISTOGRAM_PARMS**

Public Members

EC_T_DWORD **dwBinCount**
[in] amount of bins to use for the histogram.

EC_T_UINT64 **qwMinTicks**
[in] results below qwMinTicks are stored in the first bin

EC_T_UINT64 **qwMaxTicks**
[in] results above qwMaxTicks are stored in the last bin

7.1.2 emDeinitMonitor

EC_T_DWORD **emDeinitMonitor** (*EC_T_DWORD* dwInstanceId)
Deinitialize EC-Monitor.

Parameters
dwInstanceId – [in] Instance ID

Returns
EC_E_NOERROR or error code

7.1.3 emConfigureNetwork

EC_T_DWORD **emConfigureNetwork** (
EC_T_DWORD dwInstanceID,
EC_T_CNF_TYPE eCnfType,
EC_T_PBYTE pbyCnfData,
EC_T_DWORD dwCnfDataLen
)
Configure EtherCAT network.

Parameters

- **dwInstanceID** – [in] Instance ID
- **eCnfType** – [in] Type of configuration data provided
- **pbyCnfData** – [in] Configuration data
- **dwCnfDataLen** – [in] Length of configuration data in byte

Returns
EC_E_NOERROR or error code

enum **EC_T_CNF_TYPE**
Values:

enumerator **eCnfType_Unknown**

enumerator **eCnfType_Filename**
pbyCnfData: ENI filename to read

enumerator **eCnfType_Data**
pbyCnfData: ENI data

enumerator **eCnfType_Datadiag**
pbyCnfData: ENI data for diagnosis

enumerator **eCnfType_GenPreopENI**
Generate ENI based on bus-scan result to get into PREOP state

enumerator **eCnfType_GenPreopENIWithCRC**
same as eCnfType_GenPreopENI with CRC protection

enumerator **eCnfType_GenOpENI**
Generate ENI based on bus-scan result to get into OP state

enumerator **eCnfType_None**
Reset configuration

enumerator **eCnfType_ConfigData**
pbyCnfData: Binary structured configuration

enumerator **eCnfType_BCppDummy**

7.1.4 emGetMonitorStatus

EC_T_DWORD **emGetMonitorStatus** (
EC_T_DWORD dwInstanceID,
EC_T_MONITOR_STATUS *pStatus
)

Get current Monitor status.

Information about the current status of the EtherCAT frame / cycle processing

Parameters

- **dwInstanceID** – [in] Instance ID
- **pStatus** – [out] Monitor status descriptor

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized
- EC_E_INVALIDPARM if pStatus invalid

struct **EC_T_MONITOR_STATUS**

Public Members

EC_T_BOOL **bFramesInLinkLayerPending**
[out] Indicates whether there are any further EtherCAT frames in the LinkLayer

EC_T_DWORD **dwCyclesProcessed**
[out] Number of EtherCAT cycles processed

EC_T_WORD **wEthTapPositionAutoIncAddr**
[out] Ethernet tap position as auto increment address

7.1.5 emSetLicenseKey

EC_T_DWORD **emSetLicenseKey** (*EC_T_DWORD* dwInstanceID, *EC_T_CHAR* *pszLicenseKey)

Sets the license key for the protected version of EC-Master.

Must be called after initialization and before configuration. This function may not be called if a non protected version is used.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **pszLicenseKey** – [in] License key as zero terminated string with 26 characters.

Returns

- EC_E_NOERROR or error code
- EC_E_INVALIDSIZE the format of the license key is wrong. The correct length is 26 characters
- EC_E_LICENSE_MISSING the license key doesn't match to the MAC Address

Example

```
EC_T_DWORD dwRes = EC_E_NOERROR;

dwRes = emSetLicenseKey(0, "DA1099F2-15C249E9-54327FBC");
if (dwRes != EC_E_NOERROR)
{
    EcLogMsg(EC_LOG_LEVEL_ERROR, (pEcLogContext, EC_LOG_LEVEL_ERROR, "ERROR:␣
↪Cannot set license key: %s (0x%lx))\n",
        ecatGetText(dwRes), dwRes));
}
```

See also:

- *emInitMonitor()*
- *emConfigureNetwork()*

7.1.6 emRegisterClient

EC_T_DWORD **emRegisterClient** (
EC_T_DWORD dwInstanceID,
EC_PF_NOTIFY pfnNotify,
EC_T_VOID *pCallerData,
EC_T_REGISTERRESULTS *pRegResults
)

Registers a client on the EC-Master.

It must be called after configuration, otherwise the registration handle is lost. This function may not be called from within the JobTask's context.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **pfnNotify** – [in] Notification callback function. This function will be called every time a state change occurs, an error occurs or a mailbox transfer terminates.
- **pCallerData** – [in] Pointer to a caller data area which will be passed to the client on every notification callback.

- **pRegResults** – [out] Registration results, a pointer to a structure of type *EC_T_REGISTERRESULTS*.

Returns
EC_E_NOERROR or error code

typedef *EC_T_DWORD* (***EC_PF_NOTIFY**)(*EC_T_DWORD* dwCode, *EC_T_NOTIFYPARMS* *pParms)

Parameters

- **dwCode** – [in] Notification code.
- **pParms** – [in] Notification code depending data.

struct **EC_T_REGISTERRESULTS**

Public Members

EC_T_DWORD **dwClntId**
[out] Client ID

EC_T_BYTE ***pbyPDIn**
[out] Pointer to process data input memory

EC_T_DWORD **dwPDInSize**
[out] Size of process data input memory (in bytes)

EC_T_BYTE ***pbyPDOut**
[out] Pointer to process data output memory

EC_T_DWORD **dwPDOutSize**
[out] Size of process data output memory (in bytes)

7.1.7 emUnregisterClient

EC_T_DWORD **emUnregisterClient** (*EC_T_DWORD* dwInstanceID, *EC_T_DWORD* dwClntId)
Unregister a client from the EtherCAT master.

This function may not be called from within the JobTask's context.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwClntId** – [in] Client ID determined when registering with the master.

Returns
EC_E_NOERROR or error code

7.1.8 emExecJob

EC_T_DWORD **emExecJob** (
EC_T_DWORD dwInstanceID,
EC_T_USER_JOB eUserJob,
EC_T_USER_JOB_PARMS *pUserJobParms
)

Execute or initiate the requested master job.

To achieve maximum speed, this function is implemented non re-entrant. It is highly recommended that only one single task is calling all required jobs to run the stack. If multiple tasks are calling this function, the calls have to be synchronized externally. Calling it in a context that doesn't support operating system calls can lead to unpredictable behavior.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **eUserJob** – [in] user requested job
- **pUserJobParms** – [in] optional user job parameters

Returns
EC_E_NOERROR or error code

Brief job overview:

enum **EC_T_USER_JOB**
Values:

enumerator **eUsrJob_Undefined**

enumerator **eUsrJob_ProcessAllRxFrames**

enumerator **eUsrJob_SendAllCycFrames**

enumerator **eUsrJob_RunMcSm**

enumerator **eUsrJob_MasterTimer**

enumerator **eUsrJob_FlushQueuedCmds**

enumerator **eUsrJob_SendAcycFrames**

enumerator **eUsrJob_SendCycFramesByTaskId**

enumerator **eUsrJob_MasterTimerMinimal**

enumerator **eUsrJob_ProcessRxFramesByTaskId**

enumerator **eUsrJob_ProcessAcycRxFrames**

enumerator **eUsrJob_SwitchEoeFrames**

enumerator **eUsrJob_StampSendAllCycFrames**

enumerator **eUsrJob_StampSendCycFramesByTaskId**

enumerator **eUsrJob_SimulatorTimer**

enumerator **eUsrJob_BCppDummy**

union **EC_T_USER_JOB_PARMS**

Public Members

EC_T_BOOL **bAllCycFramesProcessed**

EC_T_DWORD **dwNumFramesSent**

EC_T_DWORD **dwTaskIdToSend**

EC_T_BOOL **bCycFramesProcessed**

EC_T_DWORD **dwTaskId**

struct *EC_T_USER_JOB_PARMS*::[anonymous] **ProcessRxFramesByTaskId**

EC_T_DWORD **dwMaxPortsToProcess**

EC_T_DWORD **dwNumFramesProcessed**

struct *EC_T_USER_JOB_PARMS*::[anonymous] **SwitchEoeFrames**

Detailed job description:

1. ***eUsrJob_ProcessAllRxFrames***
   When the Link Layer operates in polling mode this call will process all currently received frames, when the Link Layer operates in interrupt mode all received frames are processed immediately and this call just returns with nothing done.

   ```
   pUserJobParms->bAllCycFramesProcessed
   ```

   This flag is set to a value of `EC_TRUE` it indicates that all previously initiated cyclic frames (*eUsrJob_SendAllCycFrames*) are received and processed within this call. Not used if pUserJobParms set to `EC_NULL`.

   Return: EC_E_NOERROR if successful, error code in case of failures.

2. ***eUsrJob_MasterTimer***
   To trigger the master and slave state machines as well as the mailbox handling this call has to be executed cyclically. The master cycle time is determined by the period between calling *emExecJob()* (*eUsrJob_MasterTimer*). The state-machines are handling the EtherCAT state change transfers.

   Return: EC_E_NOERROR if successful, error code in case of failures.

7.1.9 emGetMonitorParms

EC_T_DWORD **emGetMonitorParms** (
EC_T_DWORD dwInstanceID,
EC_T_MONITOR_INIT_PARMS *pParms,
EC_T_DWORD dwParmsBufSize
)

Gets current Monitor Init Parameters.

If the given buffer is larger than the actual size of struct *EC_T_MONITOR_INIT_PARMS*, the parameters of *EC_T_MONITOR_INIT_PARMS.pOsParms*, EC_T_MONITOR_INIT_PARMS.pLinkParmsare appended.

Parameters

- **dwInstanceID** – [in] Instance ID
- **pParms** – [out] Buffer to store parameters
- **dwParmsBufSize** – [in] Size of buffer in bytes

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized
- EC_E_INVALIDPARM if buffer pParms is too small

Example

```
EC_T_DWORD dwRes = EC_E_NOERROR;
/* Read all monitor init parameters, including OS and Link parameters */
EC_T_BYTE abyBuffer[sizeof(EC_T_MONITOR_INIT_PARMS) + sizeof(EC_T_OS_PARMS) + 512 /
↪* LinkLayer parameters */];
EC_T_MONITOR_INIT_PARMS* pParms = (EC_T_MONITOR_INIT_PARMS*)abyBuffer;
OsMemset(abyBuffer, 0, sizeof(abyBuffer));

dwRes = emGetMonitorParms(0, pParms, sizeof(abyBuffer));
if (EC_E_NOERROR != dwRes)
{
    EcLogMsg(EC_LOG_LEVEL_ERROR, (pEcLogContext, EC_LOG_LEVEL_ERROR, "Cannot get␣
↪monitor parameters: %s (0x%lx))\n",
        ecatGetText(dwRes), dwRes));
}
```

See also:

emInitMonitor()

7.1.10 emSetMonitorParms

EC_T_DWORD **emSetMonitorParms** (
EC_T_DWORD dwInstanceID,
EC_T_MONITOR_INIT_PARMS *pParms
)

Change Monitor Init Parameters.

OS parms, Main Link parms cannot be changed.

Parameters

- **dwInstanceID** – [in] Instance ID
- **pParms** – [in] New Monitor init parameters

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized

See also:

emInitMonitor()

7.1.11 emGetVersion

EC_T_DWORD **emGetVersion** (*EC_T_DWORD* dwInstanceID, *EC_T_DWORD* *pdwVersion)

Gets the version number as a 32-bit value.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **pdwVersion** – [out] Pointer to EC_T_DWORD to carry out version number

Returns

- EC_E_NOERROR
- EC_E_INVALIDPARM

7.1.12 emGetText

const *EC_T_CHAR* *__emGetText__ (*EC_T_DWORD* dwInstanceID, *EC_T_DWORD* dwTextId)

Return text tokens by ID.

Parameters

dwInstanceID – [in] Master Instance ID

Returns

Textual description of the given ID

Since the texts are instance independent, a variant without instance id is also available:

const *EC_T_CHAR* *__ecatGetText__ (*EC_T_DWORD* dwTextId)

7.1.13 emGetMemoryUsage

EC_T_DWORD **emGetMemoryUsage** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD *pdwCurrentUsage,
EC_T_DWORD *pdwMaxUsage
)

Returns information about memory usage.

All calls to malloc/free and new/delete are monitored.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **pdwCurrentUsage** – [out] Current memory usage in Bytes at the time where this function is called
- **pdwMaxUsage** – [out] Maximum memory usage in Bytes since initialization at the time where this function is called

Returns

EC_E_NOERROR or error code

7.1.14 emGetMasterState

EC_T_STATE **emGetMasterState** (*EC_T_DWORD* dwInstanceID)
Get the EtherCAT master current state.

Parameters
dwInstanceID – [in] Master Instance ID

Returns
EtherCAT master state

7.1.15 emGetMasterStateEx

EC_T_DWORD **emGetMasterStateEx** (
EC_T_DWORD dwInstanceID,
EC_T_WORD *pwCurrState,
EC_T_WORD *pwReqState
)
Get the EtherCAT master extended state.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **pwCurrState** – [out] Current Master state.
- **pwReqState** – [out] Requested Master state

Returns
EtherCAT master extended state

7.1.16 emIoControl

With :ref`emIoControl` a generic control interface exists between the application and the EC-Monitor and its Link Layers.

struct **EC_T_IOCTLPARMS**

Public Members

EC_T_BYTE ***pbyInBuf**
[in] Pointer to control input parameter.

EC_T_DWORD **dwInBufSize**
[in] Size of the input buffer provided at pbyInBuf in bytes

EC_T_BYTE ***pbyOutBuf**
[out] Pointer to control output buffer where the results will be copied into

EC_T_DWORD **dwOutBufSize**
[in] Size of the output buffer provided at pbyOutBuf in bytes

EC_T_DWORD ***pdwNumOutData**
[out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer

7.1.17 emIoControl - EC_IOCTL_REGISTER_CYCFRAME_RX_CB

This function call registers an callback function which is called after the cyclic frame is received. Typically this is used when the Link Layer operates interrupt mode to get an event when the new input data (cyclic frame) is available. The callback function has to be registered after calling *emInitMonitor()* before starting the job task.

emIoControl - EC_IOCTL_REGISTER_CYCFRAME_RX_CB

Parameter

- pbyInBuf: [in] Cyclic frame received callback descriptor (EC_T_CYCFRAME_RX_CBDESC)
- dwInBufSize: [in] Size of the input buffer provided at pbyInBuf in bytes.
- pbyOutBuf: [out] Should be set to EC_NULL
- dwOutBufSize: [in] Should be set to 0
- pdwNumOutData: [out] Should be set to EC_NULL

Return
EC_E_NOERROR or error code

struct **EC_T_CYCFRAME_RX_CBDESC**

Public Members

EC_T_VOID ***pCallbackContext**
[in] Context pointer. This pointer is used as parameter every time when the callback function is called

EC_PF_CYCFRAME_RECV **pfnCallback**
[in] This function will be called after the cyclic frame is received, if there is more than one cyclic frame after the last frame. The application has to assure that these functions will not block.

typedef EC_T_VOID (***EC_PF_CYCFRAME_RECV**)(*EC_T_DWORD* dwTaskId, EC_T_VOID *pvContext)

Parameters

- **dwTaskId** – [in] Task id of the received cyclic frame.
- **pvContext** – [in] Context pointer. This pointer is used as parameter every time when the callback function is called.

7.1.18 emIoControl - EC_IOCTL_GET_CYCLIC_CONFIG_INFO

Get cyclic configuration details from ENI configuration file.

emIoControl - EC_IOCTL_GET_CYCLIC_CONFIG_INFO

Parameter

- pbyInBuf: [in] Pointer to dwCycEntryIndex: cyclic entry index for which to get information
- dwInBufSize: [in] Size of the input buffer provided at pbyInBuf in bytes.
- pbyOutBuf: [out] Pointer to EC_T_CYC_CONFIG_DESC data type
- dwOutBufSize: [in] Size of the output buffer provided at pbyOutBuf in bytes.

- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

struct **`EC_T_CYC_CONFIG_DESC`**

Public Members

EC_T_DWORD **`dwNumCycEntries`**
[out] Total number of cyclic entries

EC_T_DWORD **`dwTaskId`**
[out] Task id of selected cyclic entry

EC_T_DWORD **`dwPriority`**
[out] Priority of selected cyclic entry

EC_T_DWORD **`dwCycleTime`**
[out] Cycle time of selected cyclic entry

7.1.19 emIoControl - EC_IOCTL_IS_SLAVETOSLAVE_COMM_CONFIGURED

Determine if any slave-to-slave communication is configured.

emIoControl - EC_IOCTL_IS_SLAVETOSLAVE_COMM_CONFIGURED

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Pointer to EC_T_DWORD. If value is EC_TRUE slave-to-slave communication is configured, if EC_FALSE it is not.
- `dwOutBufSize`: [in] Size of the output buffer in bytes.
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

7.2 Packet Capture

7.2.1 emOpenPacketCapture

EC_T_DWORD **`emOpenPacketCapture`** (
EC_T_DWORD dwInstanceID,
EC_T_PACKETCAPTURE_PARMS *pParms
)
Open packet capture file (PCAP).

Opens a PCAP trace for further processing within the JobTask. No LinkLayer must have been loaded.

Note: Only the PCAP file format is currently supported.

Parameters

- **dwInstanceID** – [in] Instance ID
- **pParms** – [in] Packet capture parameter

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized or link layer loaded
- EC_E_INVALIDPARM if parameter file name invalid
- EC_E_OPENFAILED if file could not be opened
- EC_E_NOMEMORY if not enough memory available

struct **EC_T_PACKETCAPTURE_PARMS**

Public Members

EC_T_CHAR **szFileName**[EC_PACKETCAPTURE_FILE_NAME_SIZE]
[in] File name

Example

```
EC_T_DWORD dwRes = EC_E_NOERROR;
EC_T_PACKETCAPTURE_PARMS PacketCaptureParms;
OsMemset(&PacketCaptureParms, 0, sizeof(EC_T_PACKETCAPTURE_PARMS));

OsStrcpy(PacketCaptureParms.szFileName, "C:\\ecat.pcap");
dwRes = emOpenPacketCapture(0, &PacketCaptureParms);
if (EC_E_NOERROR != dwRes)
{
    EcLogMsg(EC_LOG_LEVEL_ERROR, (pEcLogContext, EC_LOG_LEVEL_ERROR, "Cannot open␣
↪packet capture: %s (0x%lx))\n",
        ecatGetText(dwRes), dwRes));
}
```

7.2.2 emClosePacketCapture

EC_T_DWORD **emClosePacketCapture**(*EC_T_DWORD* dwInstanceID)
Close packet capture file (PCAP).

Parameters
dwInstanceID – [in] Instance ID

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized or link layer loaded

7.2.3 emGetPacketCaptureInfo

EC_T_DWORD **emGetPacketCaptureInfo** (
EC_T_DWORD dwInstanceID,
EC_T_PACKETCAPTURE_INFO *pInfo
)

Get packet capture file processing status information.

Parameters

- **dwInstanceID** – [in] Instance ID
- **pInfo** – [out] Packet capture info descriptor

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized or link layer loaded

struct **EC_T_PACKETCAPTURE_INFO**

Public Members

EC_T_PACKETCAPTURE_STATUS **eStatus**
[out] Status of packet capture processing

EC_T_UINT64 **qwFrameNumber**
[out] Last processed frame number

EC_T_UINT64 **qwBytesProcessed**
[out] Number of processed bytes from the packet capture file

EC_T_UINT64 **qwFileSize**
[out] Packet capture file size

enum **EC_T_PACKETCAPTURE_STATUS**
Values:

enumerator **ePcapStatus_Unknown**
Unknown packet capture status

enumerator **ePcapStatus_NotLoaded**
No packet capture loaded

enumerator **ePcapStatus_Running**
Packet capture processing running

enumerator **ePcapStatus_Finished**
Packet capture processing finished

enumerator **ePcapStatus_Dummy**

7.2.4 emStartLivePacketCapture

EC_T_DWORD **emStartLivePacketCapture** (
EC_T_DWORD dwInstanceID,
EC_T_PACKETCAPTURE_PARMS *pParms
)

Start live packet capture (PCAP).

Starts a live recording of the EtherCAT frames in a specified PCAP file.

Note: Only the PCAP file format is currently supported.

Parameters

- **dwInstanceID** – [in] Instance ID
- **pParms** – [in] Packet capture parameter

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDPARM if parameter file name invalid
- EC_E_OPENFAILED if file could not be opened
- EC_E_NOMEMORY if not enough memory available

7.2.5 emStopLivePacketCapture

EC_T_DWORD **emStopLivePacketCapture** (*EC_T_DWORD* dwInstanceID)

Stop live packet capture (PCAP).

Stops a previously started live recording of the EtherCAT frames.

Parameters
dwInstanceID – [in] Instance ID

Returns

- EC_E_NOERROR on success
- EC_E_INVALIDSTATE if Monitor isn't initialized or no recording is in progress

7.2.6 emBacktracePacketCapture

EC_T_DWORD **emBacktracePacketCapture** (
EC_T_DWORD dwInstanceID,
EC_T_PACKETCAPTURE_PARMS *pParms
)

Dump packet capture (PCAP) from backtrace buffer.

Writes a backtrace of the received frames in a specified PCAP file. The number of frames in the backtrace buffer is parameterized via *EC_T_MONITOR_INIT_PARMS::dwBacktraceFrames*.

Note: Only the PCAP file format is currently supported.

Parameters

- **dwInstanceID** – [in] Instance ID
- **pParms** – [in] Packet capture parameter

Returns

- EC_E_NOERROR on success
- EC_E_BUSY if another dump is in progress
- EC_E_INVALIDSTATE if backtrace buffer is not initialized
- EC_E_INVALIDPARM if parameter file name invalid
- EC_E_OPENFAILED if file could not be opened
- EC_E_NOMEMORY if not enough memory available

See also:

emInitMonitor()

7.3 Process Data functions

7.3.1 emGetProcessData

EC_T_DWORD **emGetProcessData** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bOutputData,
EC_T_DWORD dwOffset,
EC_T_BYTE *pbyData,
EC_T_DWORD dwDataLen,
EC_T_DWORD dwTimeout
)

Retrieve Process data synchronized.

If process data are required outside the cyclic master job task (which is calling ecatExecJob), direct access to the process data is not recommended as data consistency cannot be guaranteed. A call to this function will send a data read request to the master stack and then check every millisecond whether new data are provided. The master stack will provide new data after calling ecatExecJob(eUsrJob_ MasterTimer) within the job task. This function is usually only called remotely (using the Remote API).

Note: This function may not be called from within the JobTask's context.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bOutputData** – [in] EC_TRUE: read output data, EC_FALSE: read input data.
- **dwOffset** – [in] Byte offset in Process data to read from.
- **pbyData** – [out] Buffer receiving transfered data
- **dwDataLen** – [in] Buffer length [bytes]
- **dwTimeout** – [in] Timeout [ms]

Returns
EC_E_NOERROR or error code

7.3.2 emGetProcessDataBits

EC_T_DWORD **emGetProcessDataBits** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bOutputData,
EC_T_DWORD dwBitOffsetPd,
EC_T_BYTE *pbyData,
EC_T_DWORD dwDataBitLen,
EC_T_DWORD dwTimeout
)

Reads a specific number of bits from the process image to the given buffer with a bit offset (synchronized).

This function may not be called from within the JobTask's context.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bOutputData** – [in] EC_TRUE: read output data, EC_FALSE: write input data.
- **dwBitOffsetPd** – [in] Bit offset in Process data image.
- **pbyData** – [out] Buffer receiving transfered data
- **dwDataBitLen** – [in] Buffer length [bit]
- **dwTimeout** – [in] Timeout [ms] The timeout value must not be set to EC_NOWAIT.

Returns
EC_E_NOERROR or error code

See also:

emGetProcessData()

7.3.3 emGetProcessImageInputPtr

EC_T_BYTE ***emGetProcessImageInputPtr** (*EC_T_DWORD* dwInstanceID)

Gets the process data input image pointer.

Parameters
dwInstanceID – [in] Master Instance ID

Returns
Process data input image pointer

7.3.4 emGetProcessImageOutputPtr

EC_T_BYTE ***emGetProcessImageOutputPtr** (*EC_T_DWORD* dwInstanceID)

Gets the process data output image pointer.

Parameters
dwInstanceID – [in] Master Instance ID

Returns
Process data output image pointer

7.3.5 emIoControl - EC_IOCTL_GET_PDMEMORYSIZE

Get the process data image size. This information may be used to provide process data image storage from outside the EC-Monitor core. This IOCTL is to be called after *emConfigureNetwork()*.

emIoControl - EC_IOCTL_GET_PDMEMORYSIZE

Parameter

- pbyInBuf: [in] Should be set to EC_NULL
- dwInBufSize: [in] Should be set to 0
- pbyOutBuf: [out] Pointer to memory where the memory size information will be stored (type: EC_T_MEMREQ_DESC).
- dwOutBufSize: [in] Size of the output buffer in bytes.
- pdwNumOutData: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

struct **EC_T_MEMREQ_DESC**

7.3.6 Process Data access functions

EC_COPYBITS

EC_COPYBITS(pbyDst, nDstBitOffs, pbySrc, nSrcBitOffs, nBitSize)
Copies a block of bits from a source buffer to a destination buffer.

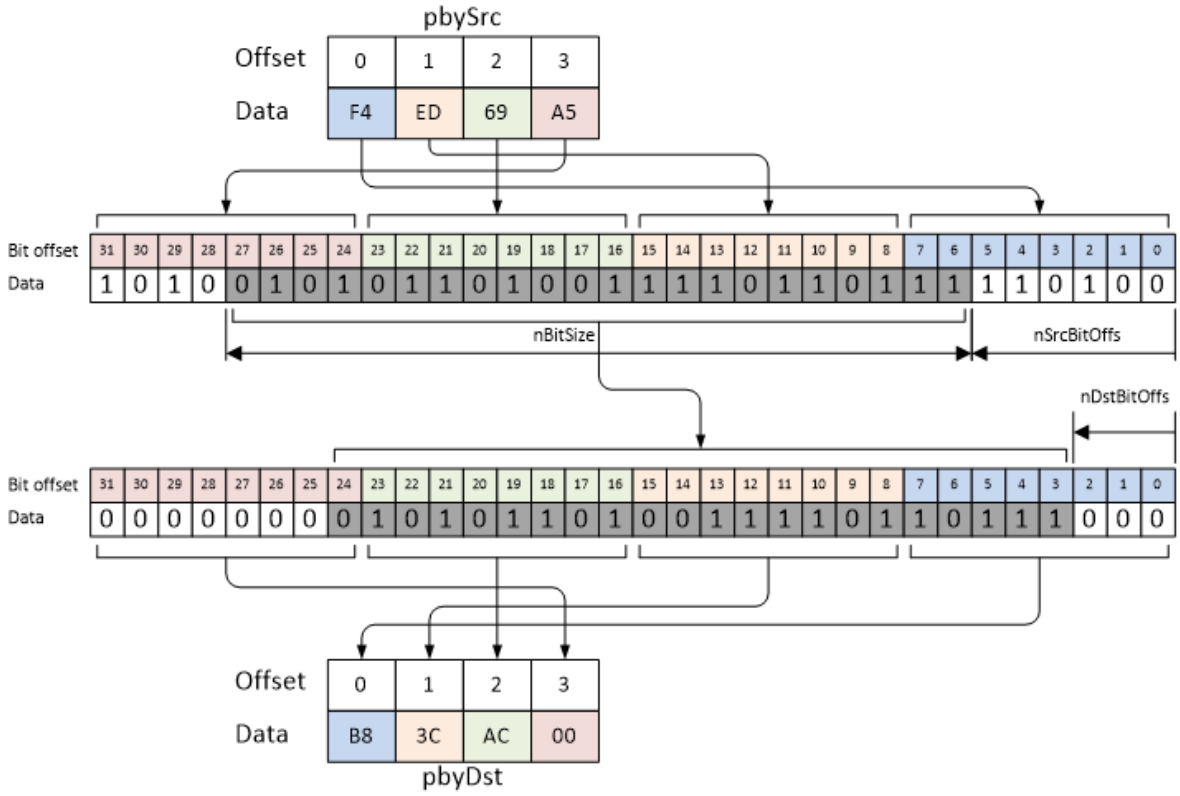
Note: The memory buffers must be allocated before. The buffers must be big enough to hold the block starting at the given offsets! The buffers are not checked for overrun.

Parameters

- **pbyDst** – [out] Destination buffer
- **nDstBitOffs** – [in] Bit offset within destination buffer
- **pbySrc** – [in] Source buffer
- **nSrcBitOffs** – [in] Bit offset within source buffer
- **nBitSize** – [in] Block size in bits

See also:

- EC_SETBITS
- *EC_GETBITS*




```
EC_T_BYTE pbySrc[] = {0xF4, 0xED, 0x69, 0xA5};
EC_T_BYTE pbyDst[] = {0x00, 0x00, 0x00, 0x00};
EC_COPYBITS(pbyDst, 3, pbySrc, 6, 22);

/* pbyDst now contains 0xB8 0x3C 0xAC 0x00 */
```

EC_GET_FRM_WORD

EC_GET_FRM_WORD (ptr)

Reads a value of type EC_T_WORD (16 bit) at given pointer. The value is swapped on big endian systems.

Parameters

- **ptr** – [in] Source buffer

Returns

EC_T_WORD value (16 bit) from buffer.

```
EC_T_BYTE byFrame[] = {0x01, 0xF4, 0xDD, 0x85, 0x03, 0x00, 0x60, 0xC1, 0x00};
EC_T_WORD wResult = 0;

wResult = EC_GET_FRM_WORD(byFrame);
/* wResult is 0xF401 on little endian systems */

wResult = EC_GET_FRM_WORD(byFrame + 5);
/* wResult is 0x6000 on little endian systems */

wResult = EC_GET_FRM_WORD(byFrame + 2);
/* wResult is 0x85DD on little endian systems */
```

EC_GET_FRM_DWORD

EC_GET_FRM_DWORD (ptr)
Reads a value of type EC_T_DWORD (32 bit) at given pointer. The value is swapped on big endian systems.

Parameters

- **ptr** – [in] Source buffer

Returns
EC_T_DWORD value (32 bit) from buffer.

```
EC_T_BYTE byFrame[] = {0x01, 0xF4, 0xDD, 0x85, 0x03, 0x00, 0x60, 0xC1, 0x00};
EC_T_DWORD dwResult = 0;

dwResult = EC_GET_FRM_DWORD(byFrame);
/* dwResult is 0x85DDF401 on little endian systems */

dwResult = EC_GET_FRM_DWORD(byFrame + 5);
/* dwResult is 0x00C16000 on little endian systems */

dwResult = EC_GET_FRM_DWORD(byFrame + 2);
/* dwResult is 0x000385DD on little endian systems */
```

EC_GET_FRM_QWORD

EC_GET_FRM_QWORD (ptr)
Reads a value of type EC_T_QWORD (64 bit) at given pointer. The value is swapped on big endian systems.

Parameters

- **ptr** – [in] Source buffer

Returns
EC_T_QWORD value (64 bit) from buffer.

```
EC_T_BYTE byFrame[] = {0x01, 0xF4, 0xDD, 0x85, 0x03, 0x00, 0x60, 0xC1, 0x00};
EC_T_UINT64 ui64Result = 0;

ui64Result = EC_GET_FRM_QWORD(byFrame + 1);
/* wResult is 0x00C160000385DDF4 on little endian systems */
```

EC_GETBITS

EC_GETBITS (pbySrcBuf, pbyDstData, nSrcBitOffs, nBitSize)
Reads a given number of bits from source buffer starting at given bit offset to destination buffer.

Note: This function should be only used to get bit-aligned data. For byte-aligned data the corresponding functions should be used.

Parameters

- **pbySrcBuf** – [in] Source buffer to be copied
- **pbyDstData** – [out] Destination buffer where data is copied to
- **nSrcBitOffs** – [in] Source bit offset where data is copied from

- **nBitSize** – [in] Bit count to be copied

See also:

- *EC_GET_FRM_WORD*
- *EC_GET_FRM_DWORD*
- *EC_GET_FRM_QWORD*

7.4 Slave status functions

7.4.1 emGetNumConfiguredSlaves

EC_T_DWORD **emGetNumConfiguredSlaves** (*EC_T_DWORD* dwInstanceID)
Returns number of slaves which are configured in the ENI.

Parameters
dwInstanceID – [in] Master Instance ID

Returns
Number of slaves

7.4.2 emGetNumConnectedSlaves

EC_T_DWORD **emGetNumConnectedSlaves** (*EC_T_DWORD* dwInstanceID)
Get amount of currently connected slaves.

Parameters
dwInstanceID – [in] Master Instance ID

Returns
Number of connected slaves

7.4.3 emGetSlaveId

EC_T_DWORD **emGetSlaveId** (*EC_T_DWORD* dwInstanceID, *EC_T_WORD* wStationAddress)
Determines the slave ID using the slave station address.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **wStationAddress** – [in] Station address of the slave

Returns
Slave ID or INVALID_SLAVE_ID if the slave could not be found or stack is not initialized

7.4.4 emGetSlaveIdAtPosition

EC_T_DWORD **emGetSlaveIdAtPosition** (
EC_T_DWORD dwInstanceID,
EC_T_WORD wAutoIncAddress
)

Determines the slave ID using the slave auto increment address.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **wAutoIncAddress** – [in] Auto increment address of the slave

Returns

Slave ID or INVALID_SLAVE_ID if the slave could not be found

7.4.5 emGetSlaveState

EC_T_DWORD **emGetSlaveState** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwSlaveId,
EC_T_WORD *pwCurrDevState,
EC_T_WORD *pwReqDevState
)

Get the slave state.

The slave state is always read automatically from the AL_STATUS register whenever necessary. It is not forced by calling this function. This function may be called from within the JobTask's context.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwSlaveId** – [in] Slave ID
- **pwCurrDevState** – [out] Current slave state.
- **pwReqDevState** – [out] Requested slave state

Returns

- EC_E_NOERROR on success.
- EC_E_SLAVE_NOT_PRESENT if the slave is not present on bus.
- EC_E_NOTFOUND if the slave with ID dwSlaveId does not exist in the XML file.

See also:

emGetSlaveId()

7.4.6 emNotify - EC_NOTIFY_SLAVE_STATECHANGED

This notification is given, when a slave changed its EtherCAT state.

emNotify - EC_NOTIFY_SLAVE_STATECHANGED

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_SLAVE_STATECHANGED_NTFY_DESC
- `dwInBufSize`: [in] Size of the input buffer provided at pbyInBuf in bytes.
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

struct **EC_T_SLAVE_STATECHANGED_NTFY_DESC**

Public Members

EC_T_SLAVE_PROP **SlaveProp**
Slave properties

EC_T_STATE **newState**
New slave state

7.4.7 emIsSlavePresent

EC_T_DWORD **emIsSlavePresent** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwSlaveId,
EC_T_BOOL *pbPresence
)

Returns whether a specific slave is currently connected to the Bus.

This function may be called from within the JobTask.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwSlaveId** – [in] Slave ID
- **pbPresence** – [out] EC_TRUE if slave is currently connected to the bus, EC_FALSE if not.

Returns

- EC_E_NOERROR if successful
- EC_E_INVALIDSTATE if the master is not initialized
- EC_E_NOTFOUND if the slave with ID dwSlaveId does not exist or no ENI File was loaded

See also:

emGetSlaveId()

7.4.8 emNotify - EC_NOTIFY_SLAVE_PRESENCE

This notification is given, if slave appears or disappears from the network.

emNotify - EC_NOTIFY_SLAVE_PRESENCE

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_SLAVE_PRESENCE_NTFY_DESC
- `dwInBufSize`: [in] Size of the input buffer provided at pbyInBuf in bytes.
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

Disconnecting the slave from the network, powering it off or a bad connection can produce this notification.

struct **EC_T_SLAVE_PRESENCE_NTFY_DESC**

Public Members

EC_T_WORD **wStationAddress**
Slave station address

EC_T_BYTE **bPresent**
EC_TRUE: present , EC_FALSE: absent

7.4.9 emGetSlaveProp

EC_T_BOOL **emGetSlaveProp** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwSlaveId,
EC_T_SLAVE_PROP *pSlaveProp
)
Determines the properties of the slave device.

Deprecated:
Use emGetCfgSlaveInfo instead

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwSlaveId** – [in] Slave ID
- **pSlaveProp** – [out] Slave properties

Returns
EC_TRUE if the slave exists, EC_FALSE if the slave id is invalid

struct **EC_T_SLAVE_PROP**

Public Members

EC_T_WORD **wStationAddress**
station address or INVALID_FIXED_ADDR

EC_T_WORD **wAutoIncAddr**
auto increment address or INVALID_AUTO_INC_ADDR

EC_T_CHAR **achName**[MAX_STD_STRLEN]
name of the slave device (NULL terminated string)

See also:

emGetSlaveId()

7.4.10 emGetSlaveInpVarInfoNumOf

EC_T_DWORD **emGetSlaveInpVarInfoNumOf** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_WORD *pwSlaveInpVarInfoNumOf
)
Gets the number of input variables of a specific slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **pwSlaveInpVarInfoNumOf** – [out] Number of found process variable entries

Returns
EC_E_NOERROR or error code

See also:

- *emGetSlaveInpVarInfo()*
- *emGetSlaveInpVarInfoEx()*

7.4.11 emGetSlaveInpVarInfo

EC_T_DWORD **emGetSlaveInpVarInfo** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_WORD wNumOfVarsToRead,
EC_T_PROCESS_VAR_INFO *pSlaveProcVarInfoEntries,
EC_T_WORD *pwReadEntries
)
Gets the process variable information entries of an specific slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **wNumOfVarsToRead** – [in] Number process variable entries that have been stored in pSlaveProcVarInfoEntries
- **pSlaveProcVarInfoEntries** – [out] The read process variable information entries
- **pwReadEntries** – [out] The number of read process variable information entries

Returns
EC_E_NOERROR or error code

struct **EC_T_PROCESS_VAR_INFO**

Public Members

EC_T_CHAR **szName**[MAX_PROCESS_VAR_NAME_LEN]
[out] Name of the found process variable

EC_T_WORD **wDataType**
[out] Data type of the found process variable (according to ETG.1000, section 5). See also EcCommon.h, DEFTYPE_BOOLEAN

EC_T_WORD **wFixedAddr**
[out] Station address of the slave that is owner of this variable

EC_T_INT **nBitSize**
[out] Size in bit of the found process variable

EC_T_INT **nBitOffs**
[out] Bit offset in the process data image

EC_T_BOOL **bIsInputData**
[out] Determines whether the found process variable is an input variable or an output variable

7.4.12 emGetSlaveInpVarInfoEx

EC_T_DWORD **emGetSlaveInpVarInfoEx** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_WORD wNumOfVarsToRead,
EC_T_PROCESS_VAR_INFO_EX *pSlaveProcVarInfoEntriesEx,
EC_T_WORD *pwReadEntries
)
Gets the input process variable extended information entries of a specific slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address

- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **wNumOfVarsToRead** – [in] Number process variable entries that have been stored in pSlaveProcVarInfoEntries
- **pSlaveProcVarInfoEntriesEx** – [out] The read process variable extended information entries
- **pwReadEntries** – [out] The number of read process variable information entries

Returns
EC_E_NOERROR or error code

struct **EC_T_PROCESS_VAR_INFO_EX**

Public Members

EC_T_CHAR **szName**[MAX_PROCESS_VAR_NAME_LEN_EX]
[out] Name of the found process variable

EC_T_WORD **wDataType**
[out] Data type of the found process variable

EC_T_WORD **wFixedAddr**
[out] Station address of the slave that is owner of this variable

EC_T_INT **nBitSize**
[out] Size in bit of the found process variable

EC_T_INT **nBitOffs**
[out] Bit offset in the process data image

EC_T_BOOL **bIsInputData**
[out] Determines whether the found process variable is an input variable or an output variable

EC_T_WORD **wIndex**
[out] Object index

EC_T_WORD **wSubIndex**
[out] Object sub index

EC_T_WORD **wPdoIndex**
[out] Index of PDO (process data object)

EC_T_WORD **wWkcStateDiagOffs**
[out] Bit offset in the diagnostic image (emGetDiagnosisImagePtr)

EC_T_WORD **wMasterSyncUnit**
[out] Master Sync Unit (ENI: RxPdo[1..4]@Su, TxPdo[1..4]@Su)

7.4.13 emGetSlaveOutpVarInfoNumOf

EC_T_DWORD **emGetSlaveOutpVarInfoNumOf** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_WORD *pwSlaveOutpVarInfoNumOf
)

Gets the number of output variables of a specific slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **pwSlaveOutpVarInfoNumOf** – [out] Number of found process variables

Returns
EC_E_NOERROR or error code

See also:

- *emGetSlaveOutpVarInfo()*
- *emGetSlaveOutpVarInfoEx()*

7.4.14 emGetSlaveOutpVarInfo

EC_T_DWORD **emGetSlaveOutpVarInfo** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_WORD wNumOfVarsToRead,
EC_T_PROCESS_VAR_INFO *pSlaveProcVarInfoEntries,
EC_T_WORD *pwReadEntries
)

Gets the output process variable information entries of a specific slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **wNumOfVarsToRead** – [in] Number of found process variable entries
- **pSlaveProcVarInfoEntries** – [out] The read process variable information entries
- **pwReadEntries** – [out] The number of read process variable information entries

Returns
EC_E_NOERROR or error code

See also:

EC_T_PROCESS_VAR_INFO

7.4.15 emGetSlaveOutpVarInfoEx

EC_T_DWORD **emGetSlaveOutpVarInfoEx** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_WORD wNumOfVarsToRead,
EC_T_PROCESS_VAR_INFO_EX *pSlaveProcVarInfoEntriesEx,
EC_T_WORD *pwReadEntries
)

Gets the output process variable extended information entries of a specific slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **wNumOfVarsToRead** – [in] Number of process variable information entries
- **pSlaveProcVarInfoEntriesEx** – [out] The read process extended variable entries
- **pwReadEntries** – [out] The number of read process variable information entries

Returns
EC_E_NOERROR or error code

See also:

EC_T_PROCESS_VAR_INFO_EX

7.4.16 emFindInpVarByName

EC_T_DWORD **emFindInpVarByName** (
EC_T_DWORD dwInstanceID,
EC_T_CHAR *szVariableName,
EC_T_PROCESS_VAR_INFO *pProcessVarInfoEntry
)

Finds an input process variable information entry by the variable name.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **szVariableName** – [in] Variable name
- **pProcessVarInfoEntry** – [out] Process variable information entry

Returns
EC_E_NOERROR or error code

See also:

EC_T_PROCESS_VAR_INFO

7.4.17 emFindInpVarByNameEx

EC_T_DWORD **emFindInpVarByNameEx** (
EC_T_DWORD dwInstanceID,
EC_T_CHAR *szVariableName,
EC_T_PROCESS_VAR_INFO_EX *pProcessVarInfoEntry
)

Finds an input process variable extended information entry by the variable name.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **szVariableName** – [in] Variable name
- **pProcessVarInfoEntry** – [out] Process variable extended information entry

Returns
EC_E_NOERROR or error code

See also:

EC_T_PROCESS_VAR_INFO_EX

7.4.18 emFindOutpVarByName

EC_T_DWORD **emFindOutpVarByName** (
EC_T_DWORD dwInstanceID,
EC_T_CHAR *szVariableName,
EC_T_PROCESS_VAR_INFO *pProcessVarInfoEntry
)

Finds an output process variable information entry by the variable name.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **szVariableName** – [in] Variable name
- **pProcessVarInfoEntry** – [out] Process variable information entry

Returns
EC_E_NOERROR or error code

See also:

EC_T_PROCESS_VAR_INFO

7.4.19 emFindOutpVarByNameEx

EC_T_DWORD **emFindOutpVarByNameEx** (
EC_T_DWORD dwInstanceID,
EC_T_CHAR *szVariableName,
EC_T_PROCESS_VAR_INFO_EX *pProcessVarInfoEntry
)

Finds an output process variable extended information entry by the variable name.

Parameters

- **dwInstanceID** – [in] Master Instance ID

- **szVariableName** – [in] Variable name
- **pProcessVarInfoEntry** – [out] Process variable extended information entry

Returns
EC_E_NOERROR or error code

See also:

EC_T_PROCESS_VAR_INFO_EX

7.4.20 emGetCfgSlaveInfo

EC_T_DWORD **emGetCfgSlaveInfo** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_CFG_SLAVE_INFO *pSlaveInfo
)

Return information about a configured slave from the ENI file.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **pSlaveInfo** – [out] Information about the slave.

Returns
EC_E_NOERROR or error code

struct **EC_T_CFG_SLAVE_INFO**

Public Members

EC_T_DWORD **dwSlaveId**
[out] The slave's ID to bind bus slave and config slave information

EC_T_CHAR **abyDeviceName**[ECAT_DEVICE_NAMESIZE]
[out] The slave's configured name (80 Byte) (from ENI file)

EC_T_DWORD **dwHCGroupIdx**
[out] Index of the hot connect group, 0 for mandatory

EC_T_BOOL **bIsPresent**
[out] Slave is currently present on bus

EC_T_BOOL **bIsHCGroupPresent**
[out] Slave's hot connect group is currently present on bus

EC_T_DWORD **dwVendorId**
[out] Vendor identification (from ENI file)

EC_T_DWORD **dwProductCode**
[out] Product code (from ENI file)

EC_T_DWORD **dwRevisionNumber**
[out] Revision number (from ENI file)

EC_T_DWORD **dwSerialNumber**
[out] Serial number (from ENI file)

EC_T_WORD **wStationAddress**
[out] The slave's station address (from ENI file)

EC_T_WORD **wAutoIncAddress**
[out] The slave's auto increment address (from ENI file)

EC_T_DWORD **dwPdOffsIn**
[out] Process input data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeIn**
[out] Process input data bit size (from ENI file)

EC_T_DWORD **dwPdOffsOut**
[out] Process output data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeOut**
[out] Process output data bit size (from ENI file)

EC_T_DWORD **dwPdOffsIn2**
[out] 2nd sync unit process input data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeIn2**
[out] 2nd sync unit process input data bit size (from ENI file)

EC_T_DWORD **dwPdOffsOut2**
[out] 2nd sync unit process output data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeOut2**
[out] 2nd sync unit process output data bit size (from ENI file)

EC_T_DWORD **dwPdOffsIn3**
[out] 3rd sync unit process input data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeIn3**
[out] 3rd sync unit process input data bit size (from ENI file)

EC_T_DWORD **dwPdOffsOut3**
[out] 3rd sync unit process output data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeOut3**
[out] 3rd sync unit process output data bit size (from ENI file)

EC_T_DWORD **dwPdOffsIn4**
[out] 4th sync unit process input data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeIn4**
[out] 4th sync unit process input data bit size (from ENI file)

EC_T_DWORD **dwPdOffsOut4**
[out] 4th sync unit process output data bit offset (from ENI file)

EC_T_DWORD **dwPdSizeOut4**
[out] 4th sync unit process output data bit size (from ENI file)

EC_T_DWORD **dwMbxSupportedProtocols**
[out] Mailbox protocols supported by the slave (from ENI file). Combination of EC_MBX_PROTOCOL_ flags

EC_T_DWORD **dwMbxOutSize**
[out] Mailbox output byte size (from ENI file)

EC_T_DWORD **dwMbxInSize**
[out] Mailbox input byte size (from ENI file)

EC_T_DWORD **dwMbxOutSize2**
[out] Bootstrap mailbox output byte size (from ENI file)

EC_T_DWORD **dwMbxInSize2**
[out] Bootstrap mailbox input byte size (from ENI file)

EC_T_BOOL **bDcSupport**
[out] Slave supports DC (from ENI file)

EC_T_WORD **wNumProcessVarsInp**
[out] Number of input process data variables (from ENI file)

EC_T_WORD **wNumProcessVarsOutp**
[out] Number of output process data variables (from ENI file)

EC_T_WORD **wPrevStationAddress**
[out] Station address of the previous slave (from ENI file)

EC_T_WORD **wPrevPort**
[out] Connected port of the previous slave (from ENI file)

EC_T_WORD **wIdentifyAdo**
[out] ADO used for identification command (from ENI file)

EC_T_WORD **wIdentifyData**
[out] Identification value to be validated (from ENI file)

EC_T_BYTE **byPortDescriptor**
[out] Port descriptor (ESC register 0x0007) (from ENI file)

EC_T_WORD **wWkcStateDiagOffsIn**[EC_CFG_SLAVE_PD_SECTIONS]
[out] Offset of WkcState bit in diagnosis image (ENI: ProcessData/Recv[1..4]/BitStart) WkcState bit values: 0 = Data Valid, 1 = Data invalid

EC_T_WORD **wWkcStateDiagOffsOut**[EC_CFG_SLAVE_PD_SECTIONS]
[out] Offset of WkcState bit in diagnosis image (ENI: ProcessData/Send[1..4]/BitStart) WkcState bit

values: 0 = Data Valid, 1 = Data invalid

EC_T_WORD **awMasterSyncUnitIn**[EC_CFG_SLAVE_PD_SECTIONS]
[out] Sync Unit (ENI: ProcessData/TxPdo[1..4]@Su)

EC_T_WORD **awMasterSyncUnitOut**[EC_CFG_SLAVE_PD_SECTIONS]
[out] Sync Unit (ENI: ProcessData/RxPdo[1..4]@Su)

EC_T_BOOL **bDisabled**
[out] Slave disabled by API (emSetSlaveDisabled / emSetSlavesDisabled).

EC_T_BOOL **bDisconnected**
[out] Slave disconnected by API (emSetSlaveDisconnected / emSetSlavesDisconnected).

EC_T_BOOL **bExtended**
[out] Slave generated by emConfigExtend

Flags EC_MBX_PROTOCOL_

EC_MBX_PROTOCOL_AOE

EC_MBX_PROTOCOL_EOE

EC_MBX_PROTOCOL_COE

EC_MBX_PROTOCOL_FOE

EC_MBX_PROTOCOL_SOE

EC_MBX_PROTOCOL_VOE

7.4.21 emGetBusSlaveInfo

EC_T_DWORD **emGetBusSlaveInfo** (
EC_T_DWORD dwInstanceID,
EC_T_BOOL bFixedAddressing,
EC_T_WORD wSlaveAddress,
EC_T_BUS_SLAVE_INFO *pSlaveInfo
)
Return information about a slave connected to the EtherCAT bus.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **bFixedAddressing** – [in] EC_TRUE: use station address, EC_FALSE: use AutoInc address
- **wSlaveAddress** – [in] Slave address according bFixedAddressing
- **pSlaveInfo** – [out] Information from the slave.

Returns

- EC_E_NOERROR if successful
- EC_E_NOTFOUND if the slave with the given address does not exist

struct **EC_T_BUS_SLAVE_INFO**

Public Members

EC_T_DWORD **dwSlaveId**
[out] The slave's ID to bind bus slave and config slave information

EC_T_DWORD **adwPortSlaveIds**[ESC_PORT_COUNT]
[out] The slave's ID of the slaves connected to ports. See port slave ID's

EC_T_WORD **wPortState**

[out] Port link state. Format: wwww xxxx yyyy zzzz (each nibble : port 3210)

wwww : Signal detected 1=yes, 0=no

xxxx : Loop closed 1=yes, 0=no

yyyy : Link established 1=yes, 0=no

zzzz : Slave connected 1=yes, 0=no (zzzz = logical result of w,x,y)

EC_T_WORD **wAutoIncAddress**
[out] The slave's auto increment address

EC_T_BOOL **bDcSupport**
[out] Slave supports DC (Bus Topology Scan)

EC_T_BOOL **bDc64Support**
[out] Slave supports 64 Bit DC (Bus Topology Scan)

EC_T_DWORD **dwVendorId**
[out] Vendor Identification stored in the EEPROM at offset 0x0008

EC_T_DWORD **dwProductCode**
[out] Product Code stored in the EEPROM at offset 0x000A

EC_T_DWORD **dwRevisionNumber**
[out] Revision number stored in the EEPROM at offset 0x000C

EC_T_DWORD **dwSerialNumber**
[out] Serial number stored in the EEPROM at offset 0x000E

EC_T_BYTE **byESCType**
[out] Type of ESC (Value of slave ESC register 0x0000)

EC_T_BYTE **byESCRevision**
[out] Revision number of ESC (Value of slave ESC register 0x0001)

EC_T_WORD **wESCBuild**
[out] Build number of ESC (Value of slave ESC register 0x0002)

EC_T_BYTE **byPortDescriptor**
[out] Port descriptor (Value of slave ESC register 0x0007)

EC_T_WORD **wFeaturesSupported**
[out] Features supported (Value of slave ESC register 0x0008)

EC_T_WORD **wStationAddress**
[out] The slave's station address (Value of slave ESC register 0x0010)

EC_T_WORD **wAliasAddress**
[out] The slave's alias address (Value of slave ESC register 0x0012)

EC_T_WORD **wAlStatus**
[out] AL status (Value of slave ESC register 0x0130)

EC_T_WORD **wAlStatusCode**
[out] AL status code. (Value of slave ESC register 0x0134 during last error acknowledge). This value is reset after a slave state change

EC_T_DWORD **dwSystemTimeDifference**
[out] System time difference. (Value of slave ESC register 0x092C)

EC_T_WORD **wMbxSupportedProtocols**
[out] Supported Mailbox Protocols stored in the EEPROM at offset 0x001C

EC_T_WORD **wDlStatus**
[out] DL status (Value of slave ESC register 0x0110)

EC_T_WORD **wPrevPort**
[out] Connected port of the previous slave

EC_T_WORD **wIdentifyData**
[out] Last read identification value see *EC_T_CFG_SLAVE_INFO.wIdentifyAdo*

EC_T_BOOL **bLineCrossed**
[out] Line crossed was detetected at this slave

EC_T_DWORD **dwSlaveDelay**
[out] Delay behind slave in ns. This value is only valid if a DC configuration is used

EC_T_DWORD **dwPropagDelay**
[out] Propagation delay in ns. ESC register 0x0928,This value is only valid if a DC configuration is used

EC_T_BOOL **bIsRefClock**
[out] Slave is reference clock

EC_T_BOOL **bIsDeviceEmulation**
[out] Slave without Firmware. ESC register 0x0141, enabled by EEPROM offset 0x0000.8.

EC_T_WORD **wLineCrossedFlags**
[out] Combination of EC_LINECROSSED_ flags

Port Slave ID's

MASTER_SLAVE_ID

MASTER_RED_SLAVE_ID

EL9010_SLAVE_ID

FRAMELOSS_SLAVE_ID

JUNCTION_RED_FLAG

Flags EC_LINECROSSED_

EC_LINECROSSED_NOT_CONNECTED_PORTA

EC_LINECROSSED_UNEXPECTED_INPUT_PORT

EC_LINECROSSED_UNEXPECTED_JUNCTION_RED

EC_LINECROSSED_UNRESOLVED_PORT_CONNECTION

EC_LINECROSSED_HIDDEN_SLAVE_CONNECTED

EC_LINECROSSED_PHYSIC_MISMATCH

EC_LINECROSSED_INVALID_PORT_CONNECTION

7.5 Diagnosis, error detection, error notifications

In case of errors on the bus or in one or multiple slaves the EtherCAT master stack will notify the application about such an event. The master automatically detects unexpected slaves states by evaluating the AL Status event interrupt. If the interrupt is set, the master reads the state of each slave and compares it to the expected (required) state. In case of a state mismatch the master generates the notification notification:emNotify - EC_NOTIFY_SLAVE_UNEXPECTED_STATE. The application will then have to enter an error handling procedure.

The error notifications can be separated into two classes:

1. Slave unrelated errors
2. Slave related errors

A slave related error notification will also contain the information about which slave has generated an error. If for example a slave could not be set into the requested state the application will get the notification:emNotify - EC_NOTIFY_SLAVE_INITCMD_RESPONSE_ERROR error notification including slave related information. A slave unrelated error does not contain this information even if one specific slave caused the error. For example if one or multiple slaves are powered off the working counter of the cyclic commands would be wrong. In that case the notification:emNotify - EC_NOTIFY_CYCCMD_WKC_ERROR error notification will be generated.

Example Error Scenario

Slave is powered off or disconnected while bus is operational

If the master is operational it cyclically sends EtherCAT commands to read and write the slave's process data. It expects the working counter to be incremented to the appropriate value. If one slave is powered off the master will generate the notification:emNotify - EC_NOTIFY_CYCCMD_WKC_ERROR to indicate such an event. Also the master detects a DL status event and performs a bus scan as reaction on this. For the not reachable slaves (powered off or disconnected) the master generates the notification *emNotify - EC_NOTIFY_SLAVE_PRESENCE*.

A possible error recovery scenario would be to stay operational and in parallel wait until the slave is powered on again. The next step would be to determine the slave's state and set it operational again:

Master calls notification:emNotify - EC_NOTIFY_CYCCMD_WKC_ERROR

- Application gets informed
- WKC State in Diagnosis Image changes

See also:

software-integration:WKC State in Diagnosis Image

Use cases

1. **Slave is disconnected or powered off:**

   - Master detects a DL status event interrupt an performs a bus scan.
   - Master calls *emNotify - EC_NOTIFY_SLAVE_PRESENCE*

- Application gets informed and could set the whole master into a lower state, e.g. `eEcatState_INIT`

2. **Slave state is not OPERATIONAL anymore**

   - Master calls notification:emNotify - EC_NOTIFY_SLAVE_UNEXPECTED_STATE
   - Application gets informed and could either set the whole master into lower state (e.g. `eEcatState_PREOP`), or calls `emSetSlaveState()` to repair the failed slave.

3. **Slave is re-connected or powered on:**

   - Master detects a DL status event interrupt an performs a bus scan.
   - Master calls *emNotify - EC_NOTIFY_SLAVE_PRESENCE*.
   - Application could wait until all slaves are re-connected by calling the functions *`emGetNumConnectedSlaves()`* and *`emGetNumConfiguredSlaves()`*.
   - After all slaves are re-connected the application could either set the whole master to `eEcatState_INIT` and afterwards to `eEcatState_OP`, or the application uses `emSetSlaveState()` to repair only the failed slaves.

7.5.1 emIoControl - EC_IOCTL_SB_STATUS_GET

This call will get the status of the last bus scan.

emIoControl - EC_IOCTL_SB_STATUS_GET

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Pointer to EC_T_SB_STATUS_NTFY_DESC.
- `dwOutBufSize`: [in] Size of the output buffer in bytes.
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

See also:

notification:emNotify - EC_NOTIFY_SB_STATUS

7.5.2 emIoControl - EC_IOCTL_GET_SLVSTATISTICS

Get Slave's statistics counter. Counters are collected on a regularly base (default: off) and show errors on Ethernet Layer.

emIoControl - EC_IOCTL_GET_SLVSTATISTICS

Parameter

- `pbyInBuf`: [in] Pointer to a EC_T_DWORD type variable containing the slave id.
- `dwInBufSize`: [in] Size of the input buffer provided at pbyInBuf in bytes.
- `pbyOutBuf`: [out] Pointer to struct EC_T_SLVSTATISTICS_DESC

- `dwOutBufSize`: [in] Size of the output buffer provided at pbyOutBuf in bytes.
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

struct **EC_T_SLVSTATISTICS_DESC**

Public Members

EC_T_BYTE **abyInvalidFrameCnt**[ESC_PORT_COUNT]
[out] Invalid Frame Counters per Slave Port

EC_T_BYTE **abyRxErrorCnt**[ESC_PORT_COUNT]
[out] RX Error Counters per Slave Port

EC_T_BYTE **abyFwdRxErrorCnt**[ESC_PORT_COUNT]
[out] Forwarded RX Error Counters per Slave Port

EC_T_BYTE **byProcessingUnitErrorCnt**
[out] Processing Unit Error Counter

EC_T_BYTE **byPdiErrorCnt**
[out] PDI Error Counter

EC_T_WORD **wAlStatusCode**
[out] AL Status Code

EC_T_BYTE **abyLostLinkCnt**[ESC_PORT_COUNT]
[out] Lost Link Counters per Slave Port

EC_T_UINT64 **qwReadTime**
[out] Timestamp of the last read [nsec]

EC_T_UINT64 **qwChangeTime**
[out] Timestamp of the last counter change [nsec]

7.5.3 emGetSlaveStatistics

EC_T_DWORD **emGetSlaveStatistics** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwSlaveId,
EC_T_SLVSTATISTICS_DESC *pSlaveStatisticsDesc
)
Get Slave's statistics counter.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwSlaveId** – [in] Slave id
- **pSlaveStatisticsDesc** – [out] Pointer to structure *EC_T_SLVSTATISTICS_DESC*

Returns
EC_E_NOERROR or error code

See also:

- *emIoControl - EC_IOCTL_GET_SLVSTATISTICS*
- *emGetSlaveId()*

7.5.4 emIoControl - EC_IOCTL_CLR_SLVSTATISTICS

Clear all buffered error registers for all slaves. The actual counters on the slaves remain unchanged.

emIoControl - EC_IOCTL_CLR_SLVSTATISTICS

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

Return
EC_E_NOERROR or error code

7.5.5 emClearSlaveStatistics

EC_T_DWORD **emClearSlaveStatistics** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwSlaveId
)
Clears all error registers of a slave.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwSlaveId** – [in] Slave Id, INVALID_SLAVE_ID clears all slaves

Returns
EC_E_NOERROR or error code

Note: Only the buffered error register values are deleted. The actual counters on the slaves remain unchanged.

See also:

emGetSlaveId()

7.6 Link Layer Control Interface

7.6.1 emIoControl - EC_IOCTL_ISLINK_CONNECTED

emIoControl - EC_IOCTL_ISLINK_CONNECTED

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Pointer to buffer of type struct EC_T_LINK_CONNECTED_INFO
- `dwOutBufSize`: [in] Size of the output buffer in bytes, sizeof(EC_T_LINK_CONNECTED_INFO)
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer

Return
EC_E_NOERROR or error code

struct **EC_T_LINK_CONNECTED_INFO**

Public Members

EC_T_BOOL **bConnected**
[out] MAIN or RED link detected

EC_T_BOOL **bSendEnabled**
[out] send enabled on MAIN or RED

EC_T_BOOL **bMainConnected**
[out] MAIN link detected

EC_T_BOOL **bMainMasked**
[out] MAIN link not used for sending, because topology changed delay not elapsed yet

EC_T_BOOL **bRedConnected**
[out] RED link detected

EC_T_BOOL **bRedMasked**
[out] RED link not used for sending, because topology changed delay not elapsed yet

7.6.2 emIoControl - EC_IOCTL_GET_LINKLAYER_MODE

emIoControl - EC_IOCTL_GET_LINKLAYER_MODE

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Pointer to buffer of type struct EC_T_LINKLAYER_MODE_DESC

- `dwOutBufSize`: [in] Size of the output buffer in bytes, sizeof(EC_T_LINKLAYER_MODE_DESC)
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer

Return
EC_E_NOERROR or error code

struct **`EC_T_LINKLAYER_MODE_DESC`**

Public Members

EC_T_LINKMODE **`eLinkMode`**
[out] Operation mode of main interface

EC_T_LINKMODE **`eLinkModeRed`**
[out] Operation mode of redundancy interface

7.6.3 emIoControl - EC_LINKIOCTL...

The generic control interface provides access to the main network adapter when adding `EC_IOCTL_LINKLAYER_MAIN` to the `EC_LINKIOCTL` parameter at dwCode.

```
EC_T_DWORD dwCode = (EC_IOCTL_LINKLAYER_MAIN | EC_LINKIOCTL_GET_ETHERNET_ADDRESS);
```

7.6.4 emIoControl - EC_LINKIOCTL_GET_ETHERNET_ADDRESS

Provides MAC addresses of main or red line.

emIoControl - EC_LINKIOCTL_GET_ETHERNET_ADDRESS

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Pointer to MAC address buffer (6 bytes).
- `dwOutBufSize`: [in] Size of the output buffer in bytes (at least 6).
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

7.6.5 emIoControl - EC_LINKIOCTL_GET_SPEED

emIoControl - EC_LINKIOCTL_GET_SPEED

Parameter

- `pbyInBuf`: [in] Should be set to EC_NULL
- `dwInBufSize`: [in] Should be set to 0
- `pbyOutBuf`: [out] Pointer to EC_T_DWORD. Set by Link Layer driver to 10/100/1000.
- `dwOutBufSize`: [in] Size of the output buffer in bytes.
- `pdwNumOutData`: [out] Pointer to EC_T_DWORD. Amount of bytes written to the output buffer.

Return
EC_E_NOERROR or error code

7.7 EtherCAT Mailbox Transfer

To be able to initiate a mailbox transfer the client has to create a mailbox transfer object first. This mailbox transfer object also contains the memory where the data to be transferred is stored. The one client that initiated the mailbox transfer will be notified about a mailbox transfer completion by the `emNotify()` callback function.

To be able to identify the transfer which was completed the client has to assign a unique transfer identifier for each mailbox transfer. The mailbox transfer object can only be used for one single mailbox transfer. If multiple transfers shall be initiated in parallel the client has to create one transfer object for each. The transfer object can be re-used after mailbox transfer completion.

Typical mailbox transfer sequence:

1. Record a mailbox transfer.
2. **Create a transfer object (for example a SDO download transfer object).**

```
MbxTferDesc.dwMaxDataLen = 10

MbxTferDesc.pbyMbxTferDescData = (EC_T_PBYTE)OsMalloc(MbxTferDesc.
↪dwMaxDataLen)

pMbxTfer = emMbxTferCreate(&MbxTferDesc)
    state of the transfer object = Idle
```

3. **Set the location to write the transferred data to, determine the transfer ID, store the client ID in the object and initiate the transfer (e.g. a SDO upload). A transfer may only be initiated if the state of the transfer object is Idle.**

```
pMbxTfer->dwDataLen = MbxTferDesc.dwMaxDataLen;

pMbxTfer->pbyMbxTferData = MbxTferDesc.pbyMbxTferDescData

pMbxTfer->dwTferId = 1;

pMbxTfer->dwClntId = dwClntId;


dwResult = emCoeSdoUplodadReq(pMbxTfer, dwSlaveId, wObIndex, ...);
    state of the transfer object = Pend or TferReqError
```

The state will then be set to Pend to indicate that this mailbox transfer object currently is in use and the transfer is not completed. If the mailbox transfer cannot be initiated the master will set the object into the state TferReqError - in such cases the client is responsible to set the state back into Idle.

4. **If the mailbox transfer is completed the notification callback function of the corresponding client (`emNotify()`) will be called with a pointer to the mailbox transfer object. The state of the transfer object is set to TferDone prior to calling `emNotify()`.**

```
if( dwResult != EC_E_NOERROR ) { ... }

emNotify( EC_NOTIFY_MBOXRCV, pParms )
    state of the transfer object = TferDone
```

5. **In case of errors the appropriate error handling has to be executed. Application must set the transfer object state to Idle.**

```
if( pMbxTfer->dwErrorCode != EC_E_NOERROR ) { ... }
    In emNotify: application may set transfer object state to Idle
```

6. **Delete the transfer object. Alternatively this object can be used for the next transfer.**

```
emMbxTferDelete(pMbxTfer);
```

7.7.1 Mailbox transfer object states

The following states exist for a mailbox transfer object:

enum **EC_T_MBXTFER_STATUS**
Values:

enumerator **eMbxTferStatus_Idle**
Mailbox transfer object not in use

enumerator **eMbxTferStatus_Pend**
Mailbox transfer in process

enumerator **eMbxTferStatus_TferDone**
Mailbox transfer completed

enumerator **eMbxTferStatus_TferReqError**
Mailbox transfer request error

enumerator **eMbxTferStatus_TferWaitingForContinue**
Mailbox transfer waiting for continue, object owned by application

enumerator **eMbxTferStatus_BCppDummy**

A mailbox transfer will be processed by the monitor independently from the client's timeout setting. Some types of mailbox transfers can be cancelled by the client, e.g. if the client's timeout elapsed.

After completion of the mailbox transfer (with timeout and the client may finally set the transfer object into the state *EC_T_MBXTFER_STATUS::eMbxTferStatus_Idle*. New mailbox transfers can only be requested if the object is in the state *EC_T_MBXTFER_STATUS::eMbxTferStatus_Idle*.

7.7.2 Mailbox transfer object

struct **EC_T_MBXTFER**

Public Members

EC_T_DWORD **dwClntId**
[] Client ID

EC_T_MBXTFER_DESC **MbxTferDesc**
[out] Mailbox transfer descriptor. All elements of pMbxTferDesc will be stored here

EC_T_MBXTFER_TYPE **eMbxTferType**
[] This type information is written to the Mailbox Transfer Object by the last call to a mailbox command function. It may be used as an information, and is required to fan out consecutive notifications. This value is only valid until next mailbox relevant API call, where this value may be overwritten

EC_T_DWORD **dwDataLen**
[] Amount of data bytes for the next mailbox transfer. If the mailbox transfer does not transfer data from or to the slave this parameter will be ignored. This element has to be set to an appropriate value every time prior to initiate a new request. When the transfer is completed (emNotify) this value will contain the amount of data that was actually transferred

EC_T_BYTE ***pbyMbxTferData**
[in/out] Pointer to data. In case of a download transfer the client has to store the data in this location. In case of an upload transfer this element points to the received data. Access to data that was uploaded from a slave is only valid within the notification function because the buffer will be re-used by the master “this data has to be copied into a separate buffer in case it has to be used later by the client

EC_T_MBXTFER_STATUS **eTferStatus**
[out] Transfer state. After a new transfer object is created the state will be set to eMbxTferStatus_Idle

EC_T_DWORD **dwErrorCode**
[out] Error code of a mailbox transfer that was terminated with error

EC_T_DWORD **dwTferId**
[] Transfer ID. For every new mailbox transfer a unique ID has to be assigned. This ID can be used after mailbox transfer completion to identify the transfer

EC_T_MBX_DATA **MbxData**
[] Mailbox data. This element contains mailbox transfer data, e.g. the CoE object dictionary list.

enum **EC_T_MBXTFER_TYPE**
Values:

enumerator **eMbxTferType_COE_SDO_DOWNLOAD**
CoE SDO download

enumerator **eMbxTferType_COE_SDO_UPLOAD**
CoE SDO upload

enumerator **eMbxTferType_COE_GETODLIST**
CoE Get object dictionary list

enumerator **eMbxTferType_COE_GETOBDESC**
CoE Get object description

enumerator **eMbxTferType_COE_GETENTRYDESC**
CoE Get object entry description

enumerator **eMbxTferType_COE_EMERGENCY**
CoE emergency request

enumerator **eMbxTferType_COE_RX_PDO**
CoE RxPDO

enumerator **eMbxTferType_FOE_FILE_UPLOAD**
FoE upload

enumerator **eMbxTferType_FOE_FILE_DOWNLOAD**
FoE download

enumerator **eMbxTferType_SOE_READREQUEST**
SoE read request

enumerator **eMbxTferType_SOE_READRESPONSE**
SoE read response

enumerator **eMbxTferType_SOE_WRITEREQUEST**
SoE write request

enumerator **eMbxTferType_SOE_WRITERESPONSE**
SoE write response

enumerator **eMbxTferType_SOE_NOTIFICATION**
SoE notification

enumerator **eMbxTferType_SOE_EMERGENCY**
SoE emergency

enumerator **eMbxTferType_VOE_MBX_READ**
VoE read

enumerator **eMbxTferType_VOE_MBX_WRITE**
VoE write

enumerator **eMbxTferType_AOE_READ**
AoE read

enumerator **eMbxTferType_AOE_WRITE**
AoE write

enumerator **eMbxTferType_AOE_READWRITE**
AoE read/write

enumerator **eMbxTferType_AOE_WRITECONTROL**
AoE write control

enumerator **eMbxTferType_RAWMBX**
Raw mbx

enumerator **eMbxTferType_FOE_SEG_DOWNLOAD**
FoE segmented download

enumerator **eMbxTferType_FOE_SEG_UPLOAD**
FoE segmented upload

enumerator **eMbxTferType_S2SMBX**
S2S mbx

enumerator **eMbxTferType_BCppDummy**

union **EC_T_MBX_DATA**

Public Members

EC_T_AOE_CMD_RESPONSE **AoE_Response**
AoE, Class A

EC_T_MBX_DATA_COE **CoE**
CoE

EC_T_COE_ODLIST **CoE_ODList**
CoE Object Dictionary list

EC_T_COE_OBDESC **CoE_ObDesc**
CoE object description

EC_T_COE_ENTRYDESC **CoE_EntryDesc**
CoE entry description

EC_T_COE_EMERGENCY **CoE_Emergency**
CoE emergency data

EC_T_MBX_DATA_COE_INITCMD **CoE_InitCmd**
CoE InitCmd

EC_T_MBX_DATA_FOE **FoE**
FoE, Class A

EC_T_MBX_DATA_SOE **SoE**
SoE

EC_T_SOE_NOTIFICATION **SoE_Notification**
SoE notification request

EC_T_SOE_EMERGENCY **SoE_Emergency**
SoE emergency request

7.7.3 emNotify - EC_NOTIFY_MBOXRCV

Indicates a mailbox transfer completion.

emNotify - EC_NOTIFY_MBOXRCV

Parameter

- `pbyInBuf`: [in] Pointer to a structure of type EC_T_MBXTFER, contains the corresponding mailbox transfer object.
- `dwInBufSize`: [in] Size of the transfer object provided at pbyInBuf in bytes.
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

The element *EC_T_MBXTFER::dwClntId* contains the corresponding ID of the client that is notified, the corresponding transfer ID can be found in *EC_T_MBXTFER::dwTferId*. The transfer result is stored in *EC_T_MBXTFER::dwErrorCode*.

On error *EC_T_MBXTFER::eTferStatus* is *eMbxTferStatus_TferReqError*, on success *eMbxTferStatus_TferDone*. In order to reuse the transfer object the application must set it back to *eMbxTferStatus_Idle*.

The *EC_T_MBXTFER::eMbxTferType* element determines the mailbox transfer type (e.g. *eMbxTferType_COE_SDO_DOWNLOAD* for a completion of a CoE SDO download transfer).

7.8 CAN application protocol over EtherCAT (CoE)

7.8.1 emCoeSdoUpload

EC_T_DWORD **emCoeSdoUpload** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwSlaveId,
EC_T_WORD wObIndex,
EC_T_BYTE byObSubIndex,
EC_T_BYTE *pbyData,
EC_T_DWORD dwDataLen,
EC_T_DWORD *pdwOutDataLen,
EC_T_DWORD dwTimeout,
EC_T_DWORD dwFlags
)

Execute a CoE SDO upload from an EtherCAT slave device to the master.

This function may not be called from within the JobTask's context.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwSlaveId** – [in] Slave ID
- **wObIndex** – [in] Object index.
- **byObSubIndex** – [in] Object sub index. 0 or 1 if Complete Access.
- **pbyData** – [out] Buffer receiving transfered data
- **dwDataLen** – [in] Buffer length [bytes]

- **pdwOutDataLen** – [out] Length of received data [byte]
- **dwTimeout** – [in] Timeout [ms]
- **dwFlags** – [in] Mailbox Flags. Bit 0: set if Complete Access (EC_MAILBOX_FLAG_SDO_COMPLETE).

Returns
EC_E_NOERROR or error code

Limitation

- Only CoE entries which have been received by the EcMonitor can be retrieved
- CoE objects read via complete access, can only be retrieved as complete access.
- When switching between complete access and access via subindexes the corresponding CoE object is overwritten.

See also:

emGetSlaveId()

7.8.2 emCoeSdoUploadReq

EC_T_DWORD **emCoeSdoUploadReq** (
EC_T_DWORD dwInstanceID,
EC_T_MBXTFER *pMbxTfer,
EC_T_DWORD dwSlaveId,
EC_T_WORD wObIndex,
EC_T_BYTE byObSubIndex,
EC_T_DWORD dwTimeout,
EC_T_DWORD dwFlags
)

Initiates a CoE SDO upload from an EtherCAT slave device to the master and returns immediately.

The length of the data to be uploaded must be set in *EC_T_MBXTFER.dwDataLen*. A unique transfer ID must be written into *EC_T_MBXTFER.dwTferId*. EC_NOTIFY_MBOXRCV is given on completion.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **pMbxTfer** – [in] Mailbox transfer object created with emMbxTferCreate
- **dwSlaveId** – [in] Slave ID
- **wObIndex** – [in] Object index
- **byObSubIndex** – [in] Object sub index. 0 or 1 if Complete Access.
- **dwTimeout** – [in] Timeout [ms]
- **dwFlags** – [in] Mailbox Flags. Bit 0: set if Complete Access (EC_MAILBOX_FLAG_SDO_COMPLETE).

Returns
EC_E_NOERROR or error code

Limitation

- Only CoE entries which have been received by the EcMonitor can be retrieved
- CoE objects read via complete access, can only be retrieved as complete access.

- When switching between complete access and access via subindexes the corresponding CoE object is overwritten.

See also:

- *emNotify - eMbxTferType_COE_SDO_UPLOAD*
- *emGetSlaveId()*

7.8.3 emNotify - eMbxTferType_COE_SDO_DOWNLOAD

SDO download transfer completion.

emNotify - eMbxTferType_COE_SDO_DOWNLOAD

Parameter

- pbyInBuf: [in] Pointer to a structure of type EC_T_MBXTFER, this structure contains the corresponding mailbox transfer object.
- dwInBufSize: [in] Size of the transfer object pbyInBuf in bytes.
- pbyOutBuf: [out] Should be set to EC_NULL
- dwOutBufSize: [in] Should be set to 0
- pdwNumOutData: [out] Should be set to EC_NULL

The transfer result is stored in *EC_T_MBXTFER::dwErrorCode*. The request parameters stored in element *EC_T_MBX_DATA::CoE* of type *EC_T_MBX_DATA_COE* are part of *EC_T_MBXTFER::MbxData*. The SDO data stored in *EC_T_MBXTFER::pbyMbxTferData*.

struct **EC_T_MBX_DATA_COE**

Public Members

EC_T_WORD **wStationAddress**
Station address of the slave

EC_T_WORD **wIndex**
Object index

EC_T_BYTE **bySubIndex**
Object subindex

EC_T_BOOL **bCompleteAccess**
Complete access

7.8.4 emNotify - eMbxTferType_COE_SDO_UPLOAD

SDO upload transfer completion.

emNotify - eMbxTferType_COE_SDO_UPLOAD

Parameter

- `pbyInBuf`: [in] Pointer to a structure of type EC_T_MBXTFER, contains the corresponding mailbox transfer object.
- `dwInBufSize`: [in] Size of the transfer object in bytes.
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

The transfer result is stored in *EC_T_MBXTFER::dwErrorCode*. The request parameters stored in element *EC_T_MBX_DATA::CoE* of type *EC_T_MBX_DATA_COE* are part of *EC_T_MBXTFER::MbxData*. The SDO data stored in *EC_T_MBXTFER::pbyMbxTferData*.

7.8.5 CoE Emergency (emNotify - eMbxTferType_COE_EMERGENCY)

Indication of a CoE emergency request. A mbx_tfer:emNotify - EC_NOTIFY_MBOXRCV is given with *EC_T_MBXTFER::eMbxTferType* = *EC_T_MBXTFER_TYPE::eMbxTferType_COE_EMERGENCY*.

emNotify - eMbxTferType_COE_EMERGENCY

Parameter

- `pbyInBuf`: [in] Pointer to a structure of type EC_T_MBXTFER, contains the corresponding mailbox transfer object.
- `dwInBufSize`: [in] Size of the transfer object in bytes.
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

In case of an emergency notification all registered clients will get this notification. The corresponding mailbox transfer object will be created. *EC_T_MBXTFER::dwTferId* is undefined as it is not needed by the client. The transfer result is stored in *EC_T_MBXTFER::dwErrorCode*.

The emergency data stored in element *EC_T_MBX_DATA::CoE_Emergency* of type *EC_T_COE_EMERGENCY* is part of *EC_T_MBXTFER::MbxData* and may have to be buffered by the client. Access to the memory area *EC_T_MBXTFER::MbxData* outside of the notification caller context is illegal and the results are undefined.

struct **EC_T_COE_EMERGENCY**

Public Members

EC_T_WORD **wErrorCode**
Error code according to EtherCAT specification

EC_T_BYTE **byErrorRegister**
Error register

EC_T_BYTE **abyData**[EC_COE_EMERGENCY_DATASIZE]
Error data

EC_T_WORD **wStationAddress**
Slave node address of the faulty slave

See also:

A more detailed description of the values can be found in the EtherCAT specification ETG.1000, section 5.

7.9 Hot Connect

7.9.1 emHCGetNumGroupMembers

EC_T_DWORD **emHCGetNumGroupMembers** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwGroupIndex
)
Get number of slaves belonging to a specific HotConnect group.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwGroupIndex** – [in] Index of HotConnect group, 0 is the mandatory group

Returns
Number of slaves belonging to specified HotConnect group

7.9.2 emHCGetSlaveIdsOfGroup

EC_T_DWORD **emHCGetSlaveIdsOfGroup** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwGroupIndex,
EC_T_DWORD *adwSlaveId,
EC_T_DWORD dwMaxNumSlaveIds
)
Return the list of ID referencing slaves belonging to a specific HotConnect group.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwGroupIndex** – [in] Index of HotConnect group, 0 is the mandatory group
- **adwSlaveId** – [out] DWORD array to carry slave ids of specified HotConncet group
- **dwMaxNumSlaveIds** – [in] size of adwSlaveId array

Returns
EC_E_NOERROR or error code

7.9.3 emNotify - EC_NOTIFY_HC_DETECTADDGROUPS

This notification is raised when HotConnect group detection is finished, after slave addition.

emNotify - EC_NOTIFY_HC_DETECTADDGROUPS

Parameter

- `pbyInBuf`: [in] pointer to notification descriptor EC_T_HC_DETECTALLGROUP_NTFY_DESC
- `dwInBufSize`: [in] sizeof(EC_T_HC_DETECTALLGROUP_NTFY_DESC)
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

struct **EC_T_HC_DETECTALLGROUP_NTFY_DESC**

Public Members

EC_T_DWORD **dwResultCode**
Result of Group detection

EC_T_DWORD **dwGroupCount**
Number of Groups

EC_T_DWORD **dwGroupsPresent**
Number of connected groups

EC_T_DWORD **dwGroupMask**
Bitmask of first 32 Groups 1 = present, 0 = absent

EC_T_DWORD **adwGroupMask**[100]
Bitmask of first 3200 Groups

7.9.4 emNotify - EC_NOTIFY_HC_PROBEALLGROUPS

This notification is raised when HotConnect Group Detection is finished, after Slave Disappearance.

emNotify - EC_NOTIFY_HC_PROBEALLGROUPS

Parameter

- `pbyInBuf`: [in] pointer to notification descriptor EC_T_HC_DETECTALLGROUP_NTFY_DESC
- `dwInBufSize`: [in] sizeof(EC_T_HC_DETECTALLGROUP_NTFY_DESC)
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

struct *EC_T_HC_DETECTALLGROUP_NTFY_DESC*

EC_T_DWORD dwResultCode
EC_T_DWORD dwGroupCount
EC_T_DWORD dwGroupsPresent
EC_T_DWORD dwGroupMask
EC_T_DWORD adwGroupMask[100]

7.9.5 emNotify - EC_NOTIFY_HC_TOPOCHGDONE

This notification is raised when HotConnect has completely processed a topology change.

emNotify - EC_NOTIFY_HC_TOPOCHGDONE

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_DWORD (EC_E_NOERROR on success, Error code otherwise)
- `dwInBufSize`: [in] sizeof(EC_T_DWORD)
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

The notification is raised when the slaves reached the current bus state.

8 Generic notification interface

One of the parameters the client has to set when registering with the EC-Monitor is a generic notification callback function (`emNotify()`). This function is called every time an event occurs about which the client needs to be informed.

Within this callback function the client must not call any active EtherCAT functions which finally would lead to send EtherCAT commands (e.g. initiation of mailbox transfers, starting/stopping the master, sending raw commands). In such cases the behavior is undefined. Only EtherCAT functions which are explicitly marked to be callable within `emNotify()` may be called.

This callback function is usually called in the context of the EC-Monitor timer thread or the EtherCAT Link Layer receiver thread. To avoid dead-lock situations the notification callback handler may not use mutex semaphores.

As the whole EtherCAT operation is blocked while calling this function the error handling must not use much CPU time or even call operating system functions that may block. Usually the error handling will be done in a separate application thread.

8.1 Notification callback

typedef *EC_T_DWORD* (**EC_PF_NOTIFY*)(*EC_T_DWORD* dwCode, *EC_T_NOTIFYPARMS* *pParms)

struct **EC_T_NOTIFYPARMS**

Public Members

EC_T_VOID ***pCallerData**
[in] Client depending caller data parameter. This pointer is one of the parameters when the client registers

EC_T_BYTE ***pbyInBuf**
[in] Notification input parameters

EC_T_DWORD **dwInBufSize**
[in] Size of input buffer in byte

EC_T_BYTE ***pbyOutBuf**
[out] Notification output (result)

EC_T_DWORD **dwOutBufSize**
[in] Size of output buffer in byte

EC_T_DWORD ***pdwNumOutData**
[out] Amount of bytes written to the output buffer

8.2 emNotifyApp

By calling this function the generic notification callback function setup by *emRegisterClient()* is called.

EC_T_DWORD **emNotifyApp** (
EC_T_DWORD dwInstanceID,
EC_T_DWORD dwCode,
EC_T_NOTIFYPARMS *pParms
)

Notify application.

By calling this function the generic notification callback function setup by emRegisterClient() is called. The maximum value for dwCode is defined by EC_NOTIFY_APP_MAX_CODE.

Parameters

- **dwInstanceID** – [in] Master Instance ID
- **dwCode** – [in] Application specific notification code
- **pParms** – [in] Parameters for application notification.

Returns
EC_E_NOERROR or error code

The maximum value for dwCode is defined by `EC_NOTIFY_APP_MAX_CODE`

8.3 Status notifications

8.3.1 emNotify - EC_NOTIFY_STATECHANGED

Notification about a change in the master's operational state. This notification is enabled by default.

emNotify - EC_NOTIFY_STATECHANGED

Parameter

- `pbyInBuf`: [in] Pointer to data of type EC_T_STATECHANGE which contains the old and the new master operational state.
- `dwInBufSize`: [in] Size of the input buffer provided at pbyInBuf in bytes.
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

struct **EC_T_STATECHANGE**

Public Members

EC_T_STATE **oldState**
old operational state

EC_T_STATE **newState**
new operational state

See also:

api:emIoControl - EC_IOCTL_SET_NOTIFICATION_ENABLED for how to control the deactivation

8.3.2 emNotify - EC_NOTIFY_HC_TOPOCHGDONE

This notification is raised when topology change has completely processed.

emNotify - EC_NOTIFY_HC_TOPOCHGDONE

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_DWORD (EC_E_NOERROR on success, Error code otherwise)
- `dwInBufSize`: [in] sizeof(EC_T_DWORD).
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

The notification is raised when the slaves have been detected and DC initialized.

8.4 Error notifications

For each error an error ID (error code) will be defined. This error ID will be used as the notification code when `emNotify()` is called. In addition to this notification code the second parameter given to `emNotify()` contains a pointer to an error notification descriptor of type *EC_T_ERROR_NOTIFICATION_DESC*. This error notification descriptor contains detailed information about the error.

struct **EC_T_ERROR_NOTIFICATION_DESC**

Public Members

EC_T_DWORD **dwNotifyErrorCode**
Error ID (same value as the notification code)

EC_T_CHAR **achErrorInfo**[MAX_ERRINFO_STRLEN]
Additional error string (may be empty)

union **_EC_T_ERROR_NOTIFICATION_PARM**

Public Members

EC_T_WKCERR_DESC **WkcErrDesc**
WKC error descriptor

EC_T_FRAME_RSPERR_DESC **FrameRspErrDesc**
Frame response error descriptor

EC_T_INITCMD_ERR_DESC **InitCmdErrDesc**
Master/Slave init command error descriptor

EC_T_SLAVE_ERROR_INFO_DESC **SlaveErrInfoDesc**
Slave Error Info Descriptor

EC_T_SLAVES_ERROR_DESC **SlavesErrDesc**
Slaves Error Descriptor

EC_T_MBOX_SDO_ABORT_DESC **SdoAbortDesc**
SDO Abort

EC_T_RED_CHANGE_DESC **RedChangeDesc**
Redundancy Descriptor

EC_T_MBOX_FOE_ABORT_DESC **FoeErrorDesc**
FoE error code and string

EC_T_MBXRCV_INVALID_DATA_DESC **MbxRcvInvalidDataDesc**
Invalid mailbox data received descriptor

EC_T_PDIWATCHDOG_DESC **PdiWatchdogDesc**
PDI Watchodg expired

EC_T_SLAVE_NOTSUPPORTED_DESC **SlaveNotSupportedDesc**
Slave not supported

EC_T_SLAVE_UNEXPECTED_STATE_DESC **SlaveUnexpectedStateDesc**
Slave in unexpected state

EC_T_SLAVES_UNEXPECTED_STATE_DESC **SlavesUnexpectedStateDesc**
Slaves in unexpected state

EC_T_EEPROM_CHECKSUM_ERROR_DESC **EEPROMChecksumErrorDesc**
EEPROM checksum error

EC_T_JUNCTION_RED_CHANGE_DESC **JunctionRedChangeDesc**
Junction redundancy change descriptor

EC_T_FRAMELOSS_AFTER_SLAVE_NTFY_DESC **FramelossAfterSlaveDesc**
Frameloss after Slave descriptor

EC_T_S2SMBX_ERROR_DESC **S2SMbxErrorDesc**
S2S Mailbox Error descriptor

EC_T_BAD_CONNECTION_NTFY_DESC **BadConnectionDesc**
Bad connection descriptor

If the pointer to this descriptor exists (is not set to `EC_NULL`) the detailed error information (e.g. information about the slave) is stored in the appropriate structure of a union. These error information structures are described in the following sections.

The EC-Monitor will call `emNotify()` every time an error is detected. In some cases this will lead to calling this function in every EtherCAT cycle (e.g. if there is no physical connection to the slaves). Using the control interface api:emIoControl - EC_IOCTL_SET_NOTIFICATION_ENABLED it is possible to determine which errors shall be signalled and which not.

8.4.1 emNotify - EC_NOTIFY_NOT_ALL_DEVICES_OPERATIONAL

When processing cyclic frames the EtherCAT master checks whether all slaves are still in OPERATIONAL state. If at least one slave device is not OPERATIONAL this error will be indicated.

8.4.2 emNotify - EC_NOTIFY_ALL_DEVICES_OPERATIONAL

When processing cyclic frames the EtherCAT master checks whether all slaves are still in OPERATIONAL state. This will be notified after *emNotify - EC_NOTIFY_NOT_ALL_DEVICES_OPERATIONAL* and all the slaves are back in OPERATIONAL state.

8.4.3 emNotify - EC_NOTIFY_CLIENTREGISTRATION_DROPPED

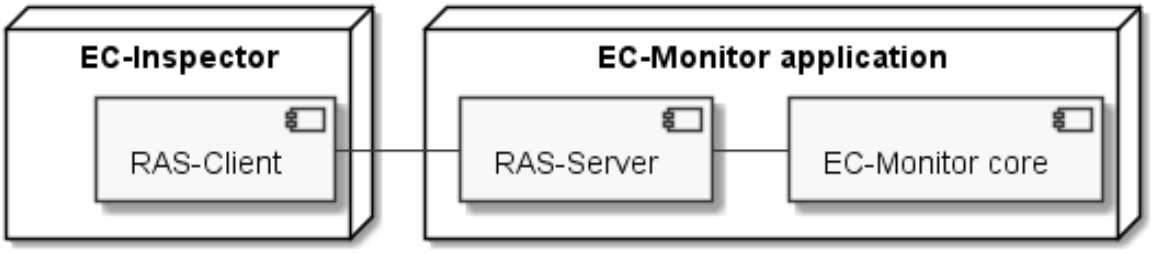
This notification will be indicated if the client registration was dropped because *emConfigureNetwork()* was called by another thread. The notification has the following parameter:

```
EC_T_DWORD dwDeinitForConfiguration; /* 0 = terminating Master, 1 = restarting␣
↪Master */
```

9 RAS-Server for EC-Inspector and EC-Engineer

9.1 Integration Requirements

To use the diagnosis tool EC-Inspector with a customer application, some modifications have to be done during integration of the EC-Monitor. The task is to integrate and start the Remote API Server system within the custom application, which provides a socket based uplink, which later on is connected by the EC-Inspector.



An example on how to integrate the Remote API Server within the application is given with the example application, which in case is pre-configured to listen for EC-Inspector on TCP Port 6000 when command line parameter "-sp" is given.

To clarify the steps, which are needed within a custom application, a developer may use the following pseudo-code segment as a point of start. The Remote API Server library "EcMonitorRasSrv.lib" (or respectively "EcMonitor-RasSrv.a") must be linked.

9.2 Application programming interface

9.2.1 emRasSrvStart

EC_T_DWORD EC_NAMESPACE::**emRasSrvStart** (
ATEMRAS_T_SRVPARMS *pParms,
EC_T_PVOID *ppHandle
)

Initializes and start remote API Server Instance.

Parameters

- **pParms** – [in] Server start-up parameters
- **ppHandle** – [out] Handle to opened instance, used for ctrl access

Returns

EC_E_NOERROR or error code

struct **ATEMRAS_T_SRVPARMS**

Public Members

EC_T_DWORD **dwSignature**
[in] Set to ATEMRASSRV_SIGNATURE

EC_T_DWORD **dwSize**
[in] Set to sizeof(ATEMRAS_T_SRVPARMS)

EC_T_LOG_PARMS **LogParms**
[in] Logging parameters

ATEMRAS_T_IPADDR **oAddr**
[in] Server Bind IP Address

EC_T_WORD **wPort**
[in] Server Bind IP Port

EC_T_WORD **wMaxClientCnt**
[in] Max. clients in parallel (0: unlimited)

EC_T_DWORD **dwCycleTime**
[in] Cycle Time of RAS Network access (acceptor, worker)

EC_T_DWORD **dwCommunicationTimeout**
[in] timeout before automatically closing connection

EC_T_CPUSET **oAcceptorThreadCpuAffinityMask**
[in] Acceptor Thread CPU affinity mask

EC_T_DWORD **dwAcceptorThreadPrio**
[in] Acceptor Thread Priority

EC_T_DWORD **dwAcceptorThreadStackSize**
[in] Acceptor Thread Stack Size

EC_T_CPUSET **oClientWorkerThreadCpuAffinityMask**
[in] Client Worker Thread CPU affinity mask

EC_T_DWORD **dwClientWorkerThreadPrio**
[in] Client Worker Thread Priority

EC_T_DWORD **dwClientWorkerThreadStackSize**
[in] Client Worker Thread Stack Size

EC_T_DWORD **dwMaxQueuedNotificationCnt**
[in] Amount of concurrently queue able Notifications

EC_T_DWORD **dwMaxParallelMbxTferCnt**
[in] Amount of concurrent active mailbox transfers

EC_PF_NOTIFY **pfnRasNotify**
[in] Function pointer called to notify error and status information generated by Remote API Layer

EC_T_VOID ***pvRasNotifyCtxt**
[in] Notification context returned while calling pfNotification

EC_T_DWORD **dwCycErrInterval**
[in] Interval which allows cyclic Notifications

9.2.2 emRasSrvStop

EC_T_DWORD EC_NAMESPACE::**emRasSrvStop**(
EC_T_PVOID pvHandle,
EC_T_DWORD dwTimeout
)
Stop and de-initialize remote API Server Instance.

Parameters

- **pvHandle** – [in] Handle to previously started Server
- **dwTimeout** – [in] Timeout [ms] used to shut down all spawned threads, it's multiplied internally by the amount of threads spawned.

Returns
EC_E_NOERROR or error code

9.2.3 emRasNotify

Callback function called by Remote API Server in case of State changes or error situations.

typedef *EC_T_DWORD* (*_EC_PF_NOTIFY_)(*EC_T_DWORD* dwCode, *EC_T_NOTIFYPARMS* *pParms)

9.2.4 emRasNotify - ATEMRAS_NOTIFY_CONNECTION

Notification about a change in the Remote API's state.

emRasNotify - ATEMRAS_T_CONNOTIFYDESC

Parameter

- pbyInBuf: [in] Pointer to data of type ATEMRAS_T_CONNOTIFYDESC
- dwInBufSize: [in] Size of the input buffer in bytes
- pbyOutBuf: [out] Should be set to EC_NULL
- dwOutBufSize: [in] Should be set to 0
- pdwNumOutData: [out] Should be set to EC_NULL

struct **ATEMRAS_T_CONNOTIFYDESC**

Public Members

EC_T_DWORD **dwCause**
[in] Cause of state connection state change

EC_T_DWORD **dwCookie**
[in] Unique identification cookie of connection instance.

9.2.5 emRasNotify - ATEMRAS_NOTIFY_REGISTER

Notification about a connected application registered a client to the EC-Monitor.

emRasNotify - ATEMRAS_NOTIFY_REGISTER

Parameter

- `pbyInBuf`: [in] Pointer to data of type ATEMRAS_T_REGNOTIFYDESC
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

struct **ATEMRAS_T_REGNOTIFYDESC**

Public Members

EC_T_DWORD **dwCookie**
[in] Unique identification cookie of connection instance

EC_T_DWORD **dwResult**
[in] Result of registration request

EC_T_DWORD **dwInstanceId**
[in] Master Instance client registered to

EC_T_DWORD **dwClientId**
[in] Client ID of registered client

9.2.6 emRasNotify - ATEMRAS_NOTIFY_UNREGISTER

Notification about a connected application un-registered a client from the EC-Monitor.

emRasNotify - ATEMRAS_NOTIFY_UNREGISTER

Parameter

- `pbyInBuf`: [in] Pointer to data of type ATEMRAS_T_REGNOTIFYDESC
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL

- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

See also:

ATEMRAS_T_REGNOTIFYDESC

9.2.7 emRasNotify - ATEMRAS_NOTIFY_MARSHALERROR

Notification about an error during marshalling in Remote API Server connection layer.

emRasNotify - ATEMRAS_NOTIFY_MARSHALERRORDESC

Parameter

- `pbyInBuf`: [in] Pointer to data of type ATEMRAS_T_MARSHALERRORDESC
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

struct **ATEMRAS_T_MARSHALERRORDESC**

Public Members

EC_T_DWORD **dwCookie**
[in] Unique identification cookie of connection instance

EC_T_DWORD **dwCause**
[in] Cause of the command marshalling error

EC_T_DWORD **dwLenStatCmd**
[in] Length faulty command

EC_T_DWORD **dwCommandCode**
[in] Command code of faulty command

9.2.8 emRasNotify - ATEMRAS_NOTIFY_ACKERROR

Notification about an error during creation of ack / nack packet.

emRasNotify - ATEMRAS_NOTIFY_ACKERROR

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_DWORD containing error code
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

9.2.9 emRasNotify - ATEMRAS_NOTIFY_NONOTIFYMEMORY

Notification given, when no empty buffers for notifications are available in pre-allocated notification store. This points to a configuration error.

emRasNotify - ATEMRAS_NOTIFY_NONOTIFYMEMORY

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_DWORD containing unique identification cookie of connection instance
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

9.2.10 emRasNotify - ATEMRAS_NOTIFY_STDNOTIFYMEMORYSMALL

Notification given, when buffersize for standard notifications available in pre-allocated notification store are too small to carry a specific notification. This points to a configuration error.

emRasNotify - ATEMRAS_NOTIFY_STDNOTIFYMEMORYSMALL

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_DWORD containing unique identification cookie of connection instance
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

9.2.11 emRasNotify - ATEMRAS_NOTIFY_MBXNOTIFYMEMORYSMALL

Notification given, when buffer size for Mailbox notifications available in pre-allocated notification store are too small to carry a specific notification. This points to a configuration error. This is a serious error. If this error is given, Mailbox Transfer objects may have been become out of sync and therefore no more valid usable. Mailbox notifications should be dimensioned correctly see `emRasSrvStart()`

emRasNotify - ATEMRAS_NOTIFY_MBXNOTIFYMEMORYSMALL

Parameter

- `pbyInBuf`: [in] Pointer to EC_T_DWORD containing unique identification cookie of connection instance
- `dwInBufSize`: [in] Size of the input buffer in bytes
- `pbyOutBuf`: [out] Should be set to EC_NULL
- `dwOutBufSize`: [in] Should be set to 0
- `pdwNumOutData`: [out] Should be set to EC_NULL

10 Error Codes

10.1 Groups

No.	Group	Abbr.	Description
1	Application Error	APP	Error within application, running the master E.g. API function call with invalid parameters
2	EtherCAT network information file problem	ENI	Master configuration XML file mismatches slave configuration on bus E.g. Bus Topology Scan cannot detect all slaves configured within network information file
3	Master parameter configuration	CFG	Master configuration parameters erroreous E.g. mailbox command queue not large enough
4	Bus/Slave Error	SLV	Slave error E.g. Working Counter Error
5	Link Layer	LLA	Link Layer errror (network interface driver) E.g. Intel Pro/1000 NIC could not be found
6	Remote API	RAS	Remote API error E.g. connection to Remote API server is not possible from client
7	Internal software error	ISW	Master internal error E.g. Master state machine in undefined state
8	DC Master Sync	DCM	DC slave and host time synchronization
9	Pass-Through-Server	PTS	Initialisation/De-Initialisation errors
10	System Setup	SYS	Errors from Operating System or obviously due to System Setup

10.2 Generic Error Codes

EC_E_NOERROR
0x00000000: No Error

EC_E_ERROR
0x98110000: Unspecific Error

EMRAS_E_ERROR
0x98110180: Unspecific RAS Error

EC_E_NOTSUPPORTED
0x98110001: APP: Feature not supported (e.g. function or property not available)

EC_E_INVALIDINDEX
0x98110002: APP: Invalid index (e.g. CoE: invalid SDO index)

EC_E_INVALIDOFFSET
0x98110003: ISW: Invalid offset (e.g. invalid offset while accessing Process Data Image)

EC_E_CANCEL
0x98110004: APP: Cancel (e.g. master should abort current mbx transfer)

EC_E_INVALIDSIZE
0x98110005: APP: Invalid size

EC_E_INVALIDDATA
0x98110006: ISW: Invalid data (multiple error sources)

EC_E_NOTREADY
0x98110007: ISW: Not ready (multiple error sources)

EC_E_BUSY
0x98110008: APP: Busy (e.g. stack is busy currently and not available to process the API request. The function may be called again later)

EC_E_ACYC_FRM_FREEQ_EMPTY
0x98110009: ISW: Cannot queue acyclic ecat command (Acyclic command queue is full. Possible solution: Increase of configuration value dwMaxQueuedEthFrames)

EC_E_NOMEMORY
0x9811000A: CFG: No memory left (e.g. memory full / fragmented))

EC_E_INVALIDPARM
0x9811000B: APP: Invalid parameter (e.g. API function called with erroneous parameter set)

EC_E_NOTFOUND
0x9811000C: APP: Not found (e.g. Network Information File ENI not found or API called with invalid slave ID)

EC_E_DUPLICATE
0x9811000D: ISW: Duplicated fixed address detected (handled internally)

EC_E_INVALIDSTATE
0x9811000E: ISW: Invalid state (master not initialized or not configured)

EC_E_TIMER_LIST_FULL
0x9811000F: ISW: Cannot add slave to timer list (slave timer list full)

EC_E_TIMEOUT
0x98110010: Timeout

EC_E_OPENFAILED
0x98110011: ISW: Open failed

EC_E_SENDFAILED
0x98110012: LLA: Frame send failed

EC_E_INSERTMAILBOX
0x98110013: CFG: Insert Mailbox error (internal limit MAX_QUEUED_COE_CMDS: 20)

EC_E_INVALIDCMD
0x98110014: ISW: Invalid Command (Unknown mailbox command code)

EC_E_UNKNOWN_MBX_PROTOCOL
0x98110015: ISW: Unknown Mailbox Protocol Command (Unknown Mailbox protocol or mailbox command with unknown protocol association)

EC_E_ACCESSDENIED
0x98110016: ISW: Access Denied (e.g. master internal software error)

EC_E_IDENTIFICATIONFAILED
0x98110017: ENI: Identification failed (e.g. identification command failed)

EC_E_LOCK_CREATE_FAILED
0x98110018: SYS: Create lock failed (e.g. OsCreateLockTyped failed)

EC_E_PRODKEY_INVALID
0x9811001A: CFG: Product Key Invalid (e.g. application using protected version of stack, which stops operation after 60 minutes if license not provided)

EC_E_WRONG_FORMAT
0x9811001B: ENI: Wrong configuration format (e.g. Network information file empty or malformed)

EC_E_FEATURE_DISABLED
0x9811001C: APP: Feature disabled (e.g. Application tried to perform a missing or disabled API function)

EC_E_SHADOW_MEMORY
0x9811001D: Shadow memory requested in wrong mode

EC_E_BUSCONFIG_MISMATCH
0x9811001E: ENI: Bus Config Mismatch (e.g. Network information file and currently connected bus topology does not match)

EC_E_CONFIGDATAREAD
0x9811001F: ENI: Error reading config file (e.g. Network information file could not be read)

EC_E_ENI_NO_SAFEOP_OP_SUPPORT
0x98110020: Configuration doesn't support SAFEOP and OP requested state

EC_E_XML_CYCCMDS_MISSING
0x98110021: ENI: Cyclic commands are missing (e.g. Network information file does not contain cyclic commands)

EC_E_XML_ALSTATUS_READ_MISSING
0x98110022: ENI: AL_STATUS register read missing in XML file for at least one state (e.g. Read of AL Status register is missing in cyclic part of given network information file)

EC_E_MCSM_FATAL_ERROR
0x98110023: ISW: Fatal internal McSm (master control state machine is in an undefined state)

EC_E_SLAVE_ERROR
0x98110024: SLV: Slave error (e.g. A slave error was detected. See also EC_NOTIFY_STATUS_SLAVE_ERROR and EC_NOTIFY_SLAVE_ERROR_STATUS_INFO)

EC_E_FRAME_LOST
0x98110025: SLV: Frame lost, IDX mismatch (EtherCAT frame(s) lost on bus, means the response was not received. In case this error shows frequently a problem with the wiring could be the cause)

EC_E_CMD_MISSING
0x98110026: SLV: At least one EtherCAT command is missing in the received frame (e.g. received EtherCAT frame incomplete)

EC_E_CYCCMD_WKC_ERROR
0x98110027: Cyclic command WKC error

EC_E_INVALID_DCL_MODE
0x98110028: APP: IOCTL EC_IOCTL_DC_LATCH_REQ_LTIMVALS invalid in DCL auto read mode (this function cannot be used if DC Latching is running in mode “Auto Read”)

EC_E_AI_ADDRESS
0x98110029: SLV: Auto increment address increment mismatch (e.g. Network information file and bus topology doesn’t match any more. Error shows only, if a already recognized slave isn’t present any more)

EC_E_INVALID_SLAVE_STATE
0x9811002A: APP: Slave in invalid state, e.g. not in OP (API not callable in this state) (mailbox commands are not allowed in current slave state)

EC_E_SLAVE_NOT_ADDRESSABLE
0x9811002B: SLV: Station address lost (or slave missing) - FPRD to AL_STATUS failed (e.g. Slave had a powercycle)

EC_E_CYC_CMDS_OVERFLOW
0x9811002C: ENI: Too many cyclic commands in XML configuration file (e.g. EC_T_INIT_MASTER_PARMS.dwMaxQueuedEthFrames too small)

EC_E_LINK_DISCONNECTED
0x9811002D: SLV: Ethernet link cable disconnected (e.g. EtherCAT bus segment not connected to network interface)

EC_E_MASTERCORE_INACCESSIBLE
0x9811002E: RAS: Master core not accessible (e.g. Connection to remote server was terminated or master instance has been stopped on remote side)

EC_E_COE_MBXSND_WKC_ERROR
0x9811002F: SLV: CoE mbox send: working counter (e.g. CoE mailbox couldn’t be read on slave, slave didn’t read out mailbox since last write)

EC_E_COE_MBXRCV_WKC_ERROR
0x98110030: SLV: CoE mbox receive: working counter (e.g. CoE Mailbox couldn’t be read from slave)

EC_E_NO_MBX_SUPPORT
0x98110031: APP: No mailbox support (e.g. Slave does not support mailbox access)

EC_E_NO_COE_SUPPORT
0x98110032: ENI: CoE protocol not supported (e.g. Configuration error or slave information file doesn’t match slave firmware)

EC_E_NO_EOE_SUPPORT
0x98110033: ENI: EoE protocol not supported (e.g. Configuration error or slave information file doesn’t match slave firmware)

EC_E_NO_FOE_SUPPORT
0x98110034: ENI: FoE protocol not supported (e.g. Configuration error or slave information file doesn’t match slave firmware)

EC_E_NO_SOE_SUPPORT
0x98110035: ENI: SoE protocol not supported (e.g. Configuration error or slave information file doesn’t match slave firmware)

EC_E_NO_VOE_SUPPORT
0x98110036: ENI: VoE protocol not supported (e.g. Configuration error or slave information file doesn't match slave firmware)

EC_E_EVAL_VIOLATION
0x98110037: ENI: Configuration violates Evaluation limits (obsolete)

EC_E_EVAL_EXPIRED
0x98110038: CFG: Evaluation Time limit reached (e.g. Licence not provided and evaluation period (1 hour) of protected version exceeded)

EC_E_LICENSE_MISSING
0x98110039: License key invalid or missing

EC_E_CFGFILENOTFOUND
0x98110070: CFG: Master configuration not found (e.g. path to master configuration file (XML) was wrong or the file is not available)

EC_E_EEPROMREADERROR
0x98110071: SLV: Command error while EEPROM upload (read slave EEPROM)

EC_E_EEPROMWRITEERROR
0x98110072: SLV: Command error while EEPROM download (write slave EEPROM)

EC_E_XML_CYCCMDS_SIZEMISMATCH
0x98110073: ENI: Cyclic command wrong size (too long) (size in master configuration file (XML) does not match size of process data)

EC_E_XML_INVALID_INP_OFF
0x98110074: ENI: Invalid input offset in cyc cmd, please check InputOffs

EC_E_XML_INVALID_OUT_OFF
0x98110075: ENI: Invalid output offset in cyc cmd, please check OutputOffs

EC_E_PORTCLOSE
0x98110076: Port close failed

EC_E_PORTOPEN
0x98110077: Port open failed

EC_E_SLAVE_NOT_PRESENT
0x9811010E: APP / SLV: command not executed (slave not present on bus) (e.g. slave disappeared or was never present)

EC_E_EEPROMRELOADERROR
0x98110110: Command error while EEPROM reload

EC_E_SLAVECTRLRESETERROR
0x98110111: Command error while Reset Slave Controller

EC_E_SYSDRIVERMISSING
0x98110112: SYS: Cannot open system driver (e.g. system driver was not loaded)

EC_E_BUSCONFIG_TOPOCHANGE
0x9811011E: Bus configuration not detected, Topology changed (e.g. Topology changed while scanning bus)

EC_E_EOE_MBX_WKC_ERROR
0x9811011F: EoE: Mailbox receive: working counter

EC_E_FOE_MBX_WKC_ERROR
0x98110120: FoE: Mailbox receive: working counter

EC_E_SOE_MBX_WKC_ERROR
0x98110121: SoE: mailbox receive: working counter

EC_E_AOE_MBX_WKC_ERROR
0x98110122: AoE: Mailbox receive: working counter

EC_E_VOE_MBX_WKC_ERROR
0x98110123: SLV: VoE mailbox send: working counter (VoE mailbox couldn't be written)

EC_E_EEPROMASSIGNERROR
0x98110124: SLV: EEPROM assignment failed

EC_E_MBX_ERROR_TYPE
0x98110125: SLV: Unknown mailbox error code received in mailbox

EC_E_REDLINEBREAK
0x98110126: SLV: Redundancy line break (e.g. cable break between slaves or between master and first slave)

EC_E_XML_INVALID_CMD_WITH_RED
0x98110127: ENI: Invalid EtherCAT cmd in cyclic frame with redundancy (e.g. BRW commands are not allowed with redundancy)

EC_E_XML_PREV_PORT_MISSING
0x98110128: ENI: <PreviousPort>-tag is missing (e.g. if the auto increment address is not the first slave on the bus we check if a previous port tag OR a hot connect tag is available)

EC_E_XML_DC_CYCCMDS_MISSING
0x98110129: DC enabled and DC cyclic commands missing (e.g. access to 0x0900)

EC_E_DLSTATUS_IRQ_TOPOCHANGED
0x98110130: SLV: Data link (DL) status interrupt because of changed topology (automatically handled by master)

EC_E_PTS_IS_NOT_RUNNING
0x98110131: PTS: Pass Through Server is not running (Pass-Through-Server was tried to be enabled/disabled or stopped without being started)

EC_E_PTS_IS_RUNNING
0x98110132: PTS: Pass Through Server is running (obsolete, replaced by EC_E_ADS_IS_RUNNING)

EC_E_ADS_IS_RUNNING
0x98110132: PTS: ADS adapter (Pass Through Server) is running (API call conflicts with ADS state (running))

EC_E_PTS_THREAD_CREATE_FAILED
0x98110133: PTS: Could not start the Pass Through Server

EC_E_PTS_SOCK_BIND_FAILED
0x98110134: PTS: The Pass Through Server could not bind the IP address with a socket (e.g. Possibly because the IPaddress (and Port) is already in use or the IP-address does not exist)

EC_E_PTS_NOT_ENABLED
0x98110135: PTS: The Pass Through Server is running but not enabled

EC_E_PTS_LL_MODE_NOT_SUPPORTED
0x98110136: PTS: The Link Layer mode is not supported by the Pass Through Server (e.g. The Master is running in interrupt mode but the Pass-Through-Server only supports polling mode)

EC_E_VOE_NO_MBX_RECEIVED
0x98110137: SLV: No VoE mailbox received yet from specific slave

EC_E_DC_REF_CLOCK_SYNC_OUT_UNIT_DISABLED
0x98110138: DC (time loop control) unit of reference clock disabled

EC_E_DC_REF_CLOCK_NOT_FOUND
0x98110139: SLV: Reference clock not found! May happen if reference clock is removed from network.

EC_E_MBX_CMD_WKC_ERROR
0x9811013B: SLV: Mailbox command working counter error (e.g. Mbx Init Cmd Retry Count exceeded)

EC_E_NO_AOE_SUPPORT
0x9811013C: APP / SLV: AoE: Protocol not supported (e.g. Application calls AoE-API although not implemented at slave)

EC_E_AOE_INV_RESPONSE_SIZE
0x9811013D: AoE: Invalid AoE response received

EC_E_AOE_ERROR
0x9811013E: AoE: Common AoE device error

EC_E_AOE_SRVNOTSUPP
0x9811013F: AoE: Service not supported by server

EC_E_AOE_INVALIDGRP
0x98110140: AoE: Invalid index group

EC_E_AOE_INVALIDOFFSET
0x98110141: AoE: Invalid index offset

EC_E_AOE_INVALIDACCESS
0x98110142: AoE: Reading/writing not permitted

EC_E_AOE_INVALIDSIZE
0x98110143: AoE: Parameter size not correct

EC_E_AOE_INVALIDDATA
0x98110144: AoE: Invalid parameter value(s)

EC_E_AOE_NOTREADY
0x98110145: AoE: Device not in a ready state

EC_E_AOE_BUSY
0x98110146: AoE: Device busy

EC_E_AOE_INVALIDCONTEXT
0x98110147: AoE: Invalid context

EC_E_AOE_NOMEMORY
0x98110148: AoE: Out of memory

EC_E_AOE_INVALIDPARM
0x98110149: AoE: Invalid parameter value(s)

EC_E_AOE_NOTFOUND
0x9811014A: AoE: Not found

EC_E_AOE_SYNTAX
0x9811014B: AoE: Syntax error in comand or file

EC_E_AOE_INCOMPATIBLE
0x9811014C: AoE: Objects do not match

EC_E_AOE_EXISTS
0x9811014D: AoE: Object already exists

EC_E_AOE_SYMBOLNOTFOUND
0x9811014E: AoE: Symbol not found

EC_E_AOE_SYMBOLVERSIONINVALID
0x9811014F: AoE: Symbol version invalid

EC_E_AOE_INVALIDSTATE
0x98110150: AoE: Server in invalid state

EC_E_AOE_TRANSMODENOTSUPP
0x98110151: AoE: AdsTransMode not supported

EC_E_AOE_NOTIFYHNDINVALID
0x98110152: AoE: Notification handle invalid

EC_E_AOE_CLIENTUNKNOWN
0x98110153: AoE: Notification client not registered

EC_E_AOE_NOMOREHDLS
0x98110154: AoE: No more notification handles

EC_E_AOE_INVALIDWATCHSIZE
0x98110155: AoE: Size for watch to big

EC_E_AOE_NOTINIT
0x98110156: AoE: Device not initialized

EC_E_AOE_TIMEOUT
0x98110157: AoE: Device has a timeout

EC_E_AOE_NOINTERFACE
0x98110158: AoE: Query interface failed

EC_E_AOE_INVALIDINTERFACE
0x98110159: AoE: Wrong interface required

EC_E_AOE_INVALIDCLSID
0x9811015A: AoE: Class ID invalid

EC_E_AOE_INVALIDOBJID
0x9811015B: AoE: Object ID invalid

EC_E_AOE_PENDING
0x9811015C: AoE: Request pending

EC_E_AOE_ABORTED
0x9811015D: AoE: Request aborted

EC_E_AOE_WARNING
0x9811015E: AoE: Signal warning

EC_E_AOE_INVALIDARRAYIDX
0x9811015F: AoE: Invalid array index

EC_E_AOE_SYMBOLNOTACTIVE
0x98110160: AoE: Symbol not active -> release handle and try again

EC_E_AOE_ACCESSDENIED
0x98110161: AoE: Access denied

EC_E_AOE_INTERNAL
0x98110162: AoE: Internal error

EC_E_AOE_TARGET_PORT_NOT_FOUND
0x98110163: AoE: Target port not found

EC_E_AOE_TARGET_MACHINE_NOT_FOUND
0x98110164: AoE: Target machine not found

EC_E_AOE_UNKNOWN_CMD_ID
0x98110165: AoE: Unknown command ID

EC_E_AOE_PORT_NOT_CONNECTED
0x98110166: AoE: Port not connected

EC_E_AOE_INVALID_AMS_LENGTH
0x98110167: AoE: Invalid AMS length

EC_E_AOE_INVALID_AMS_ID
0x98110168: AoE: invalid AMS Net ID

EC_E_AOE_PORT_DISABLED
0x98110169: AoE: Port disabled

EC_E_AOE_PORT_CONNECTED
0x9811016A: AoE: Port already connected

EC_E_AOE_INVALID_AMS_PORT
0x9811016B: AoE: Invalid AMS port

EC_E_AOE_NO_MEMORY
0x9811016C: AoE: No memory

EC_E_AOE_VENDOR_SPECIFIC
0x9811016D: AoE: Vendor specific AoE device error

EC_E_XML_AOE_NETID_INVALID
0x9811016E: ENI: AoE: Invalid NetID (e.g. Error from Configuration Tool)

EC_E_MAX_BUS_SLAVES_EXCEEDED
0x9811016F: CFG: Error: Maximum number of bus slave has been exceeded (The maximum number of pre-allocated bus slave objects are to small. The maximum number can be adjusted by the master initialization parameter EC_T_INITMASTERPARMS.dwMaxBusSlaves)

EC_E_MBXERR_SYNTAX
0x98110170: SLV: Mailbox error: Syntax of 6 octet Mailbox header is wrong (Slave error mailbox return value: 0x01)

EC_E_MBXERR_UNSUPPORTEDPROTOCOL
0x98110171: SLV: Mailbox error: The Mailbox protocol is not supported (Slave error mailbox return value: 0x02)

EC_E_MBXERR_INVALIDCHANNEL
0x98110172: SLV: Mailbox error: Field contains wrong value (Slave error mailbox return value: 0x03)

EC_E_MBXERR_SERVICENOTSUPPORTED
0x98110173: SLV: Mailbox error: The mailbox protocol header of the mailbox protocol is wrong (Slave error mailbox return value: 0x04)

EC_E_MBXERR_INVALIDHEADER
0x98110174: SLV: Mailbox error: The mailbox protocol header of the mailbox protocol is wrong (Slave error mailbox return value: 0x05)

EC_E_MBXERR_SIZETOOSHORT
0x98110175: SLV: Mailbox error: Length of received mailbox data is too short (Slave error mailbox return value: 0x06)

EC_E_MBXERR_NOMOREMEMORY
0x98110176: SLV: Mailbox error: Mailbox protocol can not be processed because of limited ressources (Slave error mailbox return value: 0x07)

EC_E_MBXERR_INVALIDSIZE
0x98110177: SLV: Mailbox error: The length of data is inconsistent (Slave error mailbox return value: 0x08)

EC_E_DC_SLAVES_BEFORE_REF_CLOCK
0x98110178: ENI: Slaves with DC configured present on bus before reference clock (e.g. The first DC Slave was not configured as potential reference clock)

EC_E_DATA_TYPE_CONVERSION_FAILED
0x98110179: Data type conversion failed

EC_E_LINE_CROSSED
0x9811017B: Line crossed (cabling wrong)

EC_E_LINE_CROSSED_SLAVE_INFO
0x9811017C: Line crossed at slave (obsolete)

EC_E_ADO_NOT_SUPPORTED
0x9811017E: SLV: ADO for slave identification not supported (e.g. Request ID mechanism (ADO 0x134) not supported by slave)

EC_E_FRAMELOSS_AFTER_SLAVE
0x9811017F: Frameloss after Slave (opening port destroys communication)

EC_E_OEM_SIGNATURE_MISMATCH
0x98130008: ENI, OEM: Manufacturer signature mismatch

EC_E_ENI_ENCRYPTION_WRONG_VERSION
0x98130009: ENI, OEM: ENI encryption algorithm version not supported

EC_E_ENI_ENCRYPTED
0x9813000A: OEM: Loading encrypted ENI needs OEM key

EC_E_OEM_KEY_MISMATCH
0x9813000B: RAS, APP: OEM key mismatch

EC_E_OEM_KEY_MISSING
0x9813000C: APP: OEM key access needs OEM key set (e.g. Application must call esSetOemKey (HiL) or set EC_T_LINK_PARMS_SIMULATOR::qwOemKey (SiL))

EC_E_S2SMBX_NOT_CONFIGURED
0x98130020: S2S: Not Configured

EC_E_S2SMBX_NO_MEMORY
0x98130021: S2S: No Memory

EC_E_S2SMBX_NO_DESCRIPTOR
0x98130022: S2S: No Descriptor

EC_E_S2SMBX_DEST_SLAVE_NOT_FOUND
0x98130023: S2S: Destination Slave not found

EC_E_MASTER_RED_STATE_INACTIVE
0x98130024: APP: Master Redundancy State is INACTIVE (e.g. API not allowed in current Master Redundancy State)

EC_E_MASTER_RED_STATE_ACTIVE
0x98130025: APP: Master Redundancy State is ACTIVE (e.g. API not allowed in current Master Redundancy State)

EC_E_JUNCTION_RED_LINE_BREAK
0x98130026: Junction redundancy line break

EC_E_VALIDATION_ERROR
0x98130027: Validation error (validation data mismatch)

EC_E_TIMEOUT_WAITING_FOR_DC
0x98130028: Timeout waiting for DC

EC_E_TIMEOUT_WAITING_FOR_DCM
0x98130029: Timeout waiting for DCM

EC_E_SIGNATURE_MISMATCH
0x98130030: Signature mismatch

EC_E_PDIWATCHDOG
0x98130031: PDI watchdog expired

EC_E_BAD_CONNECTION
0x98130032: Bad connection

10.3 DCM Error Codes

DCM_E_ERROR
0x981201C0: Unspecific DCM Error

DCM_E_NOTINITIALIZED
0x981201C1: Not initialized

DCM_E_MAX_CTL_ERROR_EXCEED
0x981201C2: DCM controller - synchronisation out of limit

DCM_E_NOMEMORY
0x981201C3: Not enough memory

DCM_E_INVALID_HWLAYER
0x981201C4: Hardware layer - (BSP) invalid

DCM_E_TIMER_MODIFY_ERROR
0x981201C5: Hardware layer - error modifying timer

DCM_E_TIMER_NOT_RUNNING
0x981201C6: Hardware layer - timer not running

DCM_E_WRONG_CPU
0x981201C7: Hardware layer - function called on wrong CPU

DCM_E_INVALID_SYNC_PERIOD
0x981201C8: Invalid DC sync period length (invalid clock master?)

DCM_E_INVALID_SETVAL
0x981201C9: DCM controller SetVal to small

DCM_E_DRIFT_TO_HIGH
0x981201CA: DCM controller - Drift between local timer and ref clock to high

DCM_E_BUS_CYCLE_WRONG
0x981201CB: DCM controller - Bus cycle time (dwBusCycleTimeUsec) doesn't match real cycle

DCX_E_NO_EXT_CLOCK
0x981201CC: DCX controller - No external synchronization clock found

DCM_E_INVALID_DATA
0x981201CD: DCM controller - Invalid data

10.4 ADS over EtherCAT (AoE) Error Codes

EC_E_AOE_NO_RTIME
0x9813000D: AoE: No Rtime

EC_E_AOE_LOCKED_MEMORY
0x9813000E: AoE: Allocation locked memory

EC_E_AOE_MAILBOX
0x9813000F: AoE: Insert mailbox error

EC_E_AOE_WRONG_HMSG
0x98130010: AoE: Wrong receive HMSG

EC_E_AOE_BAD_TASK_ID
0x98130011: AoE: Bad task ID

EC_E_AOE_NO_IO
0x98130012: AoE: No IO

EC_E_AOE_UNKNOWN_AMS_COMMAND
0x98130013: AoE: Unknown ADS command

EC_E_AOE_WIN32
0x98130014: AoE: Win 32 error

EC_E_AOE_LOW_INSTALL_LEVEL
0x98130015: AoE: Low installation level

EC_E_AOE_NO_DEBUG
0x98130016: AoE: No debug available

EC_E_AOE_AMS_SYNC_WIN32
0x98130017: AoE: Sync Win 32 error

EC_E_AOE_AMS_SYNC_TIMEOUT
0x98130018: AoE: Sync Timeout

EC_E_AOE_AMS_SYNC_AMS
0x98130019: AoE: Sync AMS error

EC_E_AOE_AMS_SYNC_NO_INDEX_MAP
0x9813001A: AoE: Sync no index map

EC_E_AOE_TCP_SEND
0x9813001B: AoE: TCP send error

EC_E_AOE_HOST_UNREACHABLE
0x9813001C: AoE: Host unreachable

EC_E_AOE_INVALIDAMSFRAGMENT
0x9813001D: AoE: Invalid AMS fragment

EC_E_AOE_NO_LOCKED_MEMORY
0x9813001E: AoE: No allocation locked memory

EC_E_AOE_MAILBOX_FULL
0x9813001F: AoE: Mailbox full

10.5 CAN application protocol over EtherCAT (CoE) SDO Error Codes

EC_E_SDO_ABORTCODE_TOGGLE
0x98110040: SLV: SDO: Toggle bit not alternated (CoE abort code 0x05030000 of slave)

EC_E_SDO_ABORTCODE_TIMEOUT
0x98110041: SLV: SDO: Protocol timed out (CoE abort code 0x05040000 of slave)

EC_E_SDO_ABORTCODE_CCS_SCS
0x98110042: SLV: SDO: Client/server command specifier not valid or unknown (CoE abort code 0x05040001 of slave)

EC_E_SDO_ABORTCODE_BLK_SIZE
0x98110043: SLV: SDO: Invalid block size (block mode only) (CoE abort code 0x05040002 of slave)

EC_E_SDO_ABORTCODE_SEQNO
0x98110044: SLV: SDO: Invalid sequence number (block mode only) (CoE abort code 0x05040003 of slave)

EC_E_SDO_ABORTCODE_CRC
0x98110045: SLV: SDO: CRC error (block mode only) (CoE abort code 0x05040004 of slave)

EC_E_SDO_ABORTCODE_MEMORY
0x98110046: SLV: SDO: Out of memory (CoE abort code 0x05040005 of slave)

EC_E_SDO_ABORTCODE_ACCESS
0x98110047: SLV: SDO: Unsupported access to an object (CoE abort code 0x06010000 of slave)

EC_E_SDO_ABORTCODE_WRITEONLY
0x98110048: SLV: SDO: Attempt to read a write only object (CoE abort code 0x06010001 of slave)

EC_E_SDO_ABORTCODE_READONLY
0x98110049: SLV: SDO: Attempt to write a read only object (CoE abort code 0x06010002 of slave)

EC_E_SDO_ABORTCODE_INDEX
0x9811004A: SLV: SDO: Object does not exist in the object dictionary (CoE abort code 0x06020000 of slave)

EC_E_SDO_ABORTCODE_PDO_MAP
0x9811004B: SLV: SDO: Object cannot be mapped to the PDO (CoE abort code 0x06040041 of slave)

EC_E_SDO_ABORTCODE_PDO_LEN
0x9811004C: SLV: SDO: The number and length of the objects to be mapped would exceed PDO length (CoE abort code 0x06040042 of slave)

EC_E_SDO_ABORTCODE_P_INCOMP
0x9811004D: SLV: SDO: General parameter incompatibility reason (CoE abort code 0x06040043 of slave)

EC_E_SDO_ABORTCODE_I_INCOMP
0x9811004E: SLV: SDO: General internal incompatibility in the device (CoE abort code 0x06040047 of slave)

EC_E_SDO_ABORTCODE_HARDWARE
0x9811004F: SLV: SDO: Access failed due to an hardware error (CoE abort code 0x06060000 of slave)

EC_E_SDO_ABORTCODE_DATA_LENGTH_NOT_MATCH
0x98110050: SLV: SDO: Data type does not match, length of service parameter does not match (CoE abort code 0x06070010 of slave)

EC_E_SDO_ABORTCODE_DATA_LENGTH_TOO_HIGH
0x98110051: SLV: SDO: Data type does not match, length of service parameter too high (CoE abort code 0x06070012 of slave)

EC_E_SDO_ABORTCODE_DATA_LENGTH_TOO_LOW
0x98110052: SLV: SDO: Data type does not match, length of service parameter too low (CoE abort code 0x06070013 of slave)

EC_E_SDO_ABORTCODE_OFFSET
0x98110053: SLV: SDO: Sub-index does not exist (CoE abort code 0x06090011 of slave)

EC_E_SDO_ABORTCODE_VALUE_RANGE
0x98110054: SLV: SDO: Value range of parameter exceeded (only for write access) (CoE abort code 0x06090030 of slave)

EC_E_SDO_ABORTCODE_VALUE_TOO_HIGH
0x98110055: SLV: SDO: Value of parameter written too high (CoE abort code 0x06090031 of slave)

EC_E_SDO_ABORTCODE_VALUE_TOO_LOW
0x98110056: SLV: SDO: Value of parameter written too low (CoE abort code 0x06090032 of slave)

EC_E_SDO_ABORTCODE_MINMAX
0x98110057: SLV: SDO: Maximum value is less than minimum value (CoE abort code 0x06090036 of slave)

EC_E_SDO_ABORTCODE_GENERAL
0x98110058: SLV: SDO: General error (CoE abort code 0x08000000 of slave)

EC_E_SDO_ABORTCODE_TRANSFER
0x98110059: SLV: SDO: Data cannot be transferred or stored to the application (CoE abort code 0x08000020 of slave)

EC_E_SDO_ABORTCODE_TRANSFER_LOCAL_CONTROL
0x9811005A: SLV: SDO: Data cannot be transferred or stored to the application because of local control (CoE abort code 0x08000021 of slave)

EC_E_SDO_ABORTCODE_TRANSFER_DEVICE_STATE
0x9811005B: SLV: SDO: Data cannot be transferred or stored to the application because of the present device state (CoE abort code 0x08000022 of slave)

EC_E_SDO_ABORTCODE_DICTIONARY
0x9811005C: SLV: SDO: Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error) (CoE abort code 0x08000023 of slave)

EC_E_SDO_ABORTCODE_UNKNOWN
0x9811005D: SLV: SDO: Unknown code (Unknown CoE abort code of slave)

EC_E_SDO_ABORTCODE_MODULE_ID_LIST_NOT_MATCH
0x9811005E: Detected Module Ident List (0xF030) and Configured Module Ident list (0xF050) does not match

EC_E_SDO_ABORTCODE_SI_NOT_WRITTEN
0x98130004: SLV: SDO: Sub Index cannot be written, SI0 must be 0 for write access (CoE abort code 0x06010003 of slave)

EC_E_SDO_ABORTCODE_CA_TYPE_MISM
0x98130005: SLV: SDO: Complete access not supported for objects of cvariable length suach as ENUM object types (CoE abort code 0x06010004 of slave)

EC_E_SDO_ABORTCODE_OBJ_TOO_BIG
0x98130006: SLV: SDO: Object length exceeds mailbox size (CoE abort code 0x06010005 of slave)

EC_E_SDO_ABORTCODE_PDO_MAPPED
0x98130007: SLV: SDO: Object mapped to RxPDO, SDO Download blocked (CoE abort code 0x06010006 of slave)

10.6 File Transfer over EtherCAT (FoE) Error Codes

EC_E_FOE_ERRCODE_NOTDEFINED
0x98110060: SLV: ERROR FoE: not defined (FoE Error Code 0 (0x8000) of slave)

EC_E_FOE_ERRCODE_NOTFOUND
0x98110061: SLV: ERROR FoE: not found (FoE Error Code 1 (0x8001) of slave)

EC_E_FOE_ERRCODE_ACCESS
0x98110062: SLV: ERROR FoE: access denied (FoE Error Code 2 (0x8002) of slave)

EC_E_FOE_ERRCODE_DISKFULL
0x98110063: SLV: ERROR FoE: disk full (FoE Error Code 3 (0x8003) of slave)

EC_E_FOE_ERRCODE_ILLEGAL
0x98110064: SLV: ERROR FoE: illegal (FoE Error Code 4 (0x8004) of slave)

EC_E_FOE_ERRCODE_PACKENO
0x98110065: SLV: ERROR FoE: packet number wrong (FoE Error Code 5 (0x8005) of slave)

EC_E_FOE_ERRCODE_EXISTS
0x98110066: SLV: ERROR FoE: already exists (FoE Error Code 6 (0x8006) of slave)

EC_E_FOE_ERRCODE_NOUSER
0x98110067: SLV: ERROR FoE: no user (FoE Error Code 7 (0x8007) of slave)

EC_E_FOE_ERRCODE_BOOTSTRAPONLY
0x98110068: SLV: ERROR FoE: bootstrap only (FoE Error Code 8 (0x8008) of slave)

EC_E_FOE_ERRCODE_NOTINBOOTSTRAP
0x98110069: SLV: ERROR FoE: Downloaded file name is not valid in Bootstrap state (FoE Error Code 9 (0x8009) of slave)

EC_E_FOE_ERRCODE_INVALIDPASSWORD
0x9811006A: SLV: ERROR FoE: no rights (FoE Error Code 10 (0x800A) of slave)

EC_E_FOE_ERRCODE_PROGERROR
0x9811006B: SLV: ERROR FoE: program error (FoE Error Code 11 (0x800B) of slave)

EC_E_FOE_ERRCODE_INVALID_CHECKSUM
0x9811006C: FoE: Wrong checksum

EC_E_FOE_ERRCODE_INVALID_FIRMWARE
0x9811006D: SLV: ERROR FoE: Firmware does not fit for Hardware (FoE Error Code 13 (0x800D) of slave)

EC_E_FOE_ERRCODE_NO_FILE
0x9811006F: SLV: ERROR FoE: No file to read (FoE Error Code 15 (0x800F) of slave)

EC_E_NO_FOE_SUPPORT_BS
0x9811010F: APP: ERROR FoE: Protocol not supported in boot strap (e.g. Application requested FoE in Bootstrap although slave does not support this)

EC_E_FOE_ERRCODE_MAX_FILE_SIZE
0x9811017A: APP: ERROR FoE: File is bigger than max file size (e.g. Slave returned more data than the

buffer provided by application can store.)

EC_E_FOE_ERRCODE_FILE_HEAD_MISSING
0x98130001: SLV: ERROR FoE: File header does not exist (FoE Error Code 16 (0x8010) of slave)

EC_E_FOE_ERRCODE_FLASH_PROBLEM
0x98130002: SLV: ERROR FoE: Flash problem (FoE Error Code 17 (0x8011) of slave)

EC_E_FOE_ERRCODE_FILE_INCOMPATIBLE
0x98130003: SLV: ERROR FoE: File incompatible (FoE Error Code 18 (0x8012) of slave)

10.7 Servo Drive Profil over EtherCAT (SoE) Error Codes

EC_E_SOE_ERRORCODE_INVALID_ACCESS
0x98110078: ERROR SoE: Invalid access to element 0

EC_E_SOE_ERRORCODE_NOT_EXIST
0x98110079: ERROR SoE: Does not exist

EC_E_SOE_ERRORCODE_INVL_ACC_ELEM1
0x9811007A: ERROR SoE: Invalid access to element 1

EC_E_SOE_ERRORCODE_NAME_NOT_EXIST
0x9811007B: ERROR SoE: Name does not exist

EC_E_SOE_ERRORCODE_NAME_UNDERSIZE
0x9811007C: ERROR SoE: Name undersize in transmission

EC_E_SOE_ERRORCODE_NAME_OVERSIZE
0x9811007D: ERROR SoE: Name oversize in transmission

EC_E_SOE_ERRORCODE_NAME_UNCHANGE
0x9811007E: ERROR SoE: Name unchangeable

EC_E_SOE_ERRORCODE_NAME_WR_PROT
0x9811007F: ERROR SoE: Name currently write-protected

EC_E_SOE_ERRORCODE_UNDERS_TRANS
0x98110080: ERROR SoE: Attribute undersize in transmission

EC_E_SOE_ERRORCODE_OVERS_TRANS
0x98110081: ERROR SoE: Attribute oversize in transmission

EC_E_SOE_ERRORCODE_ATTR_UNCHANGE
0x98110082: ERROR SoE: Attribute unchangeable

EC_E_SOE_ERRORCODE_ATTR_WR_PROT
0x98110083: ERROR SoE: Attribute currently write-protected

EC_E_SOE_ERRORCODE_UNIT_NOT_EXIST
0x98110084: ERROR SoE: Unit does not exist

EC_E_SOE_ERRORCODE_UNIT_UNDERSIZE
0x98110085: ERROR SoE: Unit undersize in transmission

EC_E_SOE_ERRORCODE_UNIT_OVERSIZE
0x98110086: ERROR SoE: Unit oversize in transmission

EC_E_SOE_ERRORCODE_UNIT_UNCHANGE
0x98110087: ERROR SoE: Unit unchangeable

EC_E_SOE_ERRORCODE_UNIT_WR_PROT
0x98110088: ERROR SoE: Unit currently write-protected

EC_E_SOE_ERRORCODE_MIN_NOT_EXIST
0x98110089: ERROR SoE: Minimum input value does not exist

EC_E_SOE_ERRORCODE_MIN_UNDERSIZE
0x9811008A: ERROR SoE: Minimum input value undersize in transmission

EC_E_SOE_ERRORCODE_MIN_OVERSIZE
0x9811008B: ERROR SoE: Minimum input value oversize in transmission

EC_E_SOE_ERRORCODE_MIN_UNCHANGE
0x9811008C: ERROR SoE: Minimum input value unchangeable

EC_E_SOE_ERRORCODE_MIN_WR_PROT
0x9811008D: ERROR SoE: Minimum input value currently write-protected

EC_E_SOE_ERRORCODE_MAX_NOT_EXIST
0x9811008E: ERROR SoE: Maximum input value does not exist

EC_E_SOE_ERRORCODE_MAX_UNDERSIZE
0x9811008F: ERROR SoE: Maximum input value undersize in transmission

EC_E_SOE_ERRORCODE_MAX_OVERSIZE
0x98110090: ERROR SoE: Maximum input value oversize in transmission

EC_E_SOE_ERRORCODE_MAX_UNCHANGE
0x98110091: ERROR SoE: Maximum input value unchangeable

EC_E_SOE_ERRORCODE_MAX_WR_PROT
0x98110092: ERROR SoE: Maximum input value currently write-protected

EC_E_SOE_ERRORCODE_DATA_NOT_EXIST
0x98110093: ERROR SoE: Data item does not exist

EC_E_SOE_ERRORCODE_DATA_UNDERSIZE
0x98110094: ERROR SoE: Data item undersize in transmission

EC_E_SOE_ERRORCODE_DATA_OVERSIZE
0x98110095: ERROR SoE: Data item oversize in transmission

EC_E_SOE_ERRORCODE_DATA_UNCHANGE
0x98110096: ERROR SoE: Data item unchangeable

EC_E_SOE_ERRORCODE_DATA_WR_PROT
0x98110097: ERROR SoE: Data item currently write-protected

EC_E_SOE_ERRORCODE_DATA_MIN_LIMIT
0x98110098: ERROR SoE: Data item less than minimum input value limit

EC_E_SOE_ERRORCODE_DATA_MAX_LIMIT
0x98110099: ERROR SoE: Data item exceeds maximum input value limit

EC_E_SOE_ERRORCODE_DATA_INCOR
0x9811009A: ERROR SoE: Data item incorrect

EC_E_SOE_ERRORCODE_PASWD_PROT
0x9811009B: ERROR SoE: Data item protected by password

EC_E_SOE_ERRORCODE_TEMP_UNCHANGE
0x9811009C: ERROR SoE: Data item temporary unchangeable (in AT or MDT)

EC_E_SOE_ERRORCODE_INVL_INDIRECT
0x9811009D: ERROR SoE: Invalid indirect

EC_E_SOE_ERRORCODE_TEMP_UNCHANGE1
0x9811009E: ERROR SoE: Data item temporary unchangeable (parameter or opmode)

EC_E_SOE_ERRORCODE_ALREADY_ACTIVE
0x9811009F: ERROR SoE: Command already active

EC_E_SOE_ERRORCODE_NOT_INTERRUPT
0x98110100: ERROR SoE: Command not interruptable

EC_E_SOE_ERRORCODE_CMD_NOT_AVAIL
0x98110101: ERROR SoE: Command not available (in this phase)

EC_E_SOE_ERRORCODE_CMD_NOT_AVAIL1
0x98110102: ERROR SoE: Command not available (invalid parameter)

EC_E_SOE_ERRORCODE_DRIVE_NO
0x98110103: ERROR SoE: Response drive number not identical with requested drive number

EC_E_SOE_ERRORCODE_IDN
0x98110104: ERROR SoE: Response IDN not identical with requested IDN

EC_E_SOE_ERRORCODE_FRAGMENT_LOST
0x98110105: ERROR SoE: At least one fragment lost

EC_E_SOE_ERRORCODE_BUFFER_FULL
0x98110106: ERROR SoE: RX buffer full (ecat call with to small data-buffer)

EC_E_SOE_ERRORCODE_NO_DATA
0x98110107: ERROR SoE: No data state

EC_E_SOE_ERRORCODE_NO_DEFAULT_VALUE
0x98110108: ERROR SoE: No default value

EC_E_SOE_ERRORCODE_DEFAULT_LONG
0x98110109: ERROR SoE: Default value transmission too long

EC_E_SOE_ERRORCODE_DEFAULT_WP
0x9811010A: ERROR SoE: Default value cannot be changed, read only

EC_E_SOE_ERRORCODE_INVL_DRIVE_NO
0x9811010B: ERROR SoE: Invalid drive number

EC_E_SOE_ERRORCODE_GENERAL_ERROR
0x9811010C: ERROR SoE: General error

EC_E_SOE_ERRCODE_NO_ELEM_ADR
0x9811010D: ERROR SoE: No element addressed

10.8 Remote API Error Codes

EC_E_SOCKET_DISCONNECTED
0x9811017D: RAS: Socket disconnected (e.g. IP connection terminated or lost)

EMRAS_E_INVALIDCOOKIE
0x98110181: RAS: Invalid Cookie (e.g.obsolete)

EMRAS_E_MULSRVDISMULCON
0x98110183: RAS: Connect 2nd server denied because Multi Server support is disabled (obsolete)

EMRAS_E_LOGONCANCELLED
0x98110184: RAS: Logon canceled (Serverside connection reject while opening a client connection.)

EMRAS_E_INVALIDVERSION
0x98110186: RAS: Invalid Version (Connection reject because of using mismatching protocol versions on client and server side)

EMRAS_E_INVALIDACCESSCONFIG
0x98110187: RAS: Access configuration is invalid (e.g. SPoC access configuration invalid)

EMRAS_E_ACCESSLESS
0x98110188: RAS: No access to this call at this accesslevel (e.g. a higher SPoC accesslevel is needed to use the called Remote API function)

EMRAS_E_INVALIDDATARECEIVED
0x98110189: RAS: Invalid data received (communication corrupted)

EMRAS_EVT_SERVERSTOPPED
0x98110191: RAS: Server stopped (e.g. connection dropped because of Remote API Server stop)

EMRAS_EVT_WDEXPIRED
0x98110192: RAS: Watchdog expired (e.g. connection dropped because of missing keep-alive messages)

EMRAS_EVT_RECONEXPIRED
0x98110193: RAS: Reconnect expired (obsolete)

EMRAS_EVT_CLIENTLOGON
0x98110194: RAS Server: Client logged on

EMRAS_EVT_RECONNECT
0x98110195: RAS: obsolete

EMRAS_EVT_SOCKCHANGE
0x98110196: RAS: Socket exchanged after reconnect (obsolete)

EMRAS_EVT_CLNTDISC
0x98110197: RAS: Client disconnect

EMRAS_E_ACCESS_NOT_FOUND
0x98110198: RAS: Access not configured for this call (e.g. SPoC access configuration missing)