

# **FE-MTP-L2-IF, R4 SS7-ISR Boards**

## **ITU-T (07/96), ANSI (1996), TTC (03/94)**

**Functional Specification**

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*File reference:*

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# 1. INTRODUCTION

## 1.1 OVERVIEW

The purpose of this document is to describe the functions implemented in the module “Front End MTP-L2 Interface” (FE-MTP-L2-IF), which combines the function of the FE-IF module with a new MTP-L2-IF module, in one process that will communicate with the SS7 Communication Controller - PCI T1/E1 Board PCI bus Driver or the SS7 Communication Controller - PMC T1/E1/J1 Board PCI bus Driver and the BE-if module, Ref. [E5].

The document also gives a detailed description of the FE-MTP-L2-IF function and provides basic descriptions of the messages originated or handled by it. The Management interface, error log handling, MTP-L2 binary test and MTP-L2-function files, configuration file(s) and all of the parameters used are described in detail.

What operating systems FE-MTP-L2-IF shall be developed for are described in Ref. [E8].

## 1.2 ACRONYMS AND TERMS

|          |                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------|
| ACK      | Acknowledge                                                                                             |
| AERM     | Alignment Error Rate Monitor                                                                            |
| ANSI     | American National Standards Institute.                                                                  |
| API      | Application Programming Interface.                                                                      |
| ASCII    | American Standard Code for Information Interchange.                                                     |
| BE       | Back End computer in highly available configurations.                                                   |
| BE-IF    | Back End InterFace.                                                                                     |
| BSN      | Backward Sequence Number.                                                                               |
| BSNT     | BSN to be Transmitted.                                                                                  |
| CP       | Common Part. A module handling IPC, memory management, timers and operating system dependent functions. |
| DL       | Data Link, a primitive to/from MTPL2.                                                                   |
| DMA      | Direct Memory Access.                                                                                   |
| Doorbell | Interrupt register for handling out of sequence alarms and signals.                                     |
| E1       | 2.048 Mbits/sec compliant to ITU G.703.                                                                 |
| EIN      | Ericsson Infotech AB.                                                                                   |
| FALC     | Used as a common name for the FALC-LH circuit and the Quad-FALC circuit.                                |
| FALC-LH  | Framing And Line interface Component for PCM 30 and PCM 24                                              |

## INTRODUCTION

|          |                                                                                                                                     |
|----------|-------------------------------------------------------------------------------------------------------------------------------------|
|          | (MTPL1 PCM circuit on the SS7CC-PCI)                                                                                                |
| FD       | Functional Description.                                                                                                             |
| FE       | Front End computer in High Availability configurations.                                                                             |
| FISU     | Fill In Signal Unit                                                                                                                 |
| FPGA     | Field Programmable Gate Array.                                                                                                      |
| FS       | Functional Specification.                                                                                                           |
| FSM      | Finite State Machine                                                                                                                |
| HA       | High Availability.                                                                                                                  |
| HSN      | Hardware Selection Number (The physical link ID number.*)                                                                           |
| HW       | Hardware.                                                                                                                           |
| ID       | Identification                                                                                                                      |
| IF       | Interface.                                                                                                                          |
| I/O      | Input or Output.                                                                                                                    |
| IOCTL    | I/O Control                                                                                                                         |
| IPC      | Inter Process Communication.                                                                                                        |
| ISR      | In-System Re-configurable FPGA.                                                                                                     |
| ITU-T    | International Telecommunication Union-Telephony                                                                                     |
| IWD      | Interwork Description                                                                                                               |
| ISUP     | ISDN User Part                                                                                                                      |
| J1       | 1.548 Mbits/sec compliant to ITU G.703.                                                                                             |
| LAN      | Local Area Network.                                                                                                                 |
| LSB      | Least Significant Bit.                                                                                                              |
| LSSU     | Link Status Signal Unit                                                                                                             |
| MGMT     | Management.                                                                                                                         |
| MSB      | Most Significant Bit.                                                                                                               |
| MSU      | Message Signal Unit.                                                                                                                |
| MTP      | Message Transfer Part.                                                                                                              |
| MTP-L1   | Message Transfer Part Level 1.                                                                                                      |
| MTP-L2   | Message Transfer Part Level 2.                                                                                                      |
| MUX      | Multiplexer circuit                                                                                                                 |
| OS       | Operating System                                                                                                                    |
| OSI      | Open Systems Interconnect                                                                                                           |
| PCI      | Peripheral Component Interconnect.                                                                                                  |
| PCM      | Pulse Code Modulation, in this document E1, T1 or J1 is meant.                                                                      |
| PMC      | PCI Mezzanine Card, IEEE P1386.1                                                                                                    |
| PR       | Protocol machine                                                                                                                    |
| PRA      | Protocol machine A                                                                                                                  |
| PRB      | Protocol machine B                                                                                                                  |
| QuadFALC | Quad E1/T1/J1 Framer and Line Interface Component for Long and Short Haul Applications, PEB 22554 Version 1.2 (MTP-L1 on SS7CC-PMC) |
| RAM      | Random Access Memory.                                                                                                               |

|              |                                                              |
|--------------|--------------------------------------------------------------|
| Rx           | Receive.                                                     |
| RS           | Requirement Specification                                    |
| SCCP         | Signalling Connection and Control Part                       |
| SDL          | Signalling Data Link (The ID number of a physical link TS.*) |
| SIB          | Signal Indication Busy                                       |
| SIPO         | Status Indication Processor Outage                           |
| SIO          | Service Information Octet                                    |
| SLM          | Signalling Logic Management.                                 |
| SMH          | Signalling Message Handling.                                 |
| SS7          | Signalling System No. 7.                                     |
| SS7CC        | SS7 Communication Controller Board.                          |
| SS7CC-PCI    | SS7 Communication Controller Board for PCI.                  |
| SS7CC-PCI V2 | SS7 Communication Controller Board for PCI version 2.        |
| SS7CC-PMC    | SS7 Communication Controller Board for PMC.                  |
| STS          | Signalling Time Slot.                                        |
| SUERM        | Signal Unit Error Rate Monitor                               |
| SW           | Software.                                                    |
| T1           | 1.548 Mbits/sec compliant to ITU G.703.                      |
| TB           | Transmit Buffer.                                             |
| TCAP         | Transaction Capabilities Application Part.                   |
| tDMAW        | Timer DMA Write.                                             |
| TP           | Twisted Pair.                                                |
| TS           | Time Slot (The ID of a division of the physical link.)       |
| TTC          | Japanese Telecommunication Technology Council.               |
| TUP          | Telephone User Part.                                         |
| tWFC         | Timer Wait For Connection.                                   |
| Tx           | Transmit.                                                    |
| VTs          | Voice Time Slot.                                             |

\* Note: See page 11 for a clarification on this usage.

### 1.3 ENVIRONMENT

In the case of standard EIN Portable SS7 Stack implementations, the stack architecture will be as illustrated in Fig. 1.

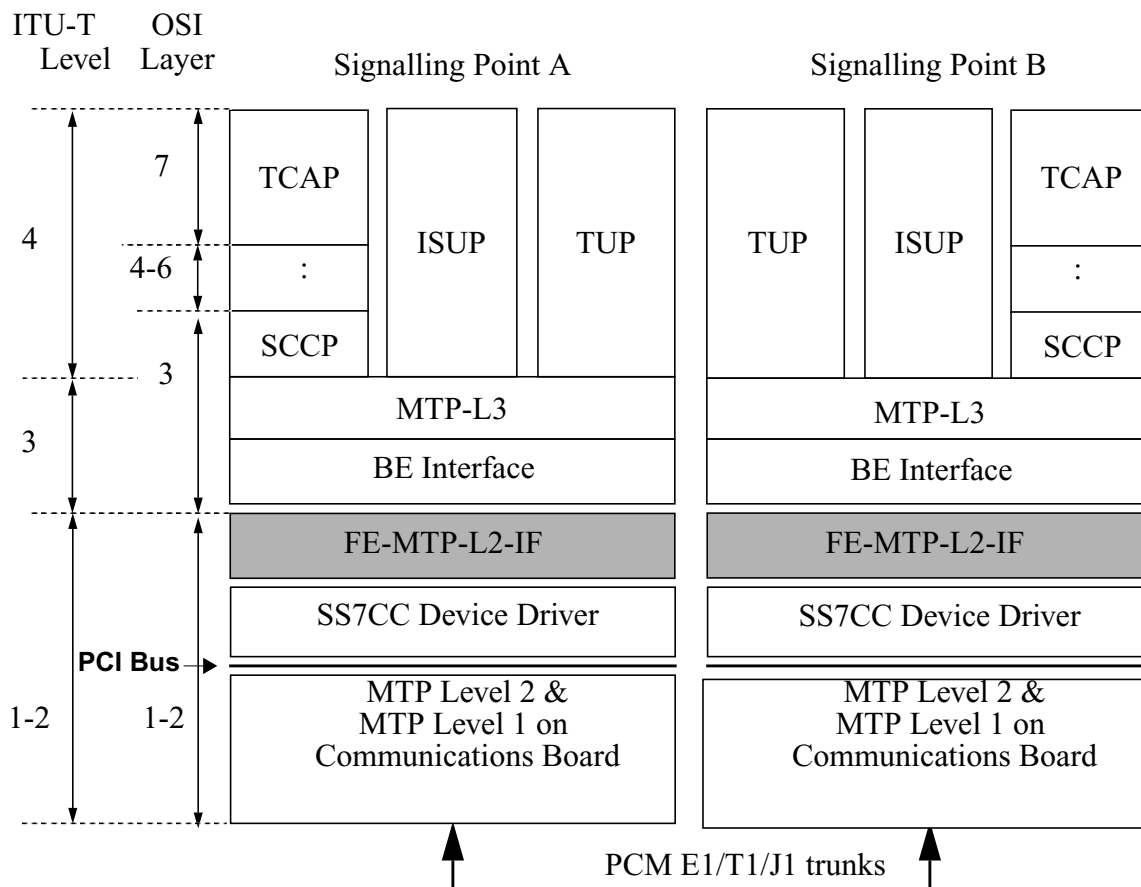


Fig. 1 Residence of the FE-MTP-L2-IF process module installed in host computers. The management interfaces are omitted.

In the case of High Availability implementations, the stack will be as illustrated below.

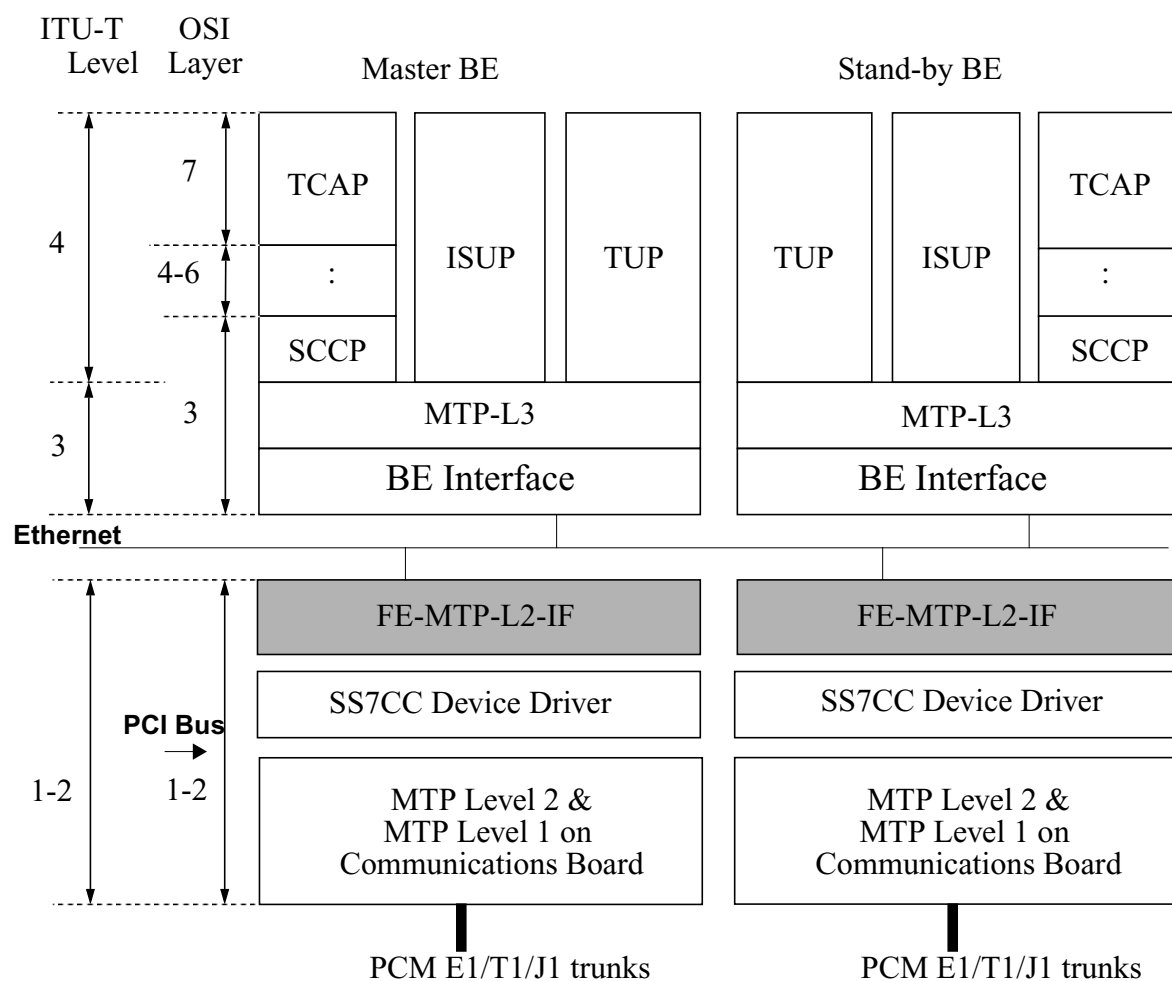


Fig. 2 Residence of the MTP Level 2 Interface module in a FE machine. Management interfaces are omitted.

In either of the cases illustrated in Fig. 1 or Fig. 2, the module architecture may be as depicted in Fig. 3, below.

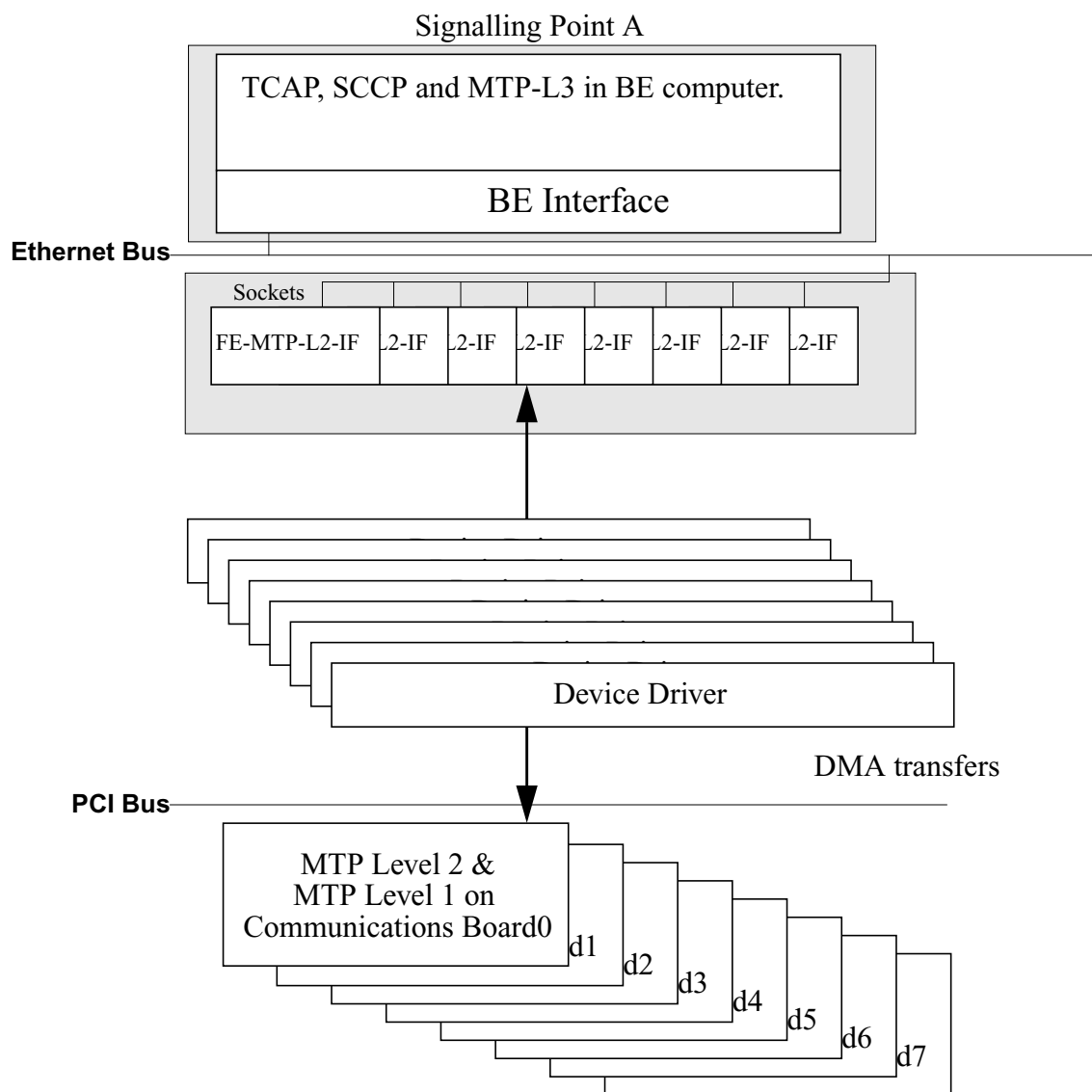


Fig. 3 Expected architecture to be described here, showing one instance of the FE-MTP-L2-IF for each communication board. Likewise, there should be one instance of Device Driver code for each FE-MTP-L2-IF/Board.

The Tx and Rx path will be implemented as a single execution thread, which uses multiplexing to handle reception and transmission in both directions.

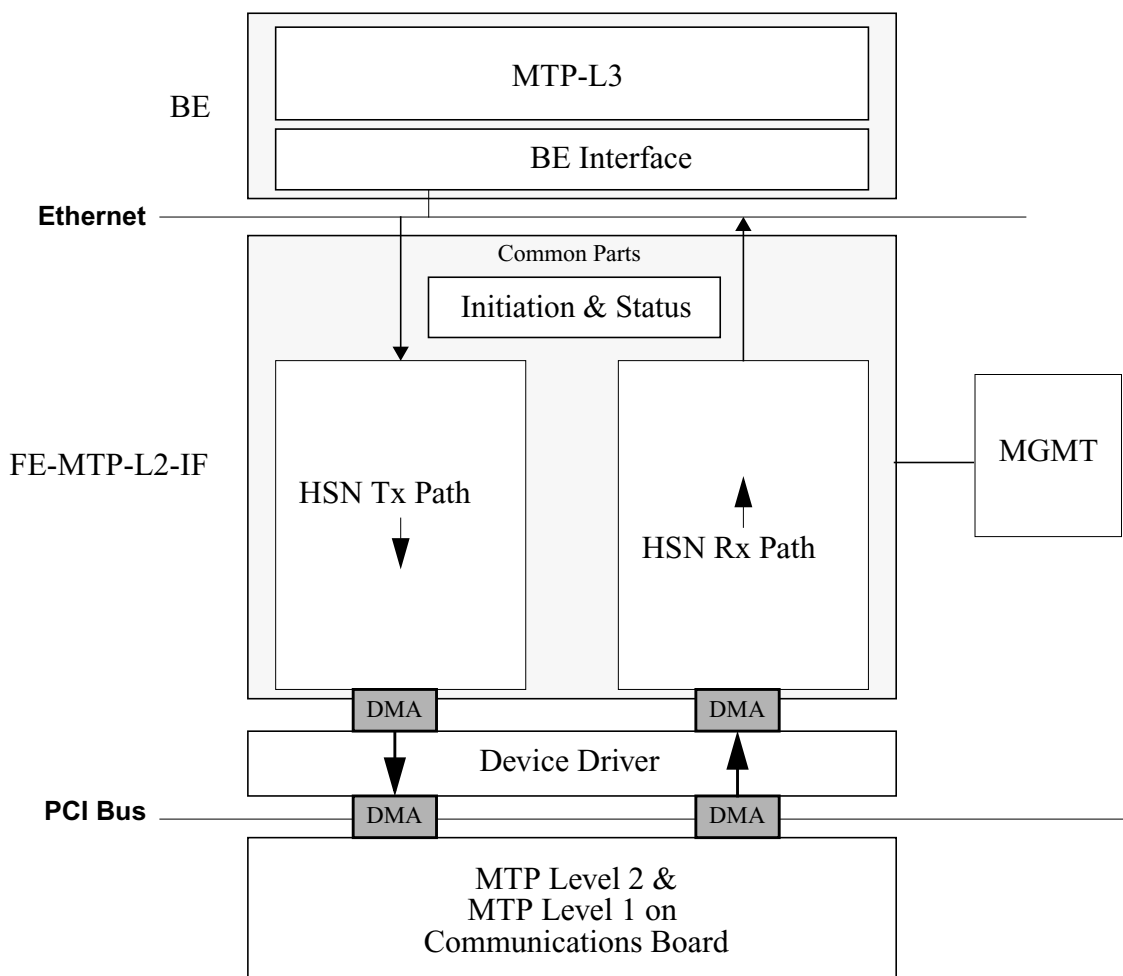


Fig. 4 Internal architecture of the FE-MTP-L2-IF.

## 1.4 RESTRICTIONS AND DEVIATIONS

The SC-bus is not implemented on the SS7-PMC board, therefore it must not be configured.

There exists no HW-diagnostic FPGA application, therefore the HW-test parameters in the FE-MTP-L2-IF main configuration file has no effect, although they must be present in the configuration file.

## 1.5 CAPABILITIES AND CONSTRAINTS

This implementation is intended to utilize a high degree of transparency, in the sense that it shall be a means for transferring the high volume of traffic and a few high-priority alarms, with a minimum amount of processing, for the input and output (I/O) paths, with the support of the EIN Common Parts system.

FE-MTP-L2-IF should be able to handle both the SS7 Communication Controller - PCI E1/T1 Board version 1 and 2 and the SS7 Communication Controller - PMC E1/T1/J1 Board.

The requirements for FE-MTP-L2-IF are listed in Ref. [E8].

The SS7 Communication Controller - PCI E1/T1 Board, SS7 Communication Controller - PCI E1/T1 Board version 2 and the SS7 Communication Controller - PMC E1/T1/J1 Board will further on in this document be called SS7CC-PCI, SS7CC-PCI V2 and SS7CC-PMC or when meaning all types of boards SS7CC.

The word trunk is used to describe a set of channels, e.g. an E1 trunk carries 32 \* 64bit/sec channels.

Each instance of FE-MTP-L2-IF shall be a separate process, with its own module ID, which will be used to access the upper module interface, via the EIN Common Parts encapsulation. See Fig. 3

Historically, because only one channel of each physical link was used for signalling, the HSN number specified a hardware device, often a board or card inserted into a back plane bus, which card implemented one or more E1, T1 or J1 links, identified by the SDL number. On each of these SDLs, one channel would be used for signalling.

In this release, however, an SS7CC will support one or two (dependant on board/bit-files combination, see Table 1 on page 12) MTP-L2 protocol machine, configurable with up to 32 multiplexed channels. Hence, an HSN number here identifies the MTP-L2 protocol machine. While, the SDL number identifies a channel, numbered 0 to 31, on each HSN.

This in no way alters the function of the EIN Portable SS7 stack modules above the FE-MTP-L2-IF. It is only required that, in the BE-IF, the HSN-SDL identification be mapped, by the BE-IF configuration, to the correct Common Parts socket address of the correct FE-MTP-L2-IF.

The FE-MTP-L2-IF code will support any of the three telecommunications standards: ANSI (ref. [A1]), ITU-T (ref. [I2]) or TTC (ref. [T1]).

Since, all operating system calls are encapsulated, the same source code can be compiled for SUN Solaris 2.6, SUN Solaris 7 as well as Windows NT 4.0 and Vx-Works 5.4.

### **1.5.1. Supported hardware**

The following SS7CC are supported

| ROA Number   | Revision | Device id | Supports HSN1 |
|--------------|----------|-----------|---------------|
| ROA 20920/3  | R2A      | 0x04      |               |
| ROA 20920/5  | R1A      | 0x04      | *             |
| ROA 20921/1  | R1A      | 0x0b      |               |
| ROA 20921/2  | R1A      | 0x0b      |               |
| ROA 20921/13 | R2B      | 0x0b      | *             |
| ROA 20921/14 | R2B      | 0x0b      | *             |

**Table 1: Supported boardtypes**

\* Note, Support for HSN1 (64 channels) depend on revision of MTPL2 bitfile.

## 1.6 HISTORY

**Table 2: Format of history**

| Revision | Date       | Author         | Comments                                                                                                                                                                                                                                                           |
|----------|------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A        | 1998-10-20 | Ahmad Mahmoudi | Original version                                                                                                                                                                                                                                                   |
| B        | 1999-12-09 | Martin Hedberg | Updated during design and implementation. Added support for EIN SS7 Communication Controller-PMC E1/T1 Board. Added clock configuration. Added M2_SIB_CONG_IND and M2_SIB_CEASED_IND.                                                                              |
| C        | 2000-01-26 | Martin Hedberg | Added error codes for SS7CC-PMC FALC-, clock- and mux-configuration. Changed DL_INSERTSERVICE_conf to be a normal priority primitive. Added MM_ORDER_req RESET_STAT. Added FALC configuration. Added error code 101. Updated according to 4/170 18-CAA 201 611 Ux. |

## INTRODUCTION

| Revision | Date       | Author          | Comments                                                                                                                                                                                                          |
|----------|------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| D        | 2000-03-09 | Martin Hedberg  | Added error codes and descriptions of MM_XSTAT_conf and MM_REINIT_conf. Added description of statistics. Changed T1 framer mode options. Corrected error codes. Corrected according to 18/170 17-CAA 201 611 Uen. |
| E        | 2000-04-13 | Martin Hedberg  | Changed description of alarm ID 1.                                                                                                                                                                                |
| F        | 2000-06-14 | Martin Hedberg  | Added description of Windows NT start-up. Changed description of configuration of T1 at 56 kbps.                                                                                                                  |
| G        | 2000-12-06 | Anders Westlund | Added TTC, J1.                                                                                                                                                                                                    |
| H        | 2001-02-07 | Anders Westlund | Removed erroneous parts, SC bus, H100, threaded, configuration etc. Updated with new MUX configuration file. Updated according to 29/170 18-CAA 201 611Ux                                                         |
| H        | 2001-03-08 | Anders Westlund | Changed in history comment for revision H. Updated ref. [E4].                                                                                                                                                     |
| I        | 2001-09-07 | Anders Westlund | Updated according to TR2240 and TR2413.                                                                                                                                                                           |
| J        | 2002-06-19 | Marie Berglund  | Updated for PCI V2. Informal inspected by ein-west.                                                                                                                                                               |

| Revision | Date       | Author          | Comments                                       |
|----------|------------|-----------------|------------------------------------------------|
| J        | 2002-06-24 | Anders Westlund | Removed unresolved cross reference.            |
| K        | 2003-02-05 | Anders Westlund | Updated for R4. Informal inspected by einanmi. |

## 1.7 REFERENCES

Ericsson Infotech AB.

- [E1] MTP-L3, ANSI, Release R2A, 1992,  
CAA 201 24 Uen, Rev. B
- [E2] MTP-L3, ITU-T, Release R4A, 1993,  
CAA 201 25 Uen, Rev. F
- [E3] MTP-L3, TTC, Release R2C, 1992, CAA 201 28 Uen,  
Rev. E
- [E4] FS Common Parts, Release R8, 155 17-CAA 201 29 Uen,  
Rev. N
- [E5] FS High Availability FE/BE-Interface, Release R2,  
155 17-CAA 201 34 Uen
- [E6] FS High Availability FE-Interface, Release R1A,  
155 17-CAA 201 39 Uen
- [E7] FS Management Interface R6, ITU/ANSI/TTC,,  
155 17-CAA 201 30 Uen
- [E8] RS for EIN Portable SS7 FE-MTP-L2-IF, Rev C  
1056-CAA 201 611 Uen
- [E9] FD FE-MTP-L2-IF, R  
155 16-CAA 201 611 Uen
- [E10] SS7 - PCI and PMC Sun Solaris Driver, Rev. F, Inter-working De-  
scription,  
155 19-CAA 201 613/1 Uen
- [E11] SS7 - PCI Windows NT Driver, Rev. D, Inter-working Descrip-  
tion,  
155 19-CAA 201 613/2 Uen
- [E12] IWD for SS7-MTPL2-PCI, ITU, Q.703 (07/96), Rev A  
1/155 19-CNA 107 378 Uen

- [E13] IWD for SS7-PCI MTPL2, ITU, Q.703 (07/96), Rev A  
1/155 19-CNA 107 378 Uen
- [E14] IWD for SS7-PMC E1/T1 Board,,Rev A  
1/155 19-CNA 107 488 Uen
- [E15] SS7 - ISR Driver API, Rev A, Inter-working Description  
155 19-CAA 115 98 Uen
- [E16] IWD for SS7-PCI MTPL2, ANSI T1.111-1996, Rev A  
2/155 19-CNA 107 378 Uen
- [E17] IWD for SS7-PCI E1/T1 BOARD, Rev B  
15519-CNA 107 371 Uen
- [E18] IWD for SS7-PCI MTPL2, JT-Q703 (Edition 3/94), Rev B,  
3/155 19-CNA 107 378 Uen
- [E19] CFD for SS7 Comm. Controller E1/T1/J1 Board, Rev F,  
190 73-CAA 201 611 Uen

#### ANSI Recommendation Standard.

- [A1] American National Standard for Telecommunications, Specification of Signalling System No. 7 (SS7) - Functional Description of the Signalling System - Message Transfer Part (MTP), ANSI T1.111 - 1996.

#### ITU-T Recommendation Standard.

- [I1] ITU-T Recommendation Q.702, MTP-L1 (07/96)
- [I2] ITU-T Recommendation Q.703, MTP-L2 (07/96)
- [I3] ITU-T Recommendation Q.704, MTP-L3 (07/96)
- [I4] ITU-T Recommendation Q.703, Annex A (07/96)
- [I5] ITU-T Recommendation Q.706, MTP Signalling Performance,  
(03/93)
- [I6] ITU-T Recommendation Q.752, Monitoring and Measurement,  
(06/97)
- [I7] ITU-T Recommendation Q.781, MTP-L2 Test Specification (07/  
96)

#### TTC Recommendation Standard.

- [T1] Telecommunications Technology Council (TTC) JT-Q703 Message Transfer Part, Signalling Link, Version 3 (04/94).
- [T2] Telecommunications Technology Council (TTC) JT-Q704 Message Transfer Part, Signalling Network Functions, Version 3 (04/93).

## 2. FUNCTIONS

The original Front End Interface (FE\_IF) is functionally divided into two logical blocks; the signalling logic management (SLM) block and the signalling message handling (SMH) block. This module will implement both of these functional blocks in one process.

The signalling logic management (SLM) handles the interface between the management module on one side and MTP-L2 and MTP-L1 on the other side. It caters for the initialization, configuration, retrieval of management information, and termination of MTP-L2.

The Signalling Message Handler (SMH), on the other hand, handles the SS7 signalling traffic between the BE, the FE-MTP-L2-IF and the SS7CC Device Driver. The BE\_IF acts as a client and uses the FE-MTP-L2-IF as a server. This means that the BE\_IF will connect to all of the configured FE-MTP-L2-IFs. Thus, the FE-MTP-L2-IF part handles the communication, most of it transparently, between the BE-IF and the MTP-L2 on the SS7CC.

By “transparently”, we mean the signals are identified and, unless they are intended for action in the FE-MTP-L2-IF, they are sent on to their destination, with no action having been taken, beyond moving them from CP space to the DMA buffers, or vice versa.

### 2.1 START UP

FE-MTP-L2-IF supports both autostart and start via MGMT. When autostart is used as an input parameter to FE-MTP-L2-IF the primitives MM\_INIT\_req and MM\_ORDER\_req (start) are sent internally at initialization, when start via MGMT is used these primitives are sent by MGMT.

In VxWorks the main function to use is EINSS7\_Ife and the first parameter should be the number of arguments including the first parameter.

#### **Autostart**

Use the parameters:

<module ID> autostart <config file> [t] (t sets trace on, optional)

### **Initialization via MGMT**

Use the parameters:

<module ID> [t] (t sets trace on, optional)

#### **2.1.1. Rules concerning Windows NT**

In Windows NT one of the following options must be specified:

- c                Run as a console application.
- install        Install as a service.
- a               Change start-up parameters for service.
- h               View help.
- remove        Removes the service.

Also the FE-MTP-L2-IF executable file must be renamed to end with a number from 01 to 08, e.g. fel2if01.exe. If more than one board shall be used in a computer then the FE-MTP-L2-IF executable files must be named different, e.g. fel2if01.exe, fel2if02.exe.

## 2.2 FE FUNCTIONAL BLOCK SLM

This function block handles the management interface, including the initialization, re-configuration, trace log, termination, statistics and alarm handling.

### 2.2.1. Initialization

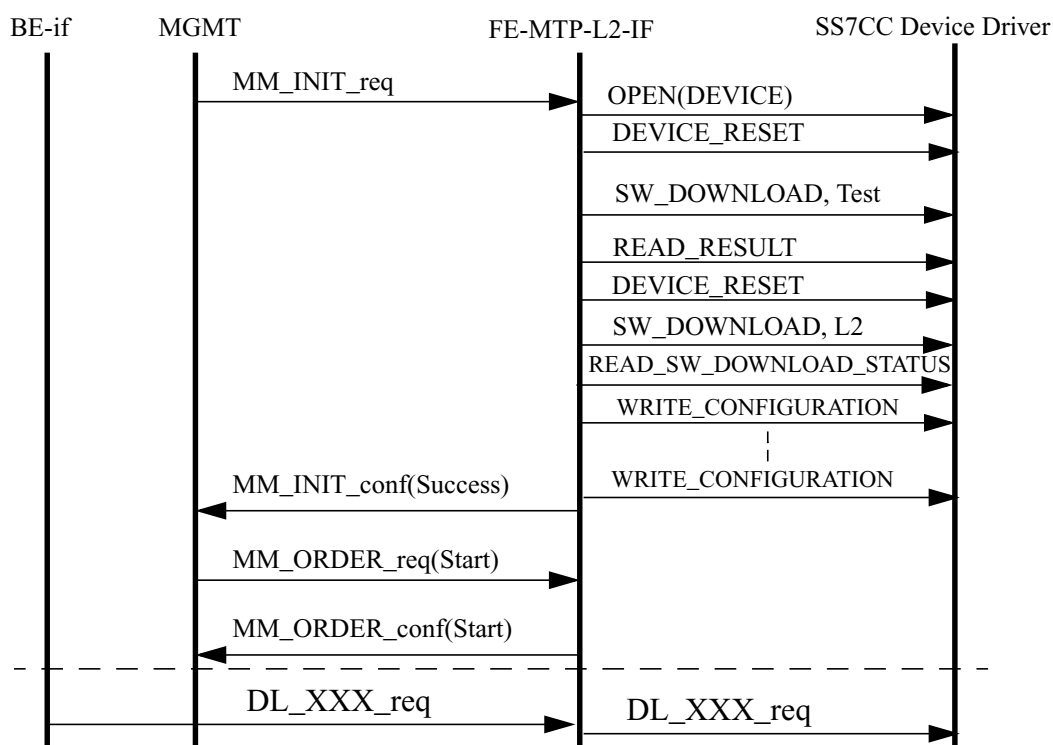


Fig. 5 The sequence to test and configure the SS7CC, initialization.

The first primitive FE-MTP-L2-IF can accept, is MM\_INIT\_req, which contains an ASCII file path address and an offset value.

This file is fetched, read from the position of the offset, and the new offset is recorded for later use, in the MM\_INIT\_conf. The specified file, which is FE-MTP-L2-IF's main configuration file, contains the following additional file names:

File 1:contains a binary test code file.

File 2:contains a binary MTP-L2 code file.

File 3:contains a configuration information of the MTP-L2.

File 4:contains a configuration information of the FALC-circuits and MUX routes. This file is board dependent.

File 5: contains board dependent FALC register setup which shall not be edited. There exists one file for each type of setup. If E1 is used then this row should contain the path of the E1 setup file for the board and so on.

The first file's binary diagnostic test code is to be loaded onto the board and executed. The test code should return indications of any defects found. If the quality is satisfactory, the following steps should be performed.

The second file contains the binary MTP-L2 code, which is fetched, down-loaded to the board, and started.

The third file contains default signalling link configuration parameters specific templates. This information is used to set the respective configuration registers of MTP-L2 protocol machine.

The fourth file is board dependent. It contains configuration information for the FALC circuits, clock and MUX routing information for configured channels. This information is used to set the respective configuration register through IOCTL() function calls.

The fifth file is board dependent and contains FALC register setup. Two files are to be delivered for the PCI board, one E1 register setup and one T1 register setup and for PCI V2 board there will be E1, T1 and J1 setup files . For the PMC board E1, T1 and J1 setup files will be delivered.

For a through description of the configuration files stated above, please see *Configuration Files* on page 62.

If these procedures are completed successfully, the MM\_INIT\_conf will return *Success*.

If any of the above steps fail, an MM\_INIT\_conf (failed) with a specific error code, will be sent to Management.

The initialization procedure is completed, when the MGMT sends an MM\_ORDER\_req (Start) to FE-MTP-L2-IF. The start order merely changes the state of the FE-MTP-L2-IF module and makes it ready to handle SS7 traffic.

### 2.2.2. Total Reconfiguration

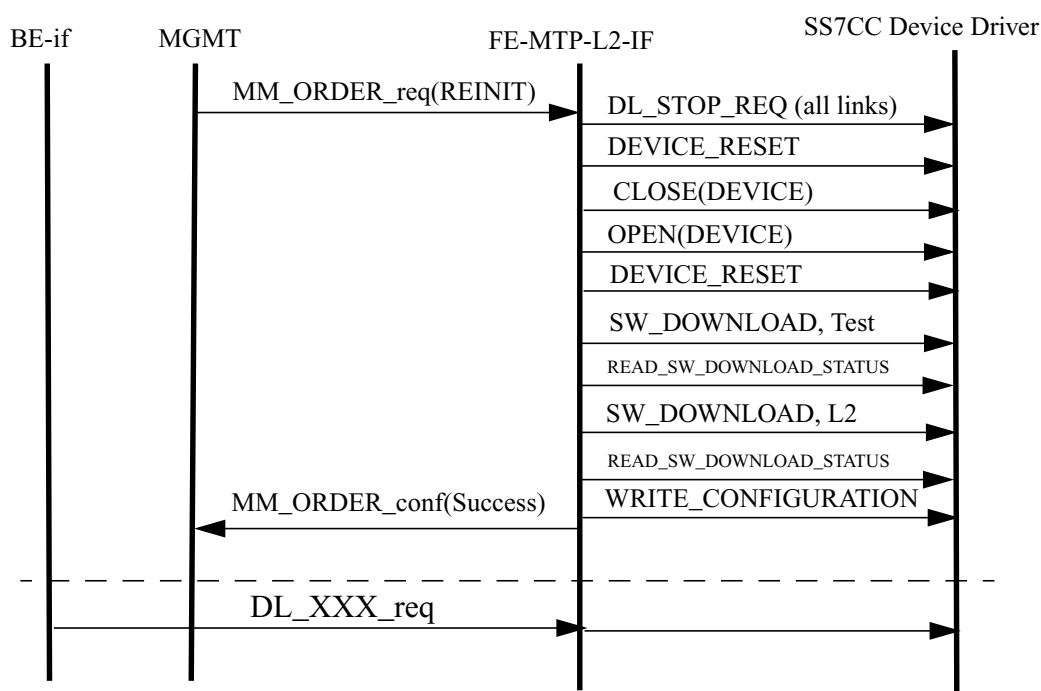


Fig. 6 The sequence to test and configure the SS7CC, total reconfiguration.

Total re-configuration entails total reset of the SS7CC, re-load of the MTP-L2 binary file with a new set of parameters, channels and MUX routes. The state of the FE-MTP-L2-IF is not affected by total re-configuration.

Reception of MM\_ORDER\_req(REINIT), after the initialization procedure, will involve total re-configuration, if the validation procedure accepts all parameter values. If the configuration information is not accepted, the old configuration will remain valid.

The MM\_ORDER\_conf returns the result of the configuration attempt to the management.

It is very important to notice that down-loading the binary MTP-L2 code to the SS7-board takes approximately 1 to 2 seconds. In a HA SS7 system with heart beat signalling between processes, it is necessary to adjust the total time for fault detection to a value higher than the time of download and configuration, else, total re-configuration will cause detection of BROKEN-COMMUNICATION due to lost heart beats.

### 2.2.3. Partial Re-configuration

Partial re-configuration refers to modification of specific parameters of FE-MTP-L2-IF or MTP-L2 on the fly, without taking any process off-line. Re-configuration can be done in two ways: real time and run time.

Both the real time and the run time re-configurations are requested through the management primitive, MM\_ORDER\_req. The result of the re-configuration is returned to management by MM\_ORDER\_conf.

For a list of the management order IDs and their parameters, please see *Order IDs on page 44*.

#### 2.2.3.1 Real Time Re-configuration

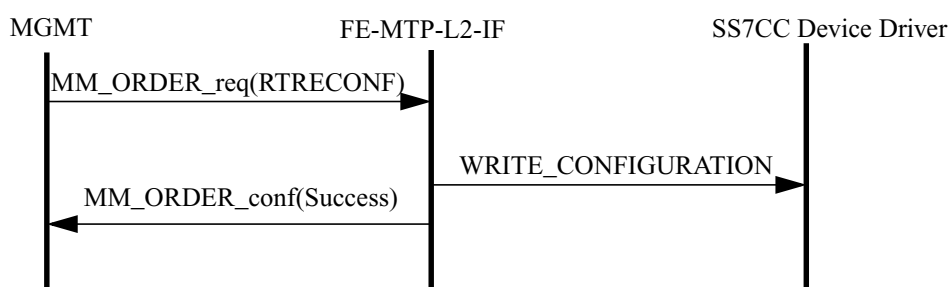


Fig. 7 The sequence to reconfigure a signalling link in real time.

Real time re-configuration of a parameter can be done without affecting any signalling link's state or functionality. Timers tWFC, tDMAW and tWFNB in the FE-

MTP-L2-IF configuration file and all parameters in the SDL Configuration Template (see ref. [E19]) can be re-configured in real time.

### 2.2.3.2 Run Time Re-configuration

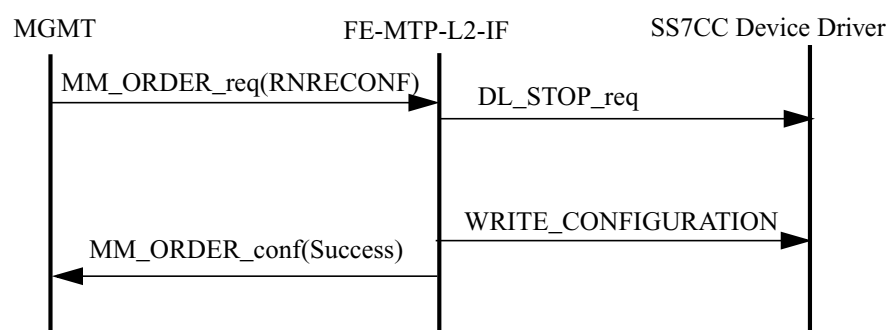


Fig. 8 The sequence to re-configure a signalling link in run time.

Run time re-configuration is pursued for a number of signalling link parameters, which must not be changed while the SDL is in service. Removing already configured signalling data links, adding new signalling data links and changing the multiplexing routes for a signalling data link require that the affected signalling data links are taken out of service prior to committing the re-configuration.

## 2.2.4. Termination

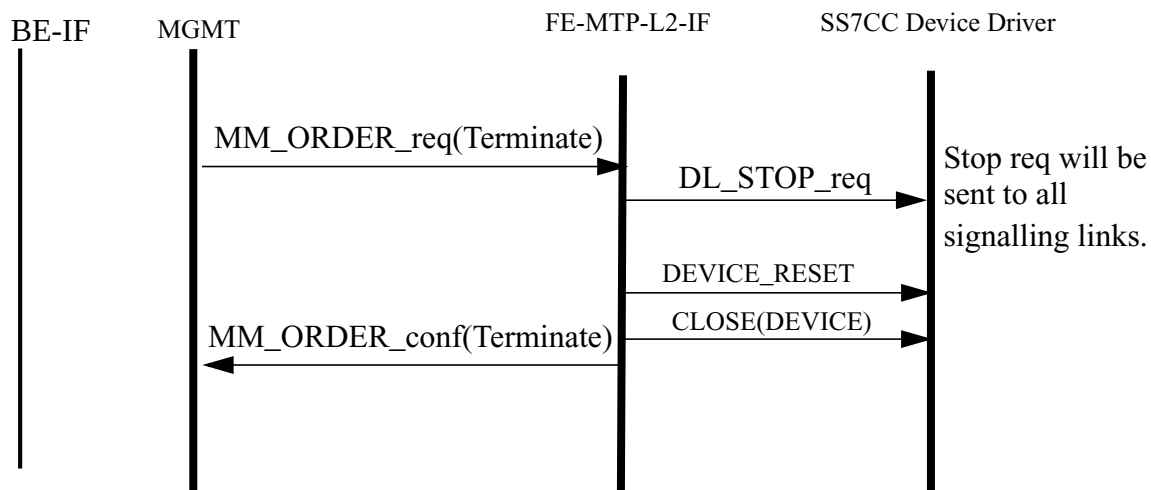


Fig. 9 *MM\_ORDER\_req(Terminate).*

When the FE-MTP-L2-IF is terminated with an `MM_ORDER_req` (terminate), it will try to make sure that the links are taken out of service by sending an `DL_STOP_req` to the MTP-L2.

## 2.2.5. Other Management Orders

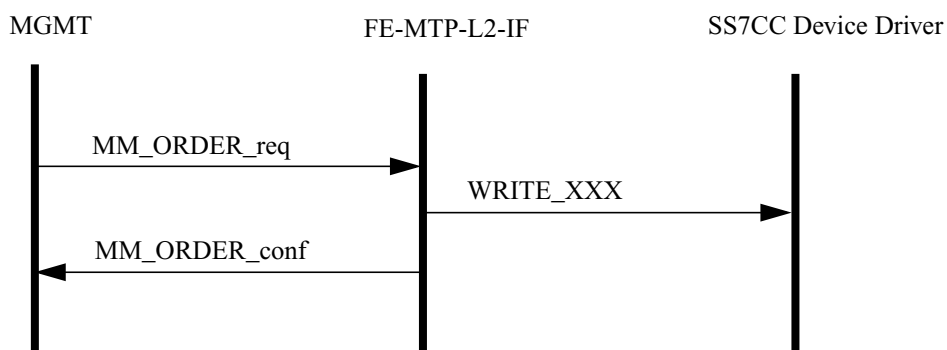


Fig. 10 *Order requests.*

The orders supported by the FE-MTP-L2-IF are described in section 3.3.4. Any requests for unsupported orders will be handled by reporting them as not implemented.

### 2.2.6. Statistics

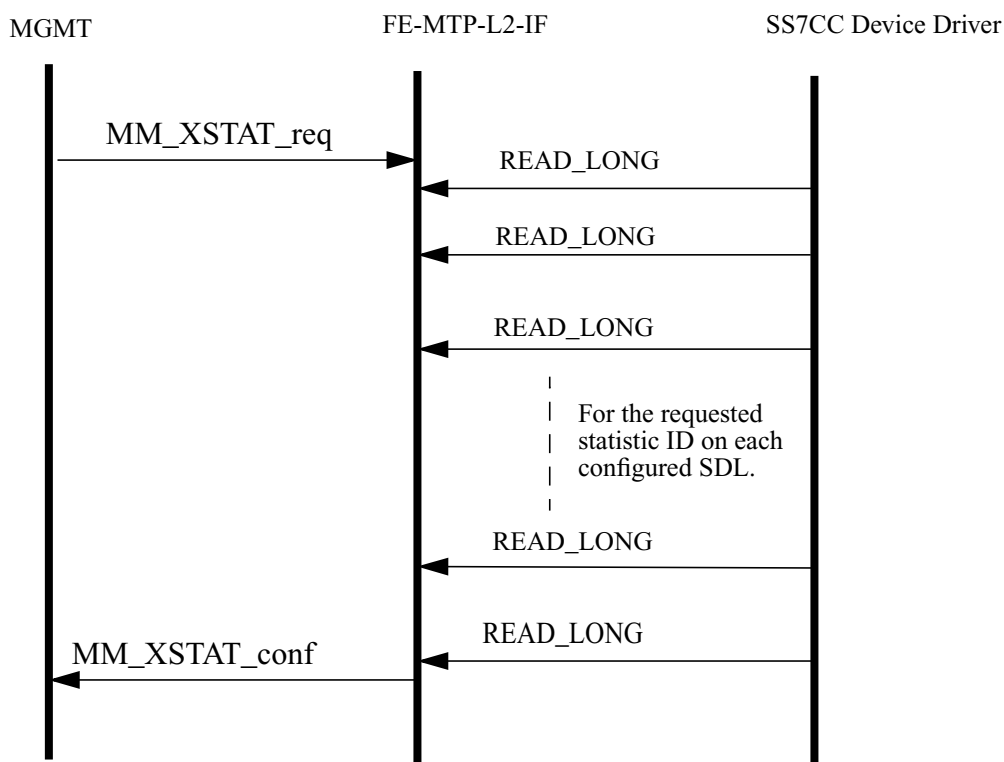


Fig. 11 Extended Statistics requests

Upon reception of an MM\_XSTAT\_req, an MM\_XSTAT\_conf will be responded to the MGMT containing statistics information for the statistics ID requested for all configured SDLs. Unknown statistics IDs will be reported as not implemented.

The statistics information is stored in a set of 4-octet-wide statistics registers on the FPGA chip on the SS7CC.

For a complete description of the statistics IDs defined for the SDLs, please refer to ch. 3.3.2.

### **2.2.7. Alarms**

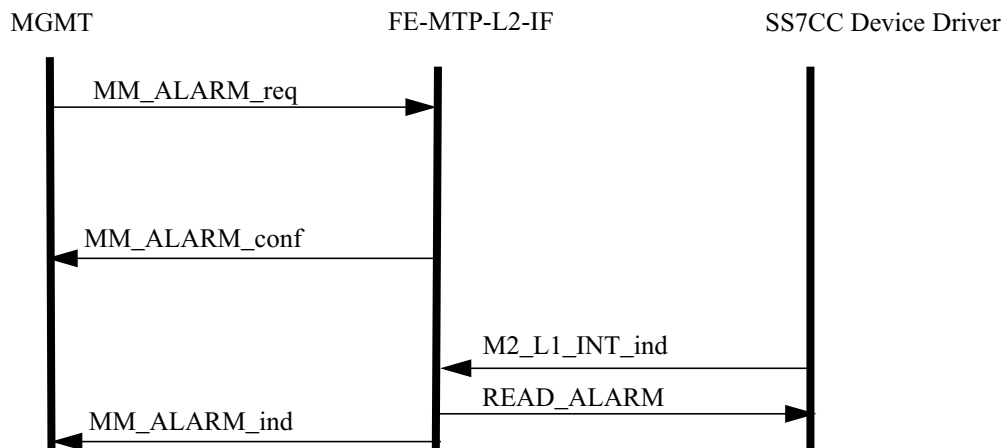


*Fig. 12 Alarm requests when requesting alarms from the board.*

The MGMT sends MM\_ALARM\_req primitive to the FE-MTP-L2-IF to subscribe to one or more alarms. The FE-MTP-L2-IF responds with MM\_ALARM\_conf, in which it confirms the subscribing request. If a request is received for an unsupported alarm, the confirmation primitive will indicate that the alarm is not supported. The alarms supported by FE-MTP-L2-IF are described in section 3.3.6.

As long as the MGMT is subscribed to an alarm, an MM\_ALARM\_ind primitive will be sent to the MGMT for each occurrence of the alarm.

## **2.3 FE FUNCTIONAL BLOCK SIGNALLING MESSAGE HANDLING (SMH)**

The Signalling Message Handling takes care of the SS7 signalling traffic between the MTP-L2, through the DMA buffers, and MTP-L3, through the BE-IF.

The Receive/Transmit directions are related to the links: Receive (Rx) from the net links and transmit (Tx) to the net links. The intention must be to make each function as small and efficient as possible.

The module will listen both to the connection from MTP-L2 and from MTP-L3, when a message becomes available the Rx or Tx DMA buffer handling will be called.

### **2.3.1. Receive DMA Buffer Handling**

DMA transfer in the receive direction is also initiated by the FE-MTP-L2-IF.

In UNIX and VxWorks the module calls the commonParts function msgRecvEvent and listens to both the socket connections on the transmit side (SS7BE processes) and the file descriptor on the receive side (SS7CC). If the event is from the driver a read() system function will then be issued to initiate a DMA transfer from the SS7CC to the host computer.

In the Windows NT environment, on the other hand, ReadFile() is called with an overlapped I/O structure. The module then calls the commonParts function msgRecvEvent() and listens to both the socket connections on the transmit side (SS7 BE processes) and file handles on the receive side (SS7CC).

### **2.3.2. Transmit DMA Buffer Handling**

The Tx path will read the Common Parts socket to the FE-MTP-L2-IF. If a message is received from the BE-IF, it will be identified and, if transparent, will have no effect on the FE-MTP-L2-IF. It will then be copied to the DMA transmit buffer, if there is room. If there is insufficient room, the DMA transmit will be initiated and the message will be placed into the next DMA buffer.

Upon copying the first message to the DMA transmit buffer, the module starts a timer, tDMAW, to supervise the maximum buffering time for messages stored in the DMA buffer before they are transmitted over the signalling links. In normal traffic

cases this timer is cancelled after each DMA transfer. In very low traffic flow, however, this timer will expire and forces a DMA transfer, even if the DMA buffer is not full, to guarantee a maximum propagation delay from MTP-L3 to MTP-L1.

The DMA transfer is carried out by the FE-MTP-L2-IF calling a write() system call in the UNIX and VxWorks environment and a WriteFile() system call in the Windows NT environment.

### **2.3.3. Priority Primitives**

The priority primitives, received on the DMA receive buffer, will be sent on a separate socket connection to the BE-IF if this is configured and implemented in BE-IF.

The primitives which may thus be processed are:

- DL\_RPO\_ind
- DL\_RPOR\_ind
- DL\_CONGESTED\_ind
- DL\_CONGCEASE\_ind

### **2.3.4. BROKEN COMMUNICATION**

This occurs when one of the msgSend() or msgRecv() function families of the Common Parts returns MSG\_BROKEN\_SOCKET indicating that the connection with the BE is lost.

It causes the FE-MTP-L2-IF internal primitive, BROKEN\_COMMUNICATION, to be sent. FE-MTP-L2-IF. A supervision timer, tWFC, is started and received messages are buffered on all signalling links.

Reception of a DL\_XXX\_req from the BE-IF indicates that the connection with the BE is restored. All buffered messages in the FE-MTP-L2-IF will then be headed to the BE.

If the loss of connection with the BE is due to a failover in a HA system, this will be indicated to the FE-MTP-L2-IF by sending a DL\_STATUS\_req to each configured SDL from the new primary BE. The primitive will cause the FE-MTP-L2-IF to discard all buffered messages during the time it had lost connection with the BE. Furthermore, the DL\_STATUS\_req will cause the FE-MTP-L2-IF to read the state

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of the specific link and return a DL\_STATUS\_conf to the BE-IF. This is illustrated in Fig. 14.

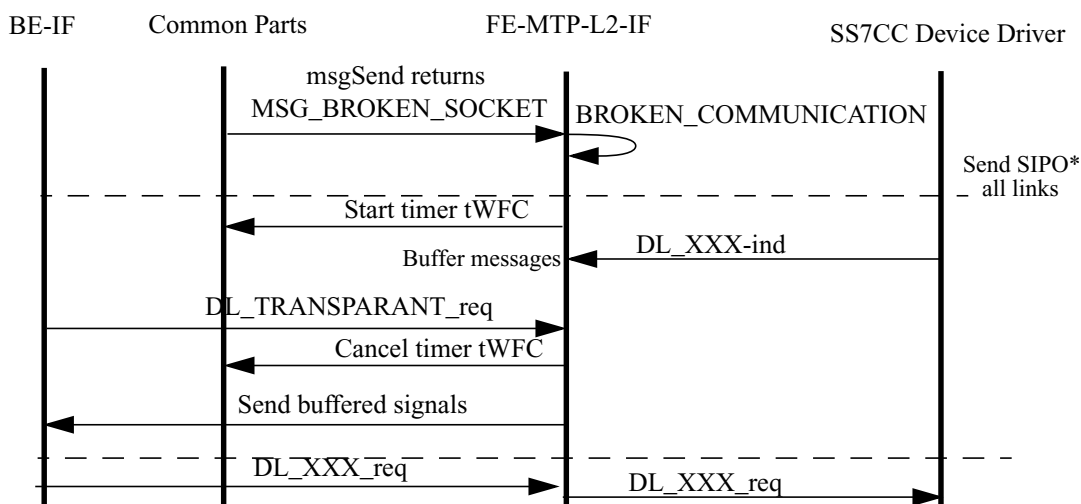


Fig. 13 An FE-MTP-L2-IF BROKEN\_COMMUNICATION sequence, where the connection is recovered before timer tWFC expires.

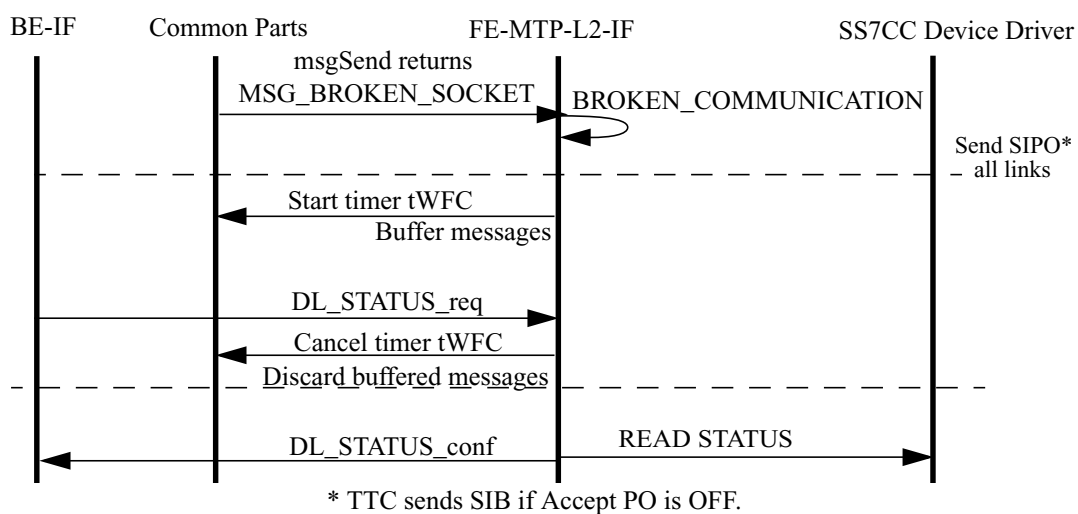


Fig. 14 The FE-MTP-L2-IF BROKEN\_COMMUNICATION sequence, when a DL\_STATUS\_req message is received before timer tWFC expires, indicating "switch-over" to another BE

## FUNCTIONS

stack.

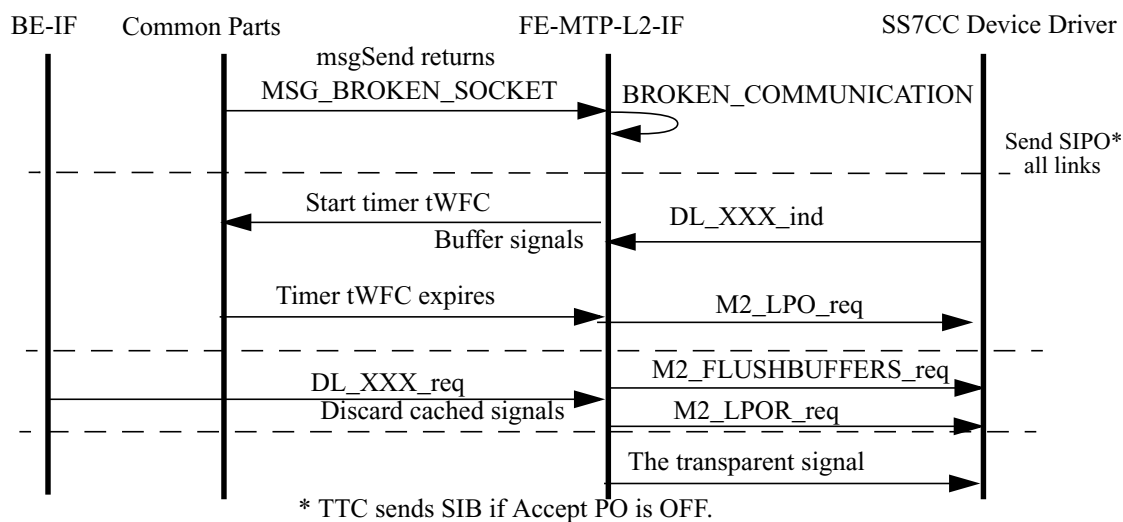


Fig. 15 The FE-MTP-L2-IF BROKEN\_COMMUNICATION sequence, when timer tWFC expires before a transparent "DL\_" message is received.

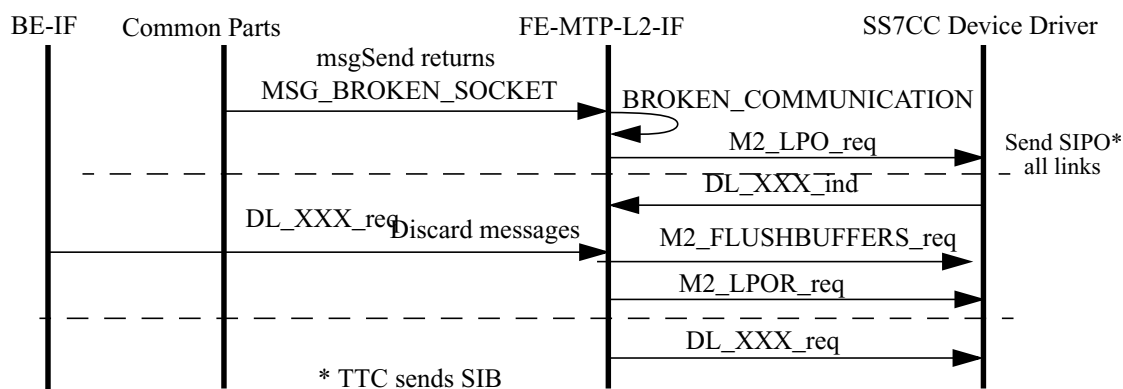


Fig. 16 The FE-MTP-L2-IF BROKEN\_COMMUNICATION sequence, when timer tWFC is zero and thus expires before any message is received.

### **2.3.5. Remote processor outage recovered**

When FE-MTP-L2-IF is in service and receives a DL\_RPOR\_ind from MTP-L2 indicating remote processor outage recovered for a specific SDL it sends a DL\_CONTINUE\_req to that SDL in order to take MTP-L2 to in service state.

### **2.3.6. Remote congestion**

This occurs when MTP-L2 receives an LSSU with Status Indication Busy (SIB). MTP-L2 will then send an M2\_SIB\_CONG\_ind to FE-MTP-L2-IF to indicate SIB received. This causes FE-MTP-L2-IF to send a DL\_CONGESTED\_ind to BE\_IF. When an increased BSN is received MTP-L2 will send an M2\_SIB\_CEASED\_ind to FE-MTP-L2-IF, which then will send a DL\_CONGCEASE\_ind to BE\_IF. This is illustrated in Fig. 17.

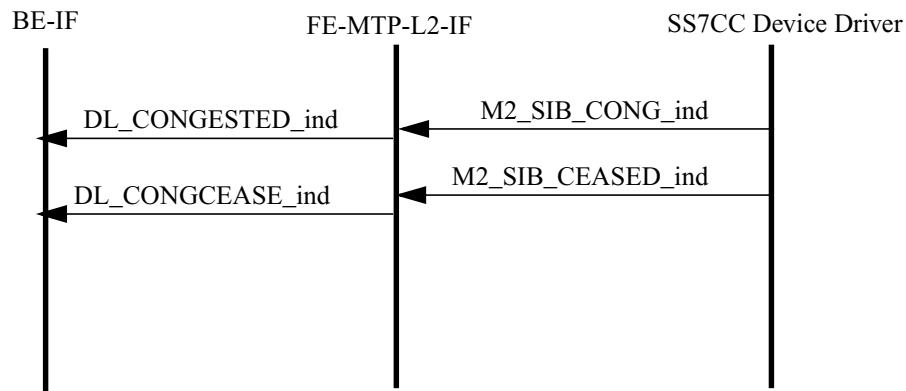


*Fig. 17 The remote congestion - remote congestion ceased sequence.*

FE-MTP-L2-IF contains the logic to prevent sending two DL\_CONGESTED\_ind for the same SDL in case of congestion. If a SDL has both local and remote congestion, DL\_CONGCEASE\_ind should not be send until both local and remote congestion have ceased. This is illustrated in Fig. 18 below.

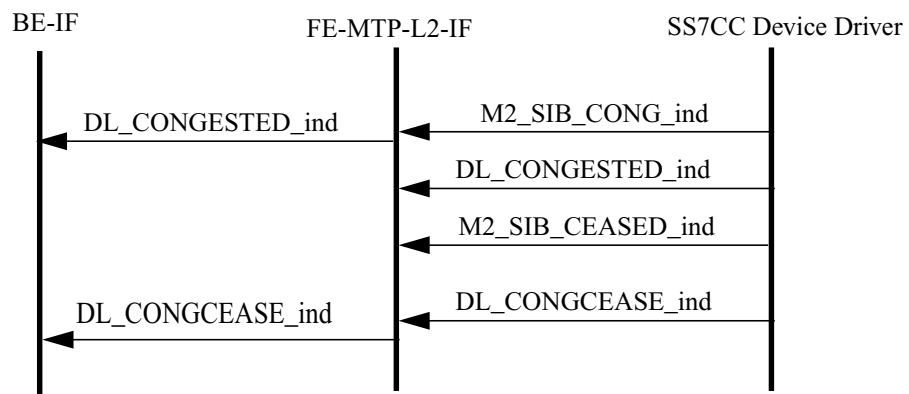


Fig. 18 Both local and remote congestion.

## 3. INTERFACES

### 3.1 SYMBOLIC DESCRIPTION

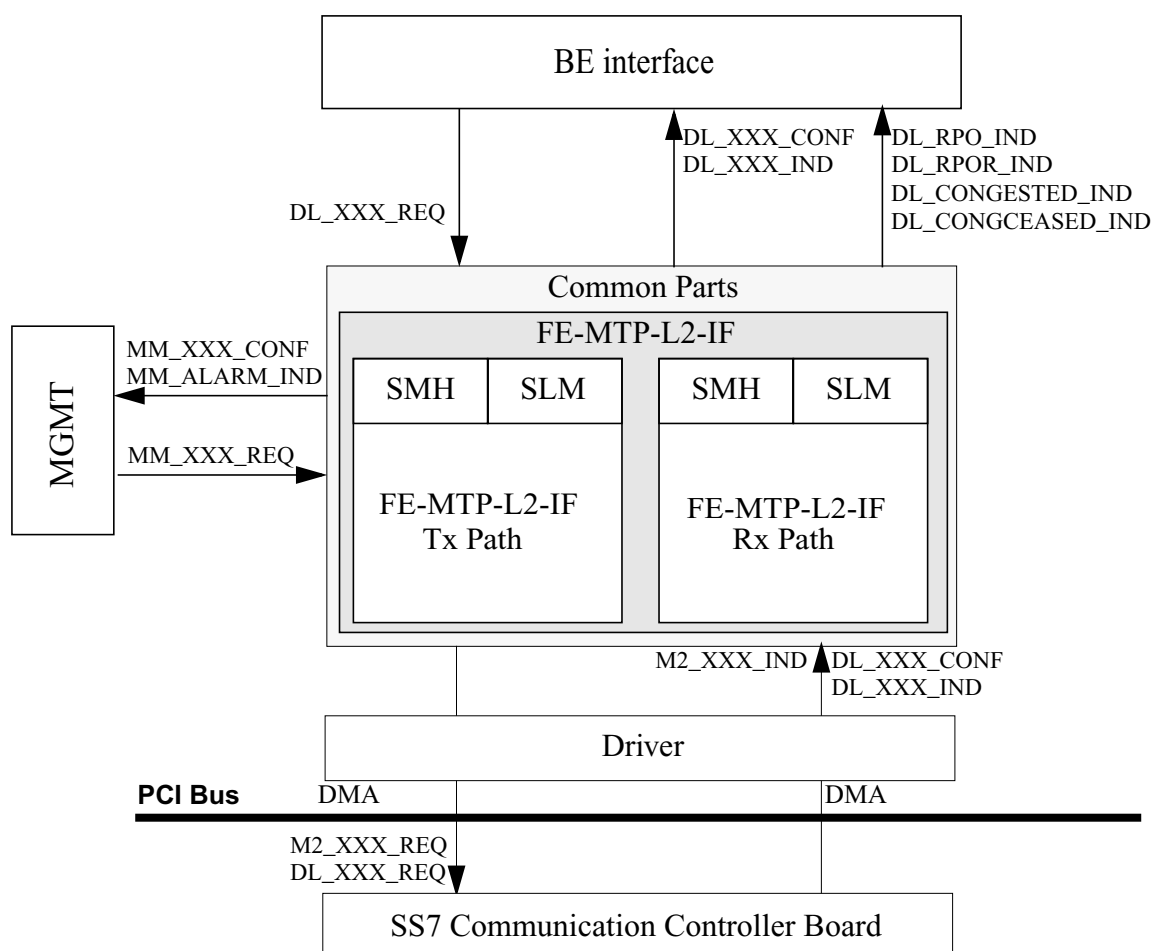


Fig. 19 Depicts the external interfaces of the FE-MTP-L2-IF.

The FE-MTP-L2-IF interface messages are shown in the table below. The table contains primitive name, originator and parameters. *Shaded areas* are Rx (receive or incoming) primitives sent from MTP-L2, and *white areas* are Tx (transmit or outgoing) to MTP-L2. Messages from MTP-L3 are not edited and are expected by

MTP-L2 to be in a format understandable to MTP-L2 and *vice versa*. Management primitives will be converted to driver function calls, to accomplish the required actions by the MTP-L2.

Messages beginning with “DL\_” are originated by MTP-L3 or BE-IF, destined for MTP-L2, or originated by MTP-L2, destined for MTP-L3. They should all be transparent to the FE-MTP-L2-IF module, i.e., they are passed FE-MTP-L2-IF without alteration.

Messages beginning with “MM\_” are originated by MGMT, destined for FE-MTP-L2-IF, or are originated by FE-MTP-L2-IF and destined for MGMT.

Messages beginning with “M2\_” are originated either by FE-MTP-L2-IF or MTP-L2. The “M2\_XXX\_req” messages are originated by FE\_MTP-L2-IF, destined for MTP-L2. The “M2\_XXX\_ind” contains information prepared by MTP-L2, destined for FE-MTP-L2-IF.

### 3.1.1. Primitives

The following is a complete reference list of primitives which are transmitted Transparently (T), Handled (H) or Initiated (I) by the FE-MTP-L2-IF. Each one is marked as belonging to one or more of these categories. Note that if T is the only indication, the inference is that it is transferred transparently.

**Table 3: Primitives**

| Name                  | Originator | Treatment | Parameters                                      |
|-----------------------|------------|-----------|-------------------------------------------------|
| DL_STATUS_req         | BE_IF      | H         | See description in section 3.2 on page 37       |
| DL_EMERG_req          | MTP-L3     | T         | HSN, SDL                                        |
| DL_EMERGCEASE_req     | MTP-L3     | T         | HSN, SDL                                        |
| DL_LPO_req*           | MTP-L3     | T         | HSN, SDL                                        |
| DL_LPOR_req*          | MTP-L3     | T         | HSN, SDL                                        |
| DL_MSU_req            | MTP-L3     | H         | HSN, SDL, Length, SIO, Routing Label, User Data |
| DL_RETRIEVEBSNT_req   | MTP-L3     | T         | HSN, SDL                                        |
| DL_RETRIEVALSTART_req | MTP-L3     | T         | HSN, SDL, BSN                                   |

**Table 3: Primitives**

| Name                                                                            | Originator              | Treatment | Parameters                                                       |
|---------------------------------------------------------------------------------|-------------------------|-----------|------------------------------------------------------------------|
| DL_START_req                                                                    | MTP-L3                  | T         | HSN, SDL                                                         |
| DL_STOP_req                                                                     | MTP-L3.<br>FE_MTP_L2-IF | T,I       | HSN, SDL                                                         |
| DL_CONGESTED_ind                                                                | MTP-L2                  | H, I      | HSN, SDL                                                         |
| DL_CONGCEASE_ind                                                                | MTP-L2                  | H, I      | HSN, SDL                                                         |
| DL_INSERTSERVICE_conf                                                           | MTP-L2                  | T         | HSN, SDL                                                         |
| DL_MSU_ind                                                                      | MTP-L2                  | T         | HSN, SDL, Length, SIO, Routing Label, User Data                  |
| DL_OOS_ind                                                                      | MTP-L2                  | T         | HSN, SDL                                                         |
| DL_RETRIEVEBSNT_conf                                                            | MTP-L2                  | T         | HSN, SDL, BSNT                                                   |
| DL_RETRIEVALMSG_ind                                                             | MTP-L2                  | T         | HSN, SDL, Totlength, MSULength, MSUData, MSULength, MSU Data,... |
| DL_RETRIEVALEND_conf                                                            | MTP-L2                  | H         | HSN, SDL                                                         |
| DL_RPO_ind                                                                      | MTP-L2                  | T         | HSN, SDL                                                         |
| DL_RPOR_ind                                                                     | MTP-L2                  | H         | HSN, SDL                                                         |
| DL_START_conf                                                                   | MTP-L2                  | T         | HSN, SDL                                                         |
| BROKEN_COMMUNICATION                                                            | FE-MTP-L2-IF            | I,H       | None                                                             |
| DL_STATUS_conf                                                                  | FE-MTP-L2-IF            | I         | See description in section 3.2 on page 37.                       |
| M2_LPO_req                                                                      | FE-MTP-L2-IF            | I         | none                                                             |
| M2_LPOR_req                                                                     | FE-MTP-L2-IF            | I         | none                                                             |
| M2_FLUSHBUFFERS_req                                                             | FE-MTP-L2-IF            | I         | none                                                             |
| M2_CONTINUE_req                                                                 | FE-MTP-L2-IF            | I         | none                                                             |
| DL_CONTINUE_req                                                                 | FE-MTP-L2-IF            | I         | HSN, SDL                                                         |
| M2_L1_INT_ind                                                                   | MTP-L2                  | H         | alarm source, see Ref. [E12] and [E14].                          |
| Note - this primitive is not implemented on the SS7-board.<br>M2_STATISTICS_ind | MTP-L2                  | H         | See description in ref. [E12] and [E14].                         |

**Table 3: Primitives**

| Name                | Originator   | Treatment | Parameters                                 |
|---------------------|--------------|-----------|--------------------------------------------|
| M2_SIB_CONG_ind     | MTP-L2       | H         | HSN, SDL                                   |
| M2_SIB_CEASED_ind   | MTP-L2       | H         | HDN, SDL                                   |
| MM_ALARM_req        | MGMT         | H         | See description in section 3.3 on page 40. |
| MM_INIT_req         | MGMT         | H         | See description in section 3.3 on page 40. |
| MM_ORDER_req        | MGMT         | H         | See description in section 3.3 on page 40. |
| MM_XSTAT_req        | MGMT         | H         | See description in section 3.3 on page 40. |
| MM_ALARM_conf       | FE-MTP-L2-IF | I         | See description in section 3.3 on page 40. |
| MM_ALARM_ind        | FE-MTP-L2-IF | I         | See description in section 3.3 on page 40. |
| MM_INIT_conf        | FE-MTP-L2-IF | I         | See description in section 3.3 on page 40. |
| MM_ORDER_conf       | FE-MTP-L2-IF | I         | See description in section 3.3 on page 40. |
| MM_XSTAT_conf       | FE-MTP-L2-IF | I         | See description in section 3.3 on page 40. |
| DL_RTBCLEAR_req     | MTP-L3       | T         | HSN, SDL                                   |
| DL_RTBCLEARED_conf  | MTP-L2       | T         | HSN,SDL                                    |
| WRITE_TXBUFFERS_req | FE-MTP-L2-IF | I,H       | HSN, SDL                                   |

\* Note: DL\_LPO\_req and DL\_LPOR\_req are not implemented in the current versions of the MTP-L3 module. These primitives are presented for future use.

Events received by FE-MTP-L2-IF originate either from the Host environment (i.e., MTP-L3, BE\_IF or MGMT) or the MTP-L2 (SS7CC) environment.

## 3.2 BE-IF INTERFACE

### 3.2.1. Primitive heading for link oriented messages (msgHead2)

Primitives exchanged between FE-MTP-L2-IF and BE-IF are solely link oriented. Hardware Selection Number (HSN) and a Signalling Data Link (SDL) are used in every primitive. These parameters, together with the primitive number, make the primitive heading for link oriented messages, msgHead2.

|               |   |   |   |   |   |   |   |           |
|---------------|---|---|---|---|---|---|---|-----------|
| 7             | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Octet No. |
| Primitive No. |   |   |   |   |   |   |   | 0         |
| HSN           |   |   |   |   |   |   |   | 1         |
| SDL           |   |   |   |   |   |   |   | 2         |

### 3.2.2. Parameters

| Name          | Description                  | Value Range |
|---------------|------------------------------|-------------|
| Primitive No. | Signal Identification Number | 0 - 255     |
| HSN           | Hardware Selection Number    | 0 - 255     |
| SDL           | Signalling Data Link         | 0 - 255     |

#### 3.2.2.1 HSN

Hardware Selection Number defines which Protocol Machine to be used. Its value range is between 0 and 255, but the values 0 and 1 is valid in this release.

#### 3.2.2.2 SDL

Signalling Data Link defines which channel within the defined HSN to be used. Its value range is between 0 and 255, but the values 1-31 are valid in this release.

### 3.2.3. Transparent DL Primitives

All DL\_XXX\_req messages, except DL\_STATUS\_req, are handled transparently by the FE-MTP-L2-IF and are collectively called TRANSPARENT\_req.

For a complete description of these primitives please refer to ref. [E1], [E2], [E3] and [E5].

**3.2.4. DL STATUS req**

The DL\_STATUS\_req primitive is initiated by the BE\_IF module to ask the FE-MTP-L2-IF the current status of the signalling links after a fail-over in a HA system.

This primitive is specified in ref. [E6].

**3.2.5. DL STATUS conf**

The DL\_STATUS\_conf primitive reports the designated SDL status to the BE-IF. This primitive is specified in ref. [E6].

**3.2.6. DL OOS ind**

This primitive is a confirmation from MTP-L2 is out of service

|          |   |   |   |   |   |   |   |         |
|----------|---|---|---|---|---|---|---|---------|
| 7        | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Oct. No |
| msgHead2 |   |   |   |   |   |   |   | 0, 1, 2 |
| Status   |   |   |   |   |   |   |   | 3       |

**msgHead2:** The primitive number 0x1F, HSN and SDL.  
**status:** A more precise description of the detected error. Coded as follows:

|      |                |                                               |
|------|----------------|-----------------------------------------------|
| Hex: | 00-0F<br>00-0F | Errors during Out Of Service phase.<br>Spare. |
|      | 10-1F          | Errors during Aligning phase.                 |
|      | 10             | AERM exceeded.                                |
|      | 11             | T1 time out.                                  |
|      | 12             | T2 time out.                                  |
|      | 13             | T3 time out.                                  |
|      | 14             | Signalling link alignment or proving failure  |
|      | 15-1F          | Spare.                                        |

|              |                                                     |
|--------------|-----------------------------------------------------|
| <b>20-2F</b> | <b>Errors during In Service phase.</b>              |
| 20           | Own transmission control out of service.            |
| 21           | Own reception control out of service.               |
| 22           | SUERM exceeded.                                     |
| 23           | T7 time out                                         |
| 24           | T6 time out                                         |
| 25-2F        | Spare.                                              |
| <b>30-3F</b> | <b>Errors during Remote Processor Outage phase.</b> |
| 30-3F        | Spare.                                              |
| <b>40-FF</b> | <b>Other Errors.</b>                                |
| 40           | Link Status Signalling unit OOS received.           |
| 41           | HW failure, FE-MTP-L2 IF ISR initiated a DL_OOS_ind |
| 42-FF        | Spare.                                              |

The fields marked as spare are left for future use.  
In this implementation the contents of the Status parameter is not used.

### 3.3 MANAGEMENT INTERFACE

The FE-MTP-L2-IF recognizes the following primitives originated from MGMT

- MM\_INIT\_req
- MM\_ALARM\_req
- MM\_XSTAT\_req
- MM\_ORDER\_req

The following management primitives are initiated from FE-MTP-L2-IF and destined for MGMT.

- MM\_INIT\_conf
- MM\_ALARM\_conf
- MM\_ALARM\_ind
- MM\_XSTAT\_conf
- MM\_ORDER\_conf

For a complete description of the above primitives, please refer to ref. [E7].

#### 3.3.1. Results

The following results, defined in ref. [E7], can be reported by different MM\_XXX\_conf primitives.

**Table 4: : Possible results for MGMT primitives**

| Result | Description                   |
|--------|-------------------------------|
| 0      | Success                       |
| 1      | File not found                |
| 2      | File could not be opened      |
| 3      | Order could not be performed  |
| 4      | Bad configuration             |
| 5      | Statistics id not implemented |
| 6      | Order id not implemented      |
| 7      | Alarm id not implemented      |

| Result | Description                              |
|--------|------------------------------------------|
| 8      | Format error                             |
| 9      | MM resources unavailable                 |
| 10     | SSN has not made a bind (Not applicable) |
| 11     | Illegal state                            |

### 3.3.2. MM XSTAT req

This primitive is used for retrieving statistics from MTP-L2. The format of MM\_XSTAT\_req is described in ref. [E7].

The reset option is coded as follows:

1        The statistics counters for the statID will be reset after retrieval.

Other    The statistics counters will not be reset.

#### 3.3.2.1 Statistic IDs

The following statistics can be requested from the SS7CC.

| StatID | Name                             | Description                                                                |
|--------|----------------------------------|----------------------------------------------------------------------------|
| 1      | inService<br>Q.752 1.1.          | In-service duration, counted in seconds.                                   |
| 2      | Duration SL NA<br>Q.752 2.1      | Time in seconds while link is OOS.                                         |
| 3      | Local busy (cong.)<br>Q.752 2.15 | Time while SIB is sent, counted in seconds.                                |
| 4      | Link failure<br>Q.752 1.2.       | Number of link failures due to all reasons. OOS. See Q.752, Section 2.2.2. |

## INTERFACES

| StatID | Name                                      | Description                                                                   |
|--------|-------------------------------------------|-------------------------------------------------------------------------------|
| 5      | Link failure<br>Q.752 1.3.                | Number of link failures due to abnormal FIBR/BSNR.                            |
| 6      | Link failure<br>Q.752 1.4.                | Number of link failures due to excessive delay of acknowledgement (timer T7). |
| 7      | Link failure<br>Q.752 1.5.                | Number of link failures due to excessive error rate. (Noisy link.)            |
| 8      | Link failure<br>Q.752 1.6.                | Number of link failures due to excessive duration of congestion (timer T6).   |
| 9      | AERM failures<br>Q.752 1.7.               | Number of link failures due to AERM alignment or proving failure.             |
| 10     | SUs received in error<br>Q.752 1.8.       | Number of Signal Units received in error, i.e., FISU+LSSU+MSU. Rx error rate. |
| 11     | Negative ACKs rcvd.<br>Q.752 1.9.         | Number of link Signal Unit Negative ACKs received. Tx error rate.             |
| 12     | Number of SIF & SIO sent<br>Q.752 3.1     | (Retransmits not counted.)                                                    |
| 13     | Number of octets re-transm. Q.752 3.2     | (Include 3 extra octets: flag+CRC.)                                           |
| 14     | Number of MSUs transm. Q.752 3.3          | (Retransmits not counted.)                                                    |
| 15     | Number of SIF & SIO received<br>Q.752 3.4 |                                                                               |
| 16     | Number of MSUs received<br>Q.752 3.5      | MSUs sent to MTP-L3.                                                          |

| StatID | Name                                            | Description |
|--------|-------------------------------------------------|-------------|
| 17     | Number of MSUs lost<br>congestion Q.752<br>3.10 |             |

### 3.3.3. MM\_XSTAT\_conf

In case of successful retrieval of statistics from the board the FE-MTP-L2-IF will respond to MGMT with two MM\_XSTAT\_conf messages, one for each HSN. These will contain parameters for each configured SDL on the HSN.

The MM\_XSTAT\_conf is coded as follows.

|                                           |   |   |   |   |   |   |   |         |
|-------------------------------------------|---|---|---|---|---|---|---|---------|
| 8                                         | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
| Primitive                                 |   |   |   |   |   |   |   | 1       |
| statID                                    |   |   |   |   |   |   |   | 2       |
| statResult                                |   |   |   |   |   |   |   | 3       |
| lastInd                                   |   |   |   |   |   |   |   | 4       |
| totLength_Lo                              |   |   |   |   |   |   |   | 5       |
| totLength_Hi                              |   |   |   |   |   |   |   | 6       |
| InfoLength = 4                            |   |   |   |   |   |   |   | 7       |
| info[1] statistic counter low byte        |   |   |   |   |   |   |   | 8       |
| info[2] statistic counter middle low byte |   |   |   |   |   |   |   | 9       |
| info[3] statistic counter middle hi byte  |   |   |   |   |   |   |   | 10      |

|                                                                          |    |
|--------------------------------------------------------------------------|----|
| info[4] statistic counter high byte                                      | 11 |
| statParamLength = 2                                                      | 12 |
| statParam[1] = HSN                                                       | 13 |
| statParam[2] = SDL                                                       | 14 |
| Octets 7-14 will here be repeated for each configured<br>SDL on the HSN. | 15 |

**Primitive:**

MM\_XSTAT\_conf 4

**statID:**

The statistic identity number. 1-17

**statResult:**

The result of the statistic request. Will be coded according to Table 4: on page 40.

**lastInd:**

Indicates if the message is the last one or not. 1=Last,0=Not last

### 3.3.4. Order IDs

The following MM\_ORDER\_req **order IDs** are defined for the FE-MTP-L2-IF

**Table 5: .MGMT Order IDs and their respective parameters**

| order ID | Name      | Parameters/Octet | Description                       |
|----------|-----------|------------------|-----------------------------------|
| 1        | TERMINATE | none             | Stop reacting on incoming events  |
| 2        | START     | none             | Start reacting on incoming events |

| order ID | Name     | Parameters/Octet                                     | Description                                                                                                                                            |
|----------|----------|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3        | TRACEON  | none                                                 | Turn on state-event and message trace                                                                                                                  |
| 4        | TRACEOFF | none                                                 | Turn off state-event and message trace                                                                                                                 |
| 23       | RTRECONF | HSN, SDL, noOfParam, paramID, paramValue             | Real-time reconfigure permitted parameters.                                                                                                            |
| 24       | RNRECONF | HSN, SDL, action                                     | action = 0 -> Add link<br>action = 1 -> Remove link                                                                                                    |
| 25       | RNREMUX  | noOfTSs, dstTrunk, dstChannel, srcTrunk, srcChannel* | Stop the signalling link, if it is terminated on this card, then, change the MUX route. *srcChannel is only used when using SS7CC-PMC or SS7CC-PCI V2. |
| 26       | REINIT   | length of file name, file name                       | See 2.2.2. on page 21.                                                                                                                                 |

The following sub-sections give a detailed specification of the MM\_ORDER\_REQ primitive data for each management order.

### 3.3.4.1 TERMINATE

The module closes open files, stops all signalling links, resets the SS7CC, closes the device driver port, returns allocated memory, returns commonParts resources, sends an MM\_ORDER\_conf(TERMINATE) and then terminates.

|              |   |   |   |   |   |   |   |         |
|--------------|---|---|---|---|---|---|---|---------|
| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |

**Value**

**Order\_Id:**

TERMINATE 1

**LengthOfInfo:**

The length of information following this octet. 0

### 3.3.4.2 START

This order primitive is used for starting up the module for the first time. This signal is awaited from management after the initialization to put the module in RUNNING state.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |

**Value**

**Order\_Id:**

START 2

**LengthOfInfo:**

The length of information following this octet. 0

### 3.3.4.3 TRACEON

This primitive turns on the message logging system.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |

|                                                                         | Value |
|-------------------------------------------------------------------------|-------|
| <b>Order_Id:</b><br>TRACEON                                             | 3     |
| <b>LengthOfInfo:</b><br>The length of information following this octet. | 0     |

#### 3.3.4.4 TRACEOFF

Turns off the message logging system.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |

|                                                                         | Value |
|-------------------------------------------------------------------------|-------|
| <b>Order_Id:</b><br>TRACEOFF                                            | 4     |
| <b>LengthOfInfo:</b><br>The length of information following this octet. | 0     |

#### 3.3.4.5 RTRECONF

This order is used for real time re-configuration of the MTP-L2 and FE-MTP-L2-IF. As the result of this re-configuration corresponding configuration register will be modified, while the state of the affected signalling links remains unchanged.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |

|                                                          |    |
|----------------------------------------------------------|----|
| hsn                                                      | 3  |
| sdl                                                      | 4  |
| noOfParam                                                | 5  |
| paramID                                                  | 6  |
| paramValue_LO                                            | 7  |
| paramValue_ML                                            | 8  |
| paramValue_MH                                            | 9  |
| paramValue_HI                                            | 10 |
| The parameters 6 - 10 are here repeated noOfParam times. | 11 |

|                                                 |              |
|-------------------------------------------------|--------------|
| <b>Order_Id:</b>                                | <b>Value</b> |
| RTRECONF                                        | 23           |
| <b>LengthOfInfo:</b>                            |              |
| The length of information following this octet. | 0-255        |
| hsn                                             | 0-1          |
| sdl                                             | 0-31         |
| noOfParam                                       | 1-23         |
| paramID                                         | 0-255        |
| paramValue_LO                                   | 0-255        |
| paramValue_ML                                   | 0-255        |
| paramValue_MH                                   | 0-255        |
| paramValue_HI                                   | 0-255        |

paramValue is a 32 bits wide value. paramValue\_LO contains its least significant byte. paramValue\_ML, paramValue\_MH and paramValue\_HI contain the higher order bytes of the paramValue.

ParamID is decoded as following:

**Table 6: ParamIDs for real time re-configuration**

| Param_ID | Description                                                                                                                                                                                                | Recommended Values                                            | Accepted range                                                    |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------|
| 1        | timer tWFC<br>Timer Wait For Connection, FE-MTP-L2-IF will buffer messages for tWFC milliseconds after a broken connection to BE.                                                                          | 0 - 10000 ms                                                  | 0-65535 ms                                                        |
| 2        | SUERM parameter T.                                                                                                                                                                                         | ANSI/ITU-T: 64 SU<br>TTC: 285                                 | ANSI/ITU-T: 1-64<br>TTC: 1-511                                    |
| 3        | SUERM parameter D.                                                                                                                                                                                         | ANSI/ITU-T: 256 SU<br>TTC: 16                                 | ANSI/ITU-T: 1- 256<br>TTC: 1-63                                   |
| 4        | Normal AERM threshold, Tin.<br>(Ti in TTC)<br>Number of signal unit errors that cause abortion of a normal proving period. In TTC there exists only one AERM threshold, this value should be entered here. | ANSI/ITU-T: 4 SU<br>TTC: 1                                    | ANSI/ITU-T: 1-7<br>TTC: 1-7                                       |
| 5        | Emergency AERM threshold, Tie.<br>Number of signal unit errors that cause abortion of an emergency proving period. (Not defined for TTC.)                                                                  | ANSI/ITU-T: 1 SU<br>TTC: Undefined.                           | ANSI/ITU-T: 1-7<br>TTC: Undefined                                 |
| 6        | Proving abort limit.<br>Number of consecutive aborted proving periods that will cause a return to the Out Of Service state.                                                                                | ANSI/ITU-T: M=5<br>TTC: L=20                                  | ANSI/ITU-T: 1-7<br>TTC: 1-31                                      |
| 7        | Timer T1.<br>Maximum time to stay in <b>Aligned Ready</b> state before signalling link failure. The time should be entered in milliseconds.                                                                | ITU-T: 40000-50000 ms<br>ANSI: 12900-16000 ms<br>TTC: 5000 ms | ITU-T: 10 - 65500 ms<br>ANSI: 10 - 16300 ms<br>TTC: 10-1048000 ms |

## INTERFACES

| Param_ID | Description                                                                                                                                                                                                                   | Recommended Values                                           | Accepted range                                                     |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------------|
| 8        | Timer T2.<br>Maximum time to stay in <b>Not Aligned</b> state before signalling link failure. The time should be entered in milliseconds.                                                                                     | ITU-T: 5000-150000 ms<br>ANSI: 5000-30000 ms<br>TTC: 3000 ms | ITU-T: 10 - 262000 ms<br>ANSI: 10 - 32700 ms<br>TTC: 10-1048000 ms |
| 9        | Timer T3.<br>Maximum time to stay in <b>Aligned</b> state before signalling link failure. The time should be entered in milliseconds.                                                                                         | ITU-T: 1000-2000 ms<br>ANSI: 5000-14000 ms<br>TTC: 3000 ms   | ITU-T: 10 - 2000 ms<br>ANSI: 10-16300 ms<br>TTC: 10-16300 ms       |
| 10       | Timer T4n. (Timer T4 in TTC)<br>Length of the normal proving period. The time should be entered in milliseconds. In TTC there exists only one type of alignment, and the time for this proving period should be entered here. | ITU-T: 7500-9500 ms<br>ANSI: 2300 ms<br>TTC: 3000 ms         | ITU-T: 10-16300 ms<br>ANSI: 10 - 4000 ms<br>TTC: 10-16300 ms       |
| 11       | Timer T4e. Length of the emergency proving period. The time should be entered in milliseconds.                                                                                                                                | ITU-T: 400-600 ms<br>ANSI: 600 ms<br>TTC: Not Used           | ITU-T: 10 - 16300 ms<br>ANSI: 10 - 4000 ms<br>TTC: Not used        |
| 12       | Timer T5.<br>Time between sending Status Indication "B" while in congested state. The time should be entered in milliseconds.                                                                                                 | ITU-T: 80-120 ms<br>ANSI: 80-120 ms<br>TTC: 200 ms           | ITU-T: 1 - 255 ms<br>ANSI: 1 - 255 ms<br>TTC: 10 - 16300 ms        |
| 13       | Timer T6.<br>Maximum time a remote site may remain in the congested state before signalling link failure. The time should be entered in milliseconds.                                                                         | ITU-T: 3000-6000 ms<br>ANSI: 1000-6000 ms<br>TTC: 10000 ms   | ITU-T: 10 - 8100 ms<br>ANSI: 10 - 8100 ms<br>TTC: 10 - 262000 ms   |
| 14       | Timer T7.<br>Maximum time to wait for an expected acknowledgement of an MSU before signalling link failure. The time should be entered in milliseconds.                                                                       | ITU-T: 500-2000 ms<br>ANSI: 500-2000 ms<br>TTC: 3000 ms      | ITU-T: 10-2000 ms<br>ANSI: 10-2000 ms<br>TTC: 10-16300 ms          |
| 15       | Transmit Buffer high watermark.                                                                                                                                                                                               | <b>See description in ref. [E19]</b>                         | 1-127                                                              |

| Param_ID                                                                                    | Description                                                                                                                     | Recommended Values                   | Accepted range |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------|
| 16                                                                                          | Transmit Buffer low watermark                                                                                                   | <b>See description in ref. [E19]</b> | 1-127          |
| The entries 17 - 22 below should only be entered when Type of MTPL2 has been defined as TTC |                                                                                                                                 |                                      |                |
| 17                                                                                          | Timer Tfa. FISU Sending Interval (aligned ready).                                                                               | 16 ms                                | 1-254 ms       |
| 18                                                                                          | Timer Tfi. FISU Sending Interval (in service).                                                                                  | 16 ms                                | 1-254 ms       |
| 19                                                                                          | Timer Ts. SIOS Sending Interval                                                                                                 | 24 ms                                | 1-254 ms       |
| 20                                                                                          | Timer To. SIO Sending Interval.                                                                                                 | 24 ms                                | 1-254 ms       |
| 21                                                                                          | Timer Ta. SIE Sending Interval                                                                                                  | 24 ms                                | 1-254 ms       |
| 22                                                                                          | Timer Te., SUERM/AERM timer.                                                                                                    | 24 ms                                | 1-254 ms       |
| 23                                                                                          | timer tDMAW<br>The Timer DMA Write sets maximum time a message is delayed in the FE-MTP-L2-IF's transmit buffer.                | 5 - 50ms                             | 0 - 65535 ms   |
| 24                                                                                          | timer tWFNB<br>Timer Wait For Non-Blocking is used when a connection is blocked, FE-MTP-L2-IF tries to send with this interval. | 10 - 1000 ms                         | 0 - 65535 ms   |

### 3.3.4.6 RNRECONF

This order is used for run time re-configuration of the MTP-L2 signalling links. As the result of this re-configuration, signalling links are added to or removed from the

current configuration without a need for a total reconfiguration of MTP-L2.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |
| hsn          |   |   |   |   |   |   |   | 3       |
| sdl          |   |   |   |   |   |   |   | 4       |
| action       |   |   |   |   |   |   |   | 5       |

|                                                                         | Value |
|-------------------------------------------------------------------------|-------|
| <b>Order_Id:</b><br>RNRECONF                                            | 24    |
| <b>LengthOfInfo:</b><br>The length of information following this octet. | 3     |
| hsn                                                                     | 0-1   |
| sdl                                                                     | 0-31  |
| action                                                                  | 0-1   |

action can be '0' or '1'. '0' means that the given signalling link (hsn, sdl) must be added to the current configuration, while '1' means that the given signalling link (hsn, sdl) must be removed from the current configuration. The links to be removed are first stopped (taken to OUT-OF-SERVICE state) before removal. The state of the added signalling links will be OUT-OF-SERVICE after re-configuration. MTPL3 will be responsible to bring the new signalling link to IN-SERVICE state.

### 3.3.4.7 RNREMUX when using SS7CC-PCI

This order is used for run time re-configuration of the MUX. As the result of this re-configuration, channels are multiplexed to other PR or PCM trunks than their original configuration. The SS7CC-PCI does not support time multiplexing of a channel on a source trunk to another channel on the destination trunk.

It is recommended that the channel which is disconnected when RNREMUX is performed is connected to the SILENCE trunk using another RNREMUX.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |
| noOfChannels |   |   |   |   |   |   |   | 3       |
| dstTrunk     |   |   |   |   |   |   |   | 4       |
| channel      |   |   |   |   |   |   |   | 5       |
| srcTrunk     |   |   |   |   |   |   |   | 6       |

|                                                                         | Value  |
|-------------------------------------------------------------------------|--------|
| <b>Order_Id:</b><br>RNREMUX                                             | 25     |
| <b>LengthOfInfo:</b><br>The length of information following this octet. | 0-253  |
| noOfChannels                                                            | 0-3    |
| dstTrunk                                                                | 0-2    |
| channel                                                                 | 0-31   |
| srcTrunk                                                                | 0-2,36 |

dstTrunk, channel and srcTrunk are here repeated noOfChannels times.

dstTrunk is one of the 3 outgoing trunks from the MUX, which is coded as in Table 7 on page 54. The channel is the channel number on that trunk.

The srcTrunk, on the other hand, is one of the 3 incoming trunks to the MUX, which is coded as in Table 8 on page 54. There are 1 incoming trunks from the on board protocol machine, 2 incoming trunks from the external PCM trunks. "dstTrunk" numbers are coded as following:

**Table 7: SS7CC-PCI dstTrunk number coding**

| dstTrunk Number | Description |
|-----------------|-------------|
| 0               | PCMA        |
| 1               | PCMB        |
| 2               | PRA         |

“srcTrunk” numbers are coded as following:

**Table 8: SS7CC-PCI srcTrunk number coding**

| srcTrunk Number | Description |
|-----------------|-------------|
| 0               | PCMA        |
| 1               | PCMB        |
| 2               | PRA         |
| 36              | SILENCE     |

### 3.3.4.8 RNREMUX when using SS7CC-PMC, SS7CC-PCI V2

This order is used for run time re-configuration of the MUX. As the result of this re-configuration, channels are multiplexed to other PR or PCM trunks than their original configuration. The SS7CC-PMC and SS7CC-PCI V2 supports time multiplexing of a channel on a source trunk to another channel on the destination trunk.

It is recommended that the channel which is disconnected when RNREMUX is performed is connected to the SILENCE trunk using another RNREMUX.

|              |   |   |   |   |   |   |   |         |
|--------------|---|---|---|---|---|---|---|---------|
| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
| Order_Id     |   |   |   |   |   |   |   | 1       |
| LengthOfInfo |   |   |   |   |   |   |   | 2       |

|              |   |
|--------------|---|
| noOfChannels | 3 |
| dstTrunk     | 4 |
| channel      | 5 |
| srcTrunk     | 6 |
| channel      | 7 |

|                                                 |              |
|-------------------------------------------------|--------------|
| <b>Order_Id:</b>                                | <b>Value</b> |
| RNREMUX                                         | 25           |
| <b>LengthOfInfo:</b>                            |              |
| The length of information following this octet. | 0-253        |
| noOfChannels                                    | 0-5          |
| dstTrunk                                        | 0-4          |
| channel1                                        | 0-31         |
| srcTrunk                                        | 0-4,70       |
| channel2                                        | 0-31         |

dstTrunk, channel1, srcTrunk and channel2 are here repeated noOfChannels times.

srcTrunk is one of the 6 incoming and dstTrunk is one of the 5 outgoing trunks from the MUX, which is coded as in Table 9 on page 55. The channel is the time slot number on that trunk. There are 1 incoming and outgoing trunk from the on board protocol machine, 4 incoming and outgoing trunks from the external PCM trunks.

Trunk numbers are coded as following:

**Table 9: SS7CC-PMC and SS7-PCI V2 Trunk number coding**

| Trunk Number | Description |
|--------------|-------------|
| 0            | PCMA        |
| 1            | PCMB        |
| 2            | PCMC        |

| Trunk Number | Description |
|--------------|-------------|
| 3            | PCMD        |
| 4            | PRA         |
| 5            | PRB         |
| 70           | SILENCE     |

### 3.3.4.9 REINIT\_request

This order is used for total reconfiguration of FE-MTP-L2-IF and SS7CC.

|                            |   |   |   |   |   |   |   |         |
|----------------------------|---|---|---|---|---|---|---|---------|
| 8                          | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
| Order_Id                   |   |   |   |   |   |   |   | 1       |
| lengthOfInfo               |   |   |   |   |   |   |   | 2       |
| offsetLo                   |   |   |   |   |   |   |   | 3       |
| offsetMi                   |   |   |   |   |   |   |   | 4       |
| offsetHi                   |   |   |   |   |   |   |   | 5       |
| filename[1]                |   |   |   |   |   |   |   | 6       |
| filename[2]                |   |   |   |   |   |   |   | 7       |
| filename[lengthOfInfo - 3] |   |   |   |   |   |   |   | n       |

**Order\_Id:**  
REINIT

**Value**

26

**LengthOfInfo:**

The length of information following this octet. 4-255

**Offset:**

The offset from where FE-MTP-L2-IF should start read.

**Filename:**

filename character 1 1-255

filename character 2 1-255

filename character no. lengthOfInfo

### 3.3.4.10 REINIT\_confirm

This order is used for total reconfiguration of FE-MTP-L2-IF and SS7CC.

.

| 8            | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|--------------|---|---|---|---|---|---|---|---------|
| Order_Id     |   |   |   |   |   |   |   | 1       |
| result       |   |   |   |   |   |   |   | 2       |
| resultInfo   |   |   |   |   |   |   |   | 3       |
| lengthOfInfo |   |   |   |   |   |   |   | 4       |
| offsetLo     |   |   |   |   |   |   |   | 5       |
| offsetMi     |   |   |   |   |   |   |   | 6       |
| offsetHi     |   |   |   |   |   |   |   | 7       |

**Value**

**Order\_Id:**

REINIT 26

**Result:**

The result of the init request. Will be coded according to Table 4: on page 40.

**ResultInfo:** 255

**LengthOfInfo:**  
The length of information following this octet. 3

**Offset:**  
The offset from where FE-MTP-L2-IF stopped read.

### 3.3.5. MM\_ALARM\_req

| 8               | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Oct. No |
|-----------------|---|---|---|---|---|---|---|---------|
| MM_ALARM_req    |   |   |   |   |   |   |   | 0       |
| noOfAlarms      |   |   |   |   |   |   |   | 1       |
| alarmID[1]      |   |   |   |   |   |   |   | 2       |
| alarmInfoLength |   |   |   |   |   |   |   | 3       |

|                                                      | Value |
|------------------------------------------------------|-------|
| <b>Primitive:</b><br>MM_ALARM_req                    | 2     |
| <b>noOfAlarms:</b><br>The number of alarms requested | 1-2   |
| <b>alarmID:</b>                                      | 1-2   |
| alarmInfoLength:<br>Must be coded 0                  | 0     |

The sequence 2 - 3 are here repeated noOfAlarms times.

### 3.3.6. Alarm IDs

All mandatory alarms, recommended in Q.752, for the MTP-L2 layer are covered by the existing MTP-L3 primitive, DL\_OOS\_ind.

The following signalling link alarm item must be collected and reported in accordance with Q.752, reference [I6]. It is completely covered by the MTPL3 management primitive, DL\_OOS\_ind.

**Table 10: . Q.752 mandatory alarm items for MTP-L1**

| Reference  | Name                   | Description                        |
|------------|------------------------|------------------------------------|
| Q.752, 1.2 | SL_failure-All reasons | Link failure due to MTPL1 problems |

Therefore, in order to be fully compliant with Q.752 recommendation the following alarm ID must be implemented for MTP-L1

**Table 11: . MGMT Alarm IDs**

| Alarm ID | Name                                                                  | Alarm Severity | Parameters   | Description                                                                           |
|----------|-----------------------------------------------------------------------|----------------|--------------|---------------------------------------------------------------------------------------|
| 1        | Link problem or failure, i.e. for Clock Slip the link may not be OOS. | Fatal          | PCM, Reason* | Link problem or failure indication due to any reason* in the physical layer (MTP-L1). |
| 2        | SS7-board Driver I/O error                                            | Fatal          | none         | Error in a read or write call to the device driver.                                   |

\*Reason will be one of the following:

|                   |   |
|-------------------|---|
| Signal Loss (LOS) | 0 |
| Clock Slip (SLP)  | 1 |

### 3.4 MTPL2 INTERFACE

The interface is composed of two groups of primitives. One group is the signalling Data Link primitives (DL primitives) and the other one is the Layer-2 primitives (M2 primitives).

For a complete list of the DL primitives, handled by the FE-MTP-L2-IF, See “Transparent DL Primitives” on page 37.

The following M2 primitives are initiated from FE-MTP-L2-IF and are destined for MTPL2.

- M2\_LPO\_req
- M2\_LPOR\_req
- M2\_FLUSHBUFFERS\_req
- M2\_CONTINUE\_req

The FE-MTP-L2-IF recognizes the following M2 primitives originated from MTPL2

- M2\_L1\_INT\_ind
- M2\_SIB\_CONG\_ind
- M2\_SIB\_CEASED\_ind

For a complete description of the above primitives, please refer to ref. [E12]:

### **3.5 DRIVER INTERFACES**

The drivers will provide a number of OS-specific function calls, to enable access to/from the SS7CC. Reference should be made to references[E10], [E11] and [E15] for specific differences.

## **4. CONFIGURATION FILES**

The configuration file must be in Unix text-file format (i.e., ASCII coded) and may only contain raw data written in decimal, hexadecimal or binary values. The only pseudo code allowed in the file shall be separated from the data value with at least one space or tab character. Data items are separated with CR (carriage return).

For more information about the configuration file parameters for this module see ref. [E19]

## 5. ERROR HANDLING

### 5.1 ERROR CODES

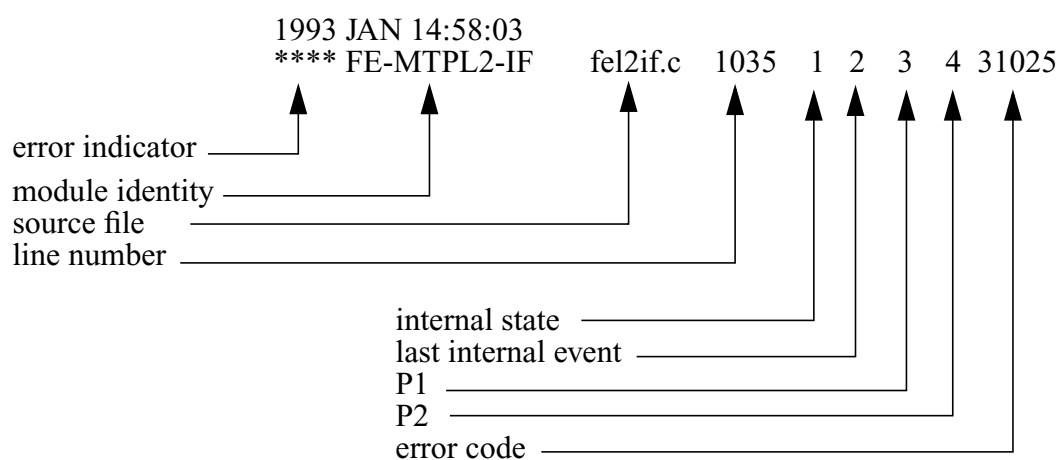


Fig. 20 Format of error entries in the log file

When an error occurs, an entry in the SysLog file will be produced. Each entry has the layout shown in the figure above. The meaning of each error code as well as the parameters P1 and P2 in each case is explained in the table below.

The following error codes will be used together with a base module specific error code number, 31000, to log different error cases in the FE-MTP-L2-IF module.

**Table 12: List of error codes**

| Error                        | Description                                                                           | P1                                        | P2                                                           |
|------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------|
| 1<br>IFE_MEM_ALLOC_ERROR     | It was not possible to allocate a fixed memory block from the process memory pool.    | 0                                         | 0                                                            |
| 2<br>IFE_TIMER_REQ_ERROR     | An attempt to start a timer has failed                                                | 0                                         | 0                                                            |
| 3<br>IFE_MEM_FREE_ERROR      | An attempt to free memory has failed.                                                 | 0                                         | 0                                                            |
| 4<br>FILE_OPEN_ERROR         | An attempt to open a file has failed                                                  | 0                                         | 0                                                            |
| 5<br>ERROR_FGETS_CNF_FILE    | An attempt to read a whole line from the configuration file has failed                | 0                                         | 0                                                            |
| 6<br>ERROR_SSCANF_CNF_FILE   | An attempt to interpret the read line of data from the configuration data has failed. | 0                                         | 0                                                            |
| 7<br>ERROR_CNF_FILE_VERS     | The FE-MTP-L2-IF configuration file version is wrong.                                 | Version number read from the config file. | 0                                                            |
| 8<br>FILE_CLOSE_ERROR        | An attempt to close a file has failed                                                 | 0                                         | 0                                                            |
| 9<br>ERROR_INVALID_PRIMITIVE | An undefined primitive has received.                                                  | Received primitive number.                | Sender. Will be 0 if the message is received from the board. |

| Error                                | Description                                                                                                                                                         | P1                   | P2 |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----|
| 10<br>ERROR_INVALID_IFE_STATE        | The value of the state attribute is out of range (fatal error). FE-MTP-L2-IF will exit if this happens.                                                             | 0                    | 0  |
| 11<br>ERROR_INVALID_MODULE_ID        | The module name read in the main configuration file for the FE-MTP-L2-IF module can not be mapped to any module ID, defined in the common-Parts configuration file. | 0                    | 0  |
| 12<br>L2_CONFIG_FILE_OPEN_ERROR      | An attempt to open the MTPL2-MTPL1 configuration file has failed.                                                                                                   | 0                    | 0  |
| 13<br>FILE_SEEK_ERROR                | The offset value to read from the configuration file is too large.                                                                                                  | offset value         | 0  |
| 14<br>ERROR_INVALID_DRV_NAME         | The device driver name in the main configuration file for the FE-MTP-L2-IF module is wrong.                                                                         | 0                    | 0  |
| 15<br>ERROR_INVALID_DIAGNOSTICS_FLAG | The value of the diagnostic test flag in the main configuration file for the FE-MTP-L2-IF module is invalid.                                                        | 0                    | 0  |
| 16<br>L2TEST_FILE_OPEN_ERROR         | An attempt to open the binary diagnostic test file has failed.                                                                                                      | 0                    | 0  |
| 17<br>MTPL2_FILE_OPEN_ERROR          | An attempt to open the binary MTPL2 file has failed.                                                                                                                | 0                    | 0  |
| 18<br>EVENT_IN_WRONG_STATE           | A valid event has received in wrong state.                                                                                                                          | 0                    | 0  |
| 19<br>ERROR_MTP_CNF_FILE_VERSIONS    | The version number of the MTPL2-MTPL1 configuration file is invalid.                                                                                                | Read version number. | 0  |

| Error                              | Description                                                                                         | P1                                       | P2 |
|------------------------------------|-----------------------------------------------------------------------------------------------------|------------------------------------------|----|
| 20<br>ERROR_TOO_MANY_MTP_TEMPLATES | The number of templates in the MTPL2-MTPL1 configuration file is invalid.                           | Read number of templates                 | 0  |
| 21<br>ERROR_BAD_MTP_TEMPLATE_NO    | A template number in the MTPL2 configuration file is invalid.                                       | Read template number.                    | 0  |
| 22<br>ERROR_INVALID_STANDARD       | The name of a standard in the MTPL2 configuration template is invalid.                              | 0                                        | 0  |
| 23<br>ERROR_BAD_SUERM_T            | The value of the SUERM-T parameter in the MTPL2 configuration template is invalid.                  | Read SUERM-T value.                      | 0  |
| 24<br>ERROR_BAD_SUERM_D            | The value of the SUERM-D parameter in the MTPL2 configuration template is invalid.                  | Read SUERM-D value.                      | 0  |
| 25<br>ERROR_BAD_TIN                | The value of normal AERM threshold Tin parameter in the MTPL2 configuration template is invalid.    | Read normal AERM threshold Tin value.    | 0  |
| 26<br>ERROR_BAD_TIE                | The value of emergency AERM threshold Tie parameter in the MTPL2 configuration template is invalid. | Read emergency AERM threshold Tie value. | 0  |
| 27<br>ERROR_BAD_ML                 | The value of the proving abort limit parameter in the MTPL2 configuration template is invalid.      | Read proving abort limit value.          | 0  |
| 28<br>ERROR_BAD_T1_VALUE           | The value of timer T1 in the MTPL2 configuration template is out of range.                          | 0                                        | 0  |
| 29<br>ERROR_BAD_T2_VALUE           | The value of timer T2 in the MTPL2 configuration template is out of range.                          | 0                                        | 0  |
| 30<br>ERROR_BAD_T3_VALUE           | The value of timer T3 in the MTPL2 configuration template is out of range.                          | Read timer value                         | 0  |

## Error Handling

| Error                       | Description                                                                                              | P1                        | P2 |
|-----------------------------|----------------------------------------------------------------------------------------------------------|---------------------------|----|
| 31<br>ERROR_BAD_T4N_VALUE   | The value of timer T4n in the MTPL2 configuration template is out of range.                              | Read timer value          | 0  |
| 32<br>ERROR_BAD_T4E_VALUE   | The value of timer T4e in the MTPL2 configuration template is out of range.                              | Read timer value          | 0  |
| 33<br>ERROR_BAD_T5_VALUE    | The value of timer T5 in the MTPL2 configuration template is out of range.                               | Read timer value          | 0  |
| 34<br>ERROR_BAD_T6_VALUE    | The value of timer T6 in the MTPL2 configuration template is out of range.                               | Read timer value          | 0  |
| 35<br>ERROR_BAD_HWM_VALUE   | The value of high watermark for the transmit buffer in the MTPL2 configuration template is out of range. | Read high watermark value | 0  |
| 36<br>ERROR_BAD_LWM_VALUE   | The value of low watermark for the transmit buffer in the MTPL2 configuration template is out of range.  | Read low watermark value  | 0  |
| 37<br>ERROR_BAD_TFA_VALUE   | The value of timer Tfa in the MTPL2 configuration template is out of range (only TTC).                   | Read timer value          | 0  |
| 38<br>ERROR_BAD_TS_VALUE    | The value of timer Ts in the MTPL2 configuration template is out of range (only TTC).                    | Read timer value          | 0  |
| 39<br>ERROR_BAD_TO_VALUE    | The value of timer To in the MTPL2 configuration template is out of range (only TTC).                    | Read timer value          | 0  |
| 40<br>ERROR_BAD_TE_VALUE    | The value of timer Te in the MTPL2 configuration template is out of range (only TTC).                    | Read timer value          | 0  |
| 41<br>ERROR_INVALID_PO_FLAG | The value of the processor outage flag in the MTPL2 configuration template is invalid (only TTC).        | 0                         | 0  |

| Error                                | Description                                                                                       | P1                         | P2               |
|--------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------|------------------|
| 42<br>ERROR_INVALID_ALIGNMENT_OPTION | The value of the Ericsson/JT.Q703 flag in the MTPL2 configuration template is invalid (only TTC). | 0                          | 0                |
| 43<br>MUX_CONFIG_FILE_OPEN_ERROR     | An attempt to open the MUX config file has failed.                                                | 0                          | 0                |
| 44<br>ERROR_MUX_CNF_FILE_VERS        | The value of the MUX config file version number is invalid.                                       | Read version number.       | 0                |
| 45<br>ERROR_INVALID_NO_OF_TRUNKS     | The number of trunks specified in the MUX configuration file is invalid.                          | Read number of trunks.     | 0                |
| 46<br>ERROR_INVALID_NO_OF_TS         | A number of time slots specified in the MUX configuration file is invalid.                        | Read number of time slots. | 0                |
| 47<br>ERROR_INVALID_TS_NO            | A time slot number specified in the MUX configuration file is invalid.                            | Read time slot number.     | 0                |
| 48<br>ERROR_INVALID_TRUNK_NAME       | A trunk name specified in the MUX configuration file is invalid.                                  | 0                          | 0                |
| 49<br>MTP_FILE_CLOSE_ERROR           | An attempt to close the FE-MTP-L2-IF main config file has failed.                                 | 0                          | 0                |
| 50<br>MUX_FILE_CLOSE_ERROR           | An attempt to close the MUX config file has failed.                                               | 0                          | 0                |
| 51<br>ERROR_ISR_OPEN                 | An attempt to open a device driver port has failed.                                               | errno (LSB WORD)           | errno (MSB WORD) |

| Error                                 | Description                                                                                                                                                                   | P1                            | P2               |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|------------------|
| 52<br>ERROR_ISR_CLOSE                 | An attempt to close a device driver port has failed.                                                                                                                          | errno (LSB WORD)              | errno (MSB WORD) |
| 53<br>L2TEST_FILE_READ_ERROR          | An error has occurred during the down load of the binary diagnostics test file on to the FPGA circuit.                                                                        | errno (LSB WORD)              | errno (MSB WORD) |
| 54<br>DEVICE_RESET_ERROR              | An temp to reset the device port has failed.                                                                                                                                  | errno (LSB WORD)              | errno (MSB WORD) |
| 55<br>READ_SW_DOWNLOAD_STATUS_ERROR   | The result of the reset of FPGA is different from the expected status result.                                                                                                 | errno (LSB WORD)              | errno (MSB WORD) |
| 56<br>SW_DOWNLOAD_ERROR               | Down load of a binary file to the FPGA circuit has failed.                                                                                                                    | 0                             | 0                |
| 57<br>ERROR_BAD_T7_VALUE              | The value of timer T7 in the MTPL2 configuration template is out of range.                                                                                                    | Read timer T7 value           | 0                |
| 58<br>ERROR_BAD_SIOS_INFINITE_OPTION  | The value of the SIOS sending timer in the MTPL2 configuration template is out of range (only TTC).                                                                           | Read SIOS timer sending value | 0                |
| 59<br>ERROR_BAD_TWFC_VALUE            | The value of timer tWFC in the main configuration file of the FE-MTP-L2-IF is out of range.                                                                                   | 0                             | 0                |
| 60<br>GET_L1_ALARM_ERROR              | An attempt to read the alarm from the board has failed.                                                                                                                       | 0                             | 0                |
| 61<br>MAX_NO_OF_BUFF_MESSAGES_REACHED | The amount of buffered messages have reached maximum, from now messages from the board will be discarded, until the number of buffered messages is less than maximum allowed. | 0                             | 0                |

| Error                             | Description                                                                                                                                                                   | P1                                                           | P2                             |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------|
| 62<br>ERROR_INVALID_ACTION        | The action requested in a runtime reconfiguration order is invalid.                                                                                                           | Action requested.                                            | 0                              |
| 63<br>ERROR_NOT_ENOUGH_PARAMETERS | FE-MTP-L2-IF has been started with too few parameters.                                                                                                                        | Number of parameters including FE-MTP-L2-IF executable name. | 0                              |
| 64<br>ERROR_INVALID_HSN_NO        | The value of the HSN read in the config file, received in an MM_ORDER_req or DL_STATUS_req is invalid or an internal error when resetting or reading statistics has occurred. | HSN                                                          | SDL                            |
| 65<br>ERROR_INVALID_PARAM_ID      | The value of the paramID received in an MM_ORDER_req (RTRECONF) is invalid.                                                                                                   | Read paramID.                                                | 0                              |
| 66<br>RTCNF_FORMAT_ERROR          | The format of the received MM_ORDER_req (RTRECONF) is invalid.                                                                                                                | 0                                                            | 0                              |
| 67<br>ERROR_INVALID_PARAM_VALUE   | The paramValue received in MM_ORDER_req (RTRECONF) is invalid.                                                                                                                | 0                                                            | 0                              |
| 68<br>ERROR_INVALID_TRUNK_NO      | A trunk number received in the MM_ORDER_req (RNREMUX) is invalid.                                                                                                             | Read source trunk number                                     | Read destination trunk number. |
| 69<br>RNMUX_INVALID_NO_OF_TS      | A numberOfTS received in the MM_ORDER_req (RNREMUX) is invalid.                                                                                                               | Read noOfTS                                                  | 0                              |
| 70<br>RNMUXCNF_FORMAT_ERROR       | The format of the received MM_ORDER_req (RNREMUX) is incorrect.                                                                                                               | noOfTs                                                       | LengthOfInfo                   |

| Error                             | Description                                                                                                                                                 | P1               | P2               |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|
| 71<br>RNCNF_FORMAT_ERROR          | The format of the received MM_ORDER_req (RNRECONF) is incorrect.                                                                                            | 0                | 0                |
| 72<br>MT_DEVICE_READ_ERROR        | This error code is only used during Module test.<br>An attempt to read from a file simulating the device port has failed.                                   | 0                | 0                |
| 73<br>MT_DEVICE_EMPTY             | This error code is only used during Module test.<br>An attempt to read from a file simulating the device port has succeeded, but there was nothing to read. | 0                | 0                |
| 74<br>IFEDBG_FILE_OPEN_ERROR      | This error code is only used if the debug flag is on.<br>An attempt to open the debug file has failed.                                                      | 0                | 0                |
| 75<br>ERROR_INVALID_ORDER         | The orderID in the MM_ORDER_req primitive is invalid.                                                                                                       | Read orderID     | 0                |
| 76<br>ERROR_ORDER_LENGTH          | The size of data in the MM_ORDER_req is invalid.                                                                                                            | Read size        | 0                |
| 77<br>FALC_SETUP_FILE_CLOSE_ERROR | An attempt to close the FALC register setup file has failed.                                                                                                | 0                | 0                |
| 78<br>FILE_READ_ERROR             | An attempt to read from a binary file to download has failed.                                                                                               | errno (LSB WORD) | errno (MSB WORD) |
| 79<br>DMA_WRITE_ERROR             | A DMA write transfer has failed.                                                                                                                            | errno (LSB WORD) | errno (MSB WORD) |
| 80<br>DMA_READ_ERROR              | A DMA read transfer has failed.                                                                                                                             | errno (LSB WORD) | errno (MSB WORD) |

| Error                             | Description                                                                                                                          | P1               | P2               |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|
| 81<br>DEVICE_IOCTL_ERROR          | An IOCTL() towards the device driver has failed.                                                                                     | 0                | 0                |
| 82<br>MT_FILE_WRITE_ERROR         | This error code is only used during Module test.<br>An attempt to write to a file simulating the device port has failed.             | 0                | 0                |
| 83<br>INVALID_SOURCE_TRUNK_NAME   | A source trunk name in the mux configuration could not be recognized.                                                                | 0                | 0                |
| 84<br>READ_DEVICE_VERSION_ERROR   | An attempt to read the device version number has failed.                                                                             | errno (LSB WORD) | errno (MSB WORD) |
| 85<br>ERROR_TDMA_EXP_BUFFER_EMPTY | The timer tDMAW has expired, but the DMA buffer is empty. An error case, which normally should not happen.                           | 0                | 0                |
| 86<br>TDMA_TIMER_IN_WRONG_STATE   | The timer tDMAW has expired in a wrong state.                                                                                        | 0                | 0                |
| 87<br>ERROR_BAD_TDMAW_VALUE       | The tDMAW value in the configuration file is wrong.                                                                                  | 0                | 0                |
| 88<br>ERROR_START_THREAD_FAILED   | An attempt to start the Rx thread has failed                                                                                         | errno (LSB WORD) | errno (MSB WORD) |
| 89<br>DMA_WRITE_SIZE_ERROR        | The DMA transmit buffer 's pointers has been corrupted. the data size is negative or the size is not valid.                          | DMA data size    |                  |
| 90<br>ERROR_CREATE_EVENT_HANDLE   | An attempt to create a Windows NT Event to be related to an overlapped ReadFile() is failed (only happens in Windows NT environment) | errno (LSB WORD) | errno (MSB WORD) |

| Error                                    | Description                                                                                                  | P1               | P2               |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------|------------------|
| 91<br>EIN_IFE_ERROR_XMALL<br>OC_DMA      | An attempt to allocate memory for the DMA buffer on the host failed.                                         | errno (LSB WORD) | errno (MSB WORD) |
| 92<br>EIN_IFE_MSU_FORMAT_ERROR           | A DL_MSU_REQ with corrupt length information has been detected.                                              | 0                | 0                |
| 93<br>DESTINATION_TRUNK_NAME_ERROR       | A destination trunk name in MUX config file points to another cards subchannel or has an not regonized name. | 0                | 0                |
| 94<br>ERROR_INVALID_BOARD_TYPE           | The type of SS7CC in FE-MTP-L2-IF's configuration file could not be recognized.                              | 0                | 0                |
| 95<br>ERROR_INVALID_CLOCK_REFERENCE      | The name of the clock reference for the SS7-board is not regonized.                                          | 0                | 0                |
| 96<br>ERROR_INVALID_CLOCK_SOURCE         | The name of the clock source is invalid.                                                                     | 0                | 0                |
| 97<br>PCM_CLOCK_MODE_ERROR               | Clock mode for PCMA or PCMB is not valid.                                                                    | 0                | 0                |
| 98<br>ERROR_INVALID_SC_BUS_CLOCK_SPEED   | The SC-bus clock speed is invalid.                                                                           | 0                | 0                |
| 99<br>ERROR_INVALID_SC_CLOCK_MODE        | The SC-bus clock mode is not valid.                                                                          | 0                | 0                |
| 100<br>ERROR_INVALID_SREF8K_MASTER_VALUE | The SREF8K option is invalid.                                                                                | 0                | 0                |

| Error                                       | Description                                                                                 | P1                   | P2  |
|---------------------------------------------|---------------------------------------------------------------------------------------------|----------------------|-----|
| 101<br>ERROR_MUST_BE_SAME_STANDARD          | The configuration of the HSNs in the MTP-L2 configuration does not use the same standard.   | 0                    | 0   |
| 102<br>MULTIPLE_TEMPLATE_DEFINITION_ERROR   | Multiple definitions of configuration entity, two configuration templates with same number. | template number      | 0   |
| 103<br>MULTIPLE_SDL_DEFINITION_ERROR        | Multiple definitions of configuration entity, the same HSN,SDL pair define twice.           | HSN                  | SDL |
| 104<br>FALC_REG_SETUP_FILE_OPEN_ERROR       | The FALC register setup file could not be opened.                                           | 0                    | 0   |
| 105<br>ERROR_FALC_SETUP_CONFIG_FILE_VERSION | The FALC setup file version is wrong.                                                       | Read version number. | 0   |
| 106<br>FALC_SETUP_BOARD_TYPE_ERROR          | The board type specified in the FALC setup file could not be recognized.                    | 0                    | 0   |
| 107<br>IFE_SS7CC_REPORT_ERROR               | The reported number of bytes written to the board is not valid.                             | 0                    | 0   |
| 108<br>ERROR_BAD_TWFNB_VALUE                | The tWFNB value in the configuration file is wrong.                                         | 0                    | 0   |
| 109<br>ERROR_INVALID_BIT_RATE               | The bit rate specified for T1 or J1 in the configuration file is wrong.                     | 0                    | 0   |
| 110<br>ERROR_INVALID_LINE_CODING            | The line coding specified for T1 or J1 in the configuration file could not be recognized.   | 0                    | 0   |

| Error                                     | Description                                                                                                                                                        | P1               | P2                                 |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------------------------|
| 111<br>ERROR_INVALID_FRAME_MODE           | The framer mode specified for T1 or J1 in the configuration file could not be recognized.                                                                          | 0                | 0                                  |
| 112<br>ERROR_INVALID_TRANSMISSION_SYSTEM  | The transmission system type specified in the configuration file could not be recognized.                                                                          | 0                | 0                                  |
| 113<br>ERROR_INVALID_LINE_INTERFACE_MODE  | The line interface mode specified in the configuration file could not be recognized.                                                                               | 0                | 0                                  |
| 114<br>ERROR_TRANSMISSION_SYSTEM_MISMATCH | The transmission system specified in the FALC configuration is different from the one specified in the FALC register setup file.                                   | 0                | 0                                  |
| 115<br>ERROR_REGISTER_ADDRESS_TOO_HIGH    | A register address specified in the FALC register setup file is too high.                                                                                          | 0                | Number of register addresses read. |
| 116<br>ERROR_REGISTER_VALUE_TOO_HIGH      | A register value specified in the FALC register setup file is too high.                                                                                            | 0                | Number of register values read.    |
| 117<br>TWFNB_RECEIVED_WITH_EMPTY_BUFFERS  | The timer tWFNB has expired without any buffered messages found.                                                                                                   | 0                | 0                                  |
| 118<br>ERROR_BAD_TA_VALUE                 | The value of timer Ta in the MTPL2 configuration template is out of range (only TTC).                                                                              | Read timer value | 0                                  |
| 119<br>IFE_NOW_EXIT_ON_ERROR              | A fatal error has occurred and FE-MTP-L2-IF will exit. Two sysLogs are done before this sysLog, this is to be able to see the last tx event and the last rx event. | 0                | 0                                  |

| Error                               | Description                                                                                                                                                             | P1               | P2               |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|
| 120<br>GET_OVERLAPPED_RESULT_ERROR  | The call to GetOverlappedResult in Windows NT failed.                                                                                                                   | errno (LSB WORD) | errno (MSB WORD) |
| 121<br>ERROR_BAD_TFI_VALUE          | The value of timer Tfi in the MTPL2 configuration template is out of range (only TTC).                                                                                  | Read timer value | 0                |
| 122<br>ERROR_DOWNLOAD_TRANSFER      | There was a transfer error when download the bitfile.                                                                                                                   | 0                | 0                |
| 123<br>ERROR_INVALID_LINE_IMPEDANCE | The line impedance in the board dependant configuration file was erroneous.                                                                                             | 0                | 0                |
| 124<br>PCI_SWITCH_SLAVE_ERROR       | A clock switch over for a trunk on the PCI board has failed.                                                                                                            | 0                | 0                |
| 125<br>PCI_CHECK_ACTIVE_PCM_ERROR   | A check if clocking is available on a trunk on the PCI board has failed.                                                                                                | 0                | 0                |
| 126<br>PCI_LOST_PCM_MASTER          | The PCI board has lost its clock master. A clock switch over has taken place.<br>NOTE:<br>Not an error, only an information log.                                        | 0                | 0                |
| 127<br>PCI_PCM_MASTER_RETURN        | The configured clock master on the PCI board has returned. The board has changed its clock source to the configured.<br>NOTE:<br>Not an error, only an information log. | 0                | 0                |

| Error                            | Description                                                                                           | P1                       | P2 |
|----------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------|----|
| 128<br>ERROR_PRB_NOT_ALLO<br>WED | An attempt to use PRB on a board/bit-<br>file combination that does not support<br>PRB has been made. | 0                        | 0  |
| 129<br>ERROR_BAD_NTT_OPTI<br>ON  | The value of the NTT option in the<br>MTPL2 configuration template is out<br>of range (only TTC).     | Read NTT option<br>value | 0  |

## **6. REFERENCE FORMATS**

### **6.1 SIGNAL FORMATS ON THE LINKS**

For reference, when signals are received from/transmitted to the physical link in the MTP-L2, the formats of the signals are (with minor variations) described in Ref. [I2], Ref. [A1] and Ref. [T1].