Signalling Data Terminal Interface (SDTI) Specification

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Abstract:

This document is a Specification containing technical details concerning the implementation of the Signalling Data Terminal Interface (SDTI) for OpenSS7. It contains recommendations on software architecture as well as platform and system applicability of the Signalling Data Terminal Interface (SDTI). It provides abstraction of the Signalling Data Terminal (SDT) interface to these components as well as providing a basis for Signalling Data Terminal control for other Signalling Data Terminal protocols.

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Notice:

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Notice

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Abstract

This document is a Specification containing technical details concerning the implementation of the Signalling Data Terminal Interface (SDTI) for OpenSS7. It contains recommendations on software architecture as well as platform and system applicability of the Signalling Data Terminal Interface (SDTI).
This document specifies a Signalling Data Terminal Interface (SDTI) Specification in support of the OpenSS7 Signalling Data Terminal (SDT) protocol stacks. It provides abstraction of the Signalling Terminal interface to these components as well as providing a basis for Signalling Terminal control for other Signalling Terminal protocols.

Purpose

The purpose of this document is to provide technical documentation of the Signalling Data Terminal Interface (SDTI). This document is intended to be included with the OpenSS7 STREAMS software package released by *OpenSS7 Corporation*. It is intended to assist software developers, maintainers and users of the Signalling Data Terminal Interface (SDTI) with understanding the software architecture and technical interfaces that are made available in the software package.

Intent

It is the intent of this document that it act as the primary source of information concerning the Signalling Data Terminal Interface (SDTI). This document is intended to provide information for writers of OpenSS7 Signalling Data Terminal Interface (SDTI) applications as well as writers of OpenSS7 Signalling Data Terminal Interface (SDTI) Users.

Audience

The audience for this document is software developers, maintainers and users and integrators of the Signalling Data Terminal Interface (SDTI). The target audience is developers and users of the OpenSS7 SS7 stack.

Revision History

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[1] `http://www.openss7.org/repos/tarballs/openss7-1.1.7.20141001.tar.bz2`

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```
$Log: sdti.texi,v $
Revision 1.1.2.2  2011-02-07 02:21:43  brian
- updated manuals

Revision 1.1.2.1  2009-06-21 10:56:34  brian
- added files to new distro
```

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As with most open source projects, this project would not have been possible without the valiant efforts and productive software of the Free Software Foundation, the Linux Kernel Community, and the open source software movement at large.

1 Introduction

This document specifies a STREAMS-based kernel-level instantiation of the ITU-T Signalling Data Terminal Interface (SDTI) definition. The Signalling Data Terminal Interface (SDTI) enables the user of a a signalling data terminal service to access and use any of a variety of conforming signalling data terminal providers without specific knowledge of the provider's protocol. The service interface is designed to support any network signalling data terminal protocol and user signalling data terminal protocol. This interface only specifies access to signalling data terminal service providers, and does not address issues concerning signalling data terminal management, protocol performance, and performance analysis tools.

This specification assumes that the reader is familiar with ITU-T state machines and signalling data terminal interfaces (e.g. Q.703, Q.2210), and STREAMS.

1.1 Related Documentation

— **ITU-T Recommendation Q.703 (White Book)**
— **ITU-T Recommendation Q.2210 (White Book)**
— **ANSI T1.111.3/2002**
— **System V Interface Definition, Issue 2 - Volume 3**

1.1.1 Role

This document specifies an interface that supports the services provided by the *Signalling System No. 7 (SS7)* for ITU-T, ANSI and ETSI applications as described in ITU-T Recommendation Q.703, ITU-T Recommendation Q.2210, ANSI T1.111.3, ETSI ETS 300 008-1. These specifications are targeted for use by developers and testers of protocol modules that require signalling data terminal service.

1.2 Definitions, Acronyms, Abbreviations

LM Local Management.

LMS Local Management Service.

LMS User A user of Local Management Services.

LMS Provider
A provider of Local Management Services.

Originating SDT User
A SDT-User that initiates a Signalling Data Terminal.

Destination SDT User
A SDT-User with whom an originating SDT user wishes to establish a Signalling Data Terminal.

ISO International Organization for Standardization

SDT User Kernel level protocol or user level application that is accessing the services of the Signalling Data Terminal sub-layer.

SDT Provider
Signalling Data Terminal sub-layer entity/entities that provide/s the services of the Signalling Data Terminal interface.

SDTI	Signalling Data Terminal Interface
TIDU	Signalling Data Terminal Interface Data Unit
TSDU	Signalling Data Terminal Service Data Unit
OSI	Open Systems Interconnection
QOS	Quality of Service
STREAMS	A communication services development facility first available with UNIX System V Release 3.

2 The Signalling Data Terminal Layer

The Signalling Data Terminal Layer provides the means to manage the association of SDT-Users into connections. It is responsible for the routing and management of data to and from signalling data terminal connections between SDT-user entities.

2.1 Model of the SDTI

The SDTI defines the services provided by the signalling data terminal layer to the signalling data terminal user at the boundary between the signalling data terminal provider and the signalling data terminal user entity. The interface consists of a set of primitives defined as STREAMS messages that provide access to the signalling data terminal layer services, and are transferred between the SDTS user entity and the SDTS provider. These primitives are of two types; ones that originate from the SDTS user, and other that originate from the SDTS provider. The primitives that originate from the SDTS user make requests to the SDTS provider, or respond to an indication of an event of the SDTS provider. The primitives that originate from the SDTS provider are either confirmations of a request or are indications to the CCS user that an event has occurred. Figure 2.1 shows the model of the SDTI.

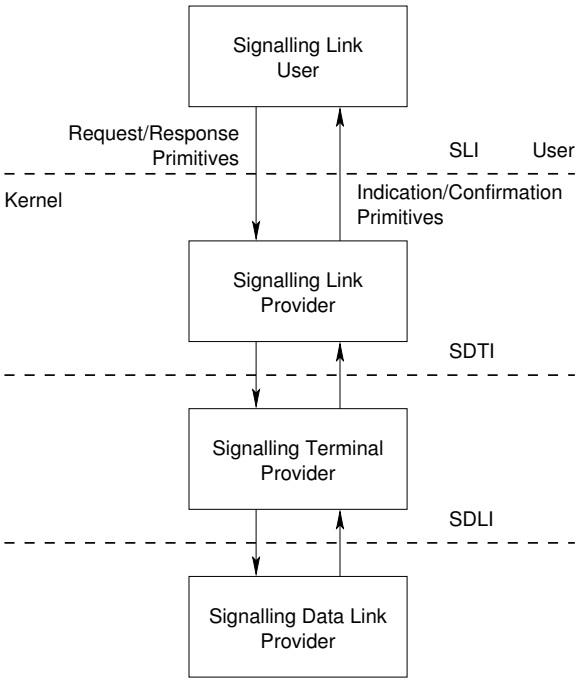

Figure 2.1: *Model of the SDTI*

The SDTI allows the SDTS provider to be configured with any signalling data terminal layer user (such as a signalling link application) that also conforms to the SDTI. A signalling data terminal layer user can also be a user program that conforms to the SDTI and accesses the SDTS provider via **putmsg**`(2s)` and **getmsg**`(2s)` system calls. The typical configuration, however, is to place a signalling link module above the signalling data terminal layer.

2.2 SDTI Services

The features of the SDTI are defined in terms of the services provided by the SDTS provider, and the individual primitives that may flow between the SDTS user and the SDTS provider.

The SDTI Services are broken into two groups: local management services and protocol services. Local management services are responsible for the local management of streams, assignment of streams to physical points of attachment, enabling and disabling of streams, management of options associated with a stream, and general acknowledgement and event reporting for the stream. Protocol services consist of connecting a stream to a medium, exchanging data with the medium, and disconnecting the stream from the medium.

2.2.1 Local Management

Local management services are listed in Table 2.1.

Phase	Service	Primitives
Local Management	Acknowledgement	LMI_OK_ACK, LMI_ERROR_ACK
	Information Reporting	LMI_INFO_REQ, LMI_INFO_ACK
	PPA Attachment	LMI_ATTACH_REQ, LMI_DETACH_REQ, LMI_OK_ACK
	Initialization	LMI_ENABLE_REQ, LMI_ENABLE_CON, LMI_DISABLE_REQ, LMI_DISABLE_CON
	Options Management	LMI_OPTMGMT_REQ, LMI_OPTMGMT_ACK
	Event Reporting	LMI_ERROR_IND, LMI_STATS_IND, LMI_EVENT_IND

Table 2.1: *Local Management Services*

The local management services interface is described in Section 3.1 [Local Management Services], page 13, and the primitives are detailed in Section 4.1 [Local Management Service Primitives], page 23. The local management services interface is defined by the `ss7/lmi.h` header file (see Appendix A [LMI Header File Listing], page 91).

2.2.2 Protocol

Protocol services are listed in Table 2.2.

Phase	Service	Primitives
Protocol	Power On	SDT_DAEDT_START_REQ, SDT_DEADR_START_REQ
	Data Transfer	SDT_DAEDT_TRANSMISSION_REQ, SDT_RC_SIGNAL_UNIT_IND, SDT_TXC_TRANSMISSION_REQUEST_IND
	Initial Alignment	SDT_AERM_START_REQ, SDT_AERM_SET_TI_TO_TIN_REQ, SDT_AERM_SET_TI_TO_TIE_REQ, SDT_IAC_CORRECT_SU_IND, SDT_IAC_ABORT_PROVING_IND, SDT_AERM_STOP_REQ
	Error Rate Monitoring	SDT_SUERM_START_REQ, SDT_LSC_LINK_FAILURE_IND, SDT_SUERM_STOP_REQ
	Receive Congestion	SDT_RC_CONGESTION_ACCEPT_IND, SDT_RC_CONGESTION_DISCARD_IND, SDT_RC_NO_CONGESTION_IND

Table 2.2: *Protocol Services*

The protocol services interface is described in Section 3.2 [Protocol Services], page 19, and the primitives are detailed in Section 4.2 [Protocol Service Primitives], page 60. The protocol services interface is defined by the `ss7/sdti.h` header file (see Appendix B [SDTI Header File Listing], page 99).

2.3 Purpose of the SDTI

The SDTI is typically implemented as a device driver controlling a MPCC (Multi-Protocol Controller Chip) device that provides access to channels. The purpose behind exposing this low level interface is that almost all communications channel devices can be placed into a SS7 HDLC mode, where a data stream can be exchanged between the driver and the medium. The SDTI provides and inteface that, once implemented as a driver for a new device, can provide complete and verified SS7 signalling link capabilities by pushing generic SL (Signalling Link) modules over an open device stream.

This allows SL modules to be verified independently for correct operation and then simply used for all manner of new device drivers that can implement the SDTI interface.

3 SDTI Services Definition

3.1 Local Management Services

3.1.1 Acknowledgement Service

The acknowledgement service provides the LMS user with the ability to receive positive and negative acknowledgements regarding the successful or unsuccessful completion of services.

- `LMI_OK_ACK`: The `LMI_OK_ACK` message is used by the LMS provider to indicate successful receipt and completion of a service primitive request that requires positive acknowledgement.
- `LMI_ERROR_ACK`: The `LMI_ERROR_ACK` message is used by the LMS provider to indicate successful receipt and failure to complete a service primitive request that requires negative acknowledgement.

A successful invocation of the acknowledgement service is illustrated in Figure 3.1.

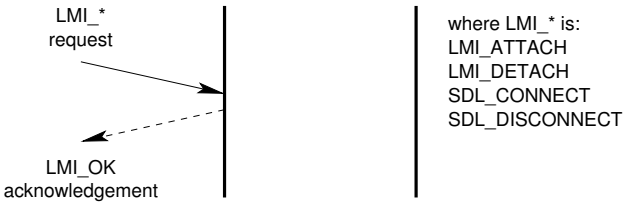

Figure 3.1: *Message Flow: Successful Acknowledgement Service*

As illustrated in Figure 3.1, the service primitives for which a positive acknowledgement may be returned are the `LMI_ATTACH_REQ` and `LMI_DETACH_REQ`.

An unsuccessful invocation of the acknowledgement service is illustrated in Figure 3.2.

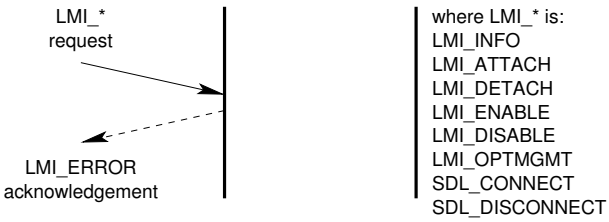

Figure 3.2: *Message Flow: Unsuccessful Acknowledgement Service*

As illustrated in Figure 3.2, the service primitives for which a negative acknowledgement may be returned are the `LMI_INFO_REQ`, `LMI_ATTACH_REQ`, `LMI_DETACH_REQ`, `LMI_ENABLE_REQ`, `LMI_DISABLE_REQ` and `LMI_OPTMGMT_REQ` messages.

3.1.2 Information Reporting Service

The information reporting service provides the LMS user with the ability to elicit information from the LMS provider.

- `LMI_INFO_REQ`: The `LMI_INFO_REQ` message is used by the LMS user to request information about the LMS provider.
- `LMI_INFO_ACK`: The `LMI_INFO_ACK` message is issued by the LMS provider to provide requested information about the LMS provider.

A successful invocation of the information reporting service is illustrated in Figure 3.3.

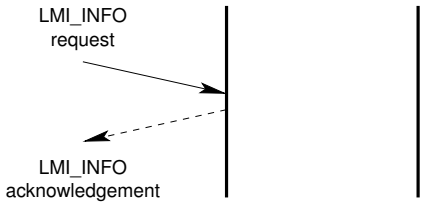

Figure 3.3: *Message Flow: Successful Information Reporting Service*

3.1.3 Physical Point of Attachment Service

The local management interface provides the LMS user with the ability to associate a stream to a physical point of appearance (*PPA*) or to disassociate a stream from a PPA. The local management interface provides for two styles of LMS provider:

Style 1 LMS Provider

A *Style 1* LMS provider is a provider that associates a stream with a PPA at the time of the first `open(2s)` call for the device, and disassociates a stream from a PPA at the time of the last `close(2s)` call for the device.

Physical points of attachment (PPA) are assigned to major and minor device number combinations. When the major and minor device number combination is opened, the opened stream is automatically associated with the PPA for the major and minor device number combination. The last close of the device disassociates the PPA from the stream.

Freshly opened *Style 1* LMS provider streams start life in the `LMI_DISABLED` state.

This approach is suitable for LMS providers implemented as real or pseudo-device drivers and is applicable when the number of minor devices is small and static.

Style 2 LMS Provider

A *Style 2* LMS provider is a provider that associates a stream with a PPA at the time that the LMS user issues the `LMI_ATTACH_REQ` message. Freshly opened streams are not associated with any PPA. The *Style 2* LMS provider stream is disassociated from a PPA when the stream is closed or when the LMS user issues the `LMI_DETACH_REQ` message.

Freshly opened *Style 2* LMS provider streams start life in the `LMI_UNATTACHED` state.

This approach is suitable for LMS providers implemented as clone real or pseudo-device drivers and is applicable when the number of minor devices is large or dynamic.

3.1.3.1 PPA Attachment Service

The PPA attachment service provides the LMS user with the ability to attach a *Style 2* LMS provider stream to a physical point of appearance (PPA).

- `LMI_ATTACH_REQ`: The `LMI_ATTACH_REQ` message is issued by the LMS user to request that a *Style 2* LMS provider stream be attached to a specified physical point of appearance (PPA).
- `LMI_OK_ACK`: Upon successful receipt and processing of the `LMI_ATTACH_REQ` message, the LMS provider acknowledges the success of the service completion with a `LMI_OK_ACK` message.
- `LMI_ERROR_ACK`: Upon successful receipt but failure to process the `LMI_ATTACH_REQ` message, the LMS provider acknowledges the failure of the service completion with a `LMI_ERROR_ACK` message.

A successful invocation of the attachment service is illustrated in Figure 3.4.

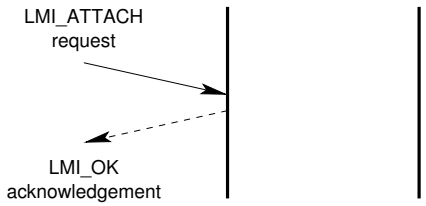

Figure 3.4: *Message Flow: Successful Attachment Service*

3.1.3.2 PPA Detachment Service

The PPA detachment service provides the LMS user with the ability to detach a *Style 2* LMS provider stream from a physical point of attachment (PPA).

- `LMI_DETACH_REQ`: The `LMI_DETACH_REQ` message is issued by the LMS user to request that a *Style 2* LMS provider stream be detached from the attached physical point of appearance (PPA).
- `LMI_OK_ACK`: Upon successful receipt and processing of the `LMI_DETACH_REQ` message, the LMS provider acknowledges the success of the service completion with a `LMI_OK_ACK` message.
- `LMI_ERROR_ACK`: Upon successful receipt but failure to process the `LMI_DETACH_REQ` message, the LMS provider acknowledges the failure of the service completion with a `LMI_ERROR_ACK` message.

A successful invocation of the detachment service is illustrated in Figure 3.5.

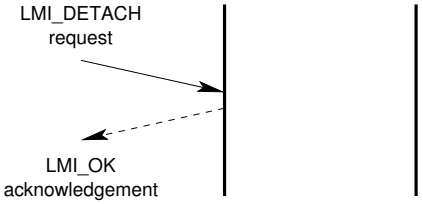

Figure 3.5: *Message Flow: Successful Detachment Service*

3.1.4 Initialization Service

The initialization service provides the LMS user with the abilty to enable and disable the stream for the associated PPA.

3.1.4.1 Interface Enable Service

The interface enable service provides the LMS user with the ability to enable an LMS provider stream that is associated with a PPA. Enabling the interface permits the LMS user to exchange protocol service interface messages with the LMS provider.

- `LMI_ENABLE_REQ`: The `LMI_ENABLE_REQ` message is issued by the LMS user to request that the protocol service interface be enabled.
- `LMI_ENABLE_CON`: Upon successful enabling of the protocol service interface, the LMS provider acknowledges successful completion of the service by issuing a `LMI_ENABLE_CON` message to the LMS user.
- `LMI_ERRORK_ACK`: Upon unsuccessful enabling of the protocol service interface, the LMS provider acknowledges the failure to complete the service by issuing an `LMI_ERROR_ACK` message to the LMS user.

A successful invocation of the enable service is illustrated in Figure 3.6.

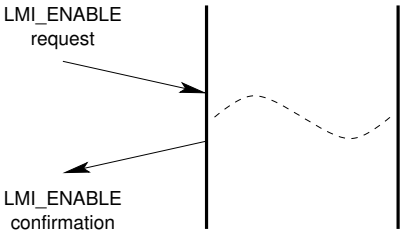

Figure 3.6: *Message Flow: Successful Enable Service*

3.1.4.2 Interface Disable Service

The interface disable service provides the LMS user with the ability to disable an LMS provider stream that is associated with a PPA. Disabling the interface withdraws the LMS user's ability to exchange protocol service interface messages with the LMS provider.

- `LMI_DISABLE_REQ`: The `LMI_DISABLE_REQ` message is issued by the LMS user to request that the protocol service interface be disabled.

- `LMI_DISABLE_CON`: Upon successful disabling of the protocol service interface, the LMS provider acknowledges successful completion of the service by issuing a `LMI_DISABLE_CON` message to the LMS user.

- `LMI_ERRORK_ACK`: Upon unsuccessful disabling of the protocol service interface, the LMS provider acknowledges the failure to complete the service by issuing an `LMI_ERROR_ACK` message to the LMS user.

A successful invocation of the disable service is illustrated in Figure 3.7.

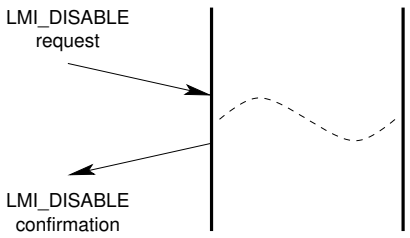

Figure 3.7: *Message Flow: Successful Disable Service*

3.1.5 Options Management Service

The options management service provides the LMS user with the ability to control and affect various generic and provider-specific options associated with the LMS provider.

- `LMI_OPTMGMT_REQ`: The LMS user issues a `LMI_OPTMGMT_REQ` message when it wishes to interrogate or affect the setting of various generic or provider-specific options associated with the LMS provider for the stream upon which the message is issued.

- `LMI_OPTMGMT_ACK`: Upon successful receipt of the `LMI_OPTMGMT_REQ` message, and successful options processing, the LMS provider acknowledges the successful completion of the service with an `LMI_OPTMGMT_ACK` message.

- `LMI_ERROR_ACK`: Upon successful receipt of the `LMI_OPTMGMT_REQ` message, and unsuccessful options processing, the LMS provider acknowledges the failure to complete the service by issuing an `LMI_ERROR_ACK` message to the LMS user.

A successful invocation of the options management service is illustrated in Figure 3.8.

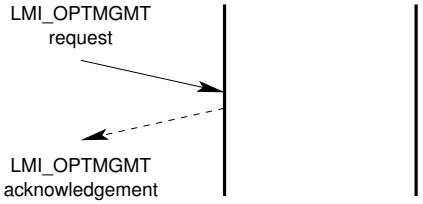

Figure 3.8: *Message Flow: Successful Options Management Service*

3.1.6 Error Reporting Service

The error reporting service provides the LMS provider with the ability to indicate asynchronous errors to the LMS user.

- `LMI_ERROR_IND`: The LMS provider issues the `LMI_ERROR_IND` message to the LMS user when it needs to indicate an asynchronous error (such as the unusability of the communications medium).

A successful invocation of the error reporting service is illustrated in Figure 3.9.

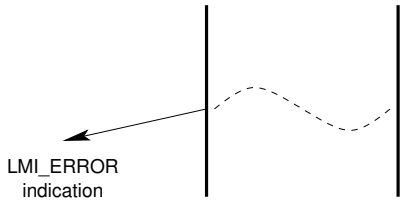

Figure 3.9: *Message Flow: Successful Error Reporting Service*

3.1.7 Statistics Reporting Service

- `LMI_STATS_IND`:

A successful invocation of the statistics reporting service is illustrated in Figure 3.10.

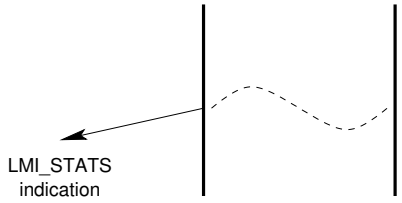

Figure 3.10: *Message Flow: Successful Statistics Reporting Service*

3.1.8 Event Reporting Service

The event reporting service provides the LMS provider with the ability to indicate specific asynchronous management events to the LMS user.

- `LMI_EVENT_IND`: The LMS provider issues the `LMI_EVENT_IND` message to the LMS user when it wishes to indicate an asynchronous (management) event to the LMS user.

A successful invocation of the event reporting service is illustrated in Figure 3.11.

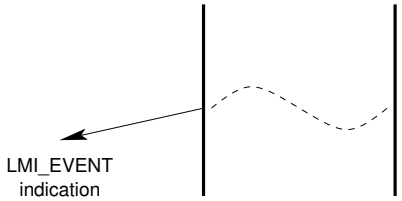

Figure 3.11: *Message Flow: Successful Event Reporting Service*

3.2 Protocol Services

Protocol services are specific to the Signalling Data Terminal interface. These services consist of connection services that permit the transmit and receive directions to be connected to or disconnected from the medium, and data transfer services that permit the exchange of data between SDTS users. The service primitives that implement the protocol services are described in detail in Section 4.2 [Protocol Service Primitives], page 60.

3.2.1 Power On Service

The power on service provides the SDTS user with the ability to power up the receive and trasmitters associated with the medium. Transmitters and receivers can be powered up independently. Data trasnfer cannot occur until the transmitters or receivers have been powered up.

- `SDT_DAEDT_START_REQ`: This service primitive allows the SDTS user to request that transmission of bits begin on the medium.
- `SDT_DAEDR_START_REQ`: This service primitive allows the SDTS user to request that receiption of bits from the medium begin.

3.2.2 Data Transfer Service

The data transfer service provides the SDTS user with the ability to exchange signal units with the SDTS provider. Signal units may be sent to the SDTS provider for transmission and received signal units are delivered to the SDTS user by the SDTS provider. Timing queues can also be indicated by the SDTS provider.

- `SDT_DAEDT_TRANSMISSION_REQ`: This service primitive allows the SDTS user to request the transmission of a signal unit.
- `SDT_RC_SIGNAL_UNIT_IND`: This service primitive allows the SDTS provider to indicate when a signal unit has been received.
- `SDT_TXC_TRANSMISSION_REQUEST_IND`: This service primitive allows the SDTS provider to indicate when it is idle (that is, it is requesting transmission).

3.2.3 Initial Alignment Service

The initial alignment service provides for all of the mechanisms associated with the Alignment Error Rate Monitor (AERM). This includes the ability for the SDTS user to start and stop the AERM, set the proving period to either normal proving or emergency proving, to receive correct signal unit indications and indications of when the error rate exceeds the configured threshold.

- `SDT_AERM_START_REQ`: This service primitive allows the SDTS user to request that the ERM for alignment be started. This is normally performed when initial alignment begins on the signalling link.
- `SDT_AERM_SET_TI_TO_TIN_REQ`: This service primitive allows the SDTS user to request that the ERM for alignment use the error threshold values for normal alignment.
- `SDT_AERM_SET_TI_TO_TIE_REQ`: This service primitive allows the SDTS user to request that the ERM for alignment use the error threshold values for emergency alignment.
- `SDT_IAC_CORRECT_SU_IND`: This service primitive allows the SDTS provider to indicate when a signal unit has sucessfully been received during initial alignment.
- `SDT_IAC_ABORT_PROVING_IND`: This service primitive allows the SDTS provider to indicate when the Alignment Error Rate Monitor (AERM) exceeds it threshold.
- `SDT_AERM_STOP_REQ`: This service primitive allows the SDTS user to request that the ERM for alignment be stopped. This is normally performed when initial alignement ends for the signalling link.

3.2.4 Error Rate Monitoring Service

The error rate monitoring service provides all of the mechanisms associated with the Signal Unit Error Rate Monitor (SUERM) or Errored Interval Monitor (EIM). This includes the ability for the SDTS user to start and stop the SUERM/EIM, and be notified when the error rate exceeds the configured threshold.

- `SDT_SUERM_START_REQ`: This service primitive allows the SDTS user to request that the ERM for normal operation be started. This is normally performed when intial alignment ends for the signalling link.
- `SDT_LSC_LINK_FAILURE_IND`: This service primitive allows the SDTS provider to indicate when the Signal Unit Error Rate Monitor (SUERM) exceeds its threshold.
- `SDT_SUERM_STOP_REQ`: This service primitive allows the SDTS user to request that the ERM for normal operation be stopped. This is normally performed when initial alignment begins for the signalling link.

3.2.5 Receive Congestion Service

The receive congestion service providers mechanisms to implement provider-specific receive congestion indications to the SDTS user.

- `SDT_RC_CONGESTION_ACCEPT_IND`: This service primitive allows the SDTS provider to indicate when receive congestion has onset, but not to the point that it is dicarding signal units.
- `SDT_RC_CONGESTION_DISCARD_IND`: This service primitive allows the SDTS provider to indicate when receive congestion has onset, and signal units are being dicarded.
- `SDT_RC_NO_CONGESTION_IND`: This service primitive allows the SDTS provider to indicate when receive congestion abates.

4 SDTI Primitives

4.1 Local Management Service Primitives

These service primitives implement the local management services (see Section 3.1 [Local Management Services], page 13).

4.1.1 Acknowledgement Service Primitives

These service primitives implement the acknowledgement service (see Section 3.1.1 [Acknowledgement Service], page 13).

4.1.1.1 LMI_OK_ACK

Description

This primitive is used to acknowledge receipt and successful service completion for primitives requiring acknowledgement that have no confirmation primitive.

Format

This primitive consists of one `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_long lmi_correct_primitive;
    lmi_ulong lmi_state;
} lmi_ok_ack_t;
```

Parameters

The service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_OK_ACK`.

lmi_correct_primitive
: Indicates the service primitive that was received and serviced correctly. This field can be one of the following values:

  `LMI_ATTACH_REQ`
  : Attach request.

  `LMI_DETACH_REQ`
  : Detach request.

lmi_state
: Indicates the current state of the LMS provider at the time that the primitive was issued. This field can be one of the following values:

  `LMI_UNATTACHED`
  : No PPA attached, awaiting `LMI_ATTACH_REQ`.

  `LMI_UNUSABLE`
  : Device cannot be used, STREAM in hung state.

`LMI_DISABLED`
: PPA attached, awaiting `LMI_ENABLE_REQ`.

`LMI_ENABLED`
: Ready for use, awaiting primitive exchange.

State

This primitive is issued by the LMS provider in the `LMI_ATTACH_PENDING` or `LMI_DETACH_PENDING` state.

New State

The new state is `LMI_UNATTACHED` or `LMI_DISABLED`, depending on thee primitive to which the message is responding.

4.1.1.2 LMI_ERROR_ACK

Description

The error acknowledgement primitive is used to acknowledge receipt and unsuccessful service completion for primitives requiring acknowledgement.

Format

The error acknowledgement primitive consists of one `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_errno;
    lmi_ulong lmi_reason;
    lmi_long lmi_error_primitive;
    lmi_ulong lmi_state;
} lmi_error_ack_t;
```

Parameters

The error acknowledgement primitive contains the following parameters:

lmi_primitive
: Indicates the primitive type. Always `LMI_ERROR_ACK`.

lmi_errno
: Indicates the LM error number. This field can have one of the following values:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
: (Not used.)

`[LMI_BADDISPOSAL]`
: Invalid disposal parameter.

`[LMI_BADFRAME]`
: Defective SDU received.

`[LMI_BADPPA]`
: Invalid PPA identifier.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_WRITEFAIL]`
: Unitdata request failed.

`[LMI_CRCERR]`
: CRC or FCS error.

`[LMI_DLE_EOT]`
: DLE EOT detected.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_HDLC_ABORT]`
: Aborted frame detected.

`[LMI_OVERRUN]`
: Input overrun.

`[LMI_TOOSHORT]`
: Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

lmi_reason

Indicates the reason for failure. This field is protocol-specific. When the *lmi_errno* field is `[LMI_SYSERR]`, the *lmi_reason* field is the UNIX error number as described in `errno(3)`.

lmi_error_primitive

Indicates the primitive that was in error. This field can have one of the following values:

`LMI_INFO_REQ`
: Information request.

`LMI_ATTACH_REQ`
: Attach request.

`LMI_DETACH_REQ`
: Detach request.

`LMI_ENABLE_REQ`
: Enable request.

`LMI_DISABLE_REQ`
: Disable request.

`LMI_OPTMGMT_REQ`
: Options management request.

`LMI_INFO_ACK`
: Information acknowledgement.

`LMI_OK_ACK`
: Successful receipt acknowledgement.

`LMI_ERROR_ACK`
: Error acknowledgement.

`LMI_ENABLE_CON`
: Enable confirmation.

`LMI_DISABLE_CON`
: Disable confirmation.

`LMI_OPTMGMT_ACK`
: Options Management acknowledgement.

`LMI_ERROR_IND`
: Error indication.

`LMI_STATS_IND`
: Statistics indication.

`LMI_EVENT_IND`
: Event indication.

lmi_state

Indicates the state of the LMS provider at the time that the primitive was issued. This field can have one of the following values:

`LMI_UNATTACHED`
: No PPA attached, awaiting `LMI_ATTACH_REQ`.

`LMI_ATTACH_PENDING`
: Waiting for attach.

`LMI_UNUSABLE`
: Device cannot be used, STREAM in hung state.

`LMI_DISABLED`
: PPA attached, awaiting `LMI_ENABLE_REQ`.

`LMI_ENABLE_PENDING`
: Waiting to send `LMI_ENABLE_CON`.

`LMI_ENABLED`
: Ready for use, awaiting primitive exchange.

`LMI_DISABLE_PENDING`
: Waiting to send `LMI_DISABLE_CON`.

`LMI_DETACH_PENDING`
: Waiting for detach.

State

This primitive can be issued in any state for which a local acknowledgement is not pending. The LMS provider state at the time that the primitive was issued is indicated in the primitive.

New State

The new state remains unchanged.

4.1.2 Information Reporting Service Primitives

These service primitives implement the information reporting service (see Section 3.1.2 [Information Reporting Service], page 14).

4.1.2.1 LMI_INFO_REQ

Description

This LMS user originated primitive is issued by the LMS user to request that the LMS provider return information concerning the capabilities and state of the LMS provider.

Format

The primitive consists of one `M_PROTO` or `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    lmi_ulong lmi_primitive;
} lmi_info_req_t;
```

Parameters

This primitive contains the following parameters:

lmi_primitive
: Specifies the primitive type. Always `LMI_INFO_REQ`.

State

This primitive may be issued in any state but only when a local acknowledgement is not pending.

New State

The new state remains unchanged.

Response

This primitive requires the LMS provider to acknowledge receipt of the primitive as follows:

- **Successful**: The LMS provider is required to acknowledge receipt of the primitive and provide the requested information using the `LMI_INFO_ACK` primitive.
- **Unsuccessful (non-fatal errors)**: The LMS provider is required to negatively acknowledge the primitive using the `LMI_ERROR_ACK` primitive, and include the reason for failure in the primitive.

Reasons for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
(Not used.)

`[LMI_BADDISPOSAL]`
Invalid disposal parameter.

`[LMI_BADFRAME]`
Defective SDU received.

`[LMI_BADPPA]`
Invalid PPA identifier.

`[LMI_BADPRIM]`
Unrecognized primitive.

`[LMI_DISC]`
Disconnected.

`[LMI_EVENT]`
Protocol-specific event occurred.

`[LMI_FATALERR]`
Device has become unusable.

`[LMI_INITFAILED]`
Link initialization failed.

`[LMI_NOTSUPP]`
Primitive not supported by this device.

`[LMI_OUTSTATE]`
Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
`M_PROTO` block too short.

`[LMI_SYSERR]`
UNIX system error.

`[LMI_WRITEFAIL]`
Unitdata request failed.

`[LMI_CRCERR]`
CRC or FCS error.

`[LMI_DLE_EOT]`
DLE EOT detected.

`[LMI_FORMAT]`
Format error detected.

`[LMI_HDLC_ABORT]`
Aborted frame detected.

`[LMI_OVERRUN]`
Input overrun.

`[LMI_TOOSHORT]`
Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.1.2.2 LMI_INFO_ACK

Description

This LMS provider originated primitive acknowledges receipt and successful processing of the LMI_INFO_REQ primitive and provides the request information concerning the LMS provider.

Format

This message is formatted a one M_PROTO or M_PCPROTO message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_version;
    lmi_ulong lmi_state;
    lmi_ulong lmi_max_sdu;
    lmi_ulong lmi_min_sdu;
    lmi_ulong lmi_header_len;
    lmi_ulong lmi_ppa_style;
    lmi_uchar lmi_ppa_addr[0];
} lmi_info_ack_t;
```

Parameters

The information acknowledgement service primitive has the following parameters:

lmi_primitive
: Indicates the service primitive type. Always LMI_INFO_ACK.

lmi_version
: Indicates the version of this specification that is being used by the LMS provider.

lmi_state
: Indicates the state of the LMS provider at the time that the information acknowledgement service primitive was issued. This field can be one of the following values:

  LMI_UNATTACHED
  : No PPA attached, awaiting LMI_ATTACH_REQ.

  LMI_ATTACH_PENDING
  : Waiting for attach.

  LMI_UNUSABLE
  : Device cannot be used, STREAM in hung state.

  LMI_DISABLED
  : PPA attached, awaiting LMI_ENABLE_REQ.

  LMI_ENABLE_PENDING
  : Waiting to send LMI_ENABLE_CON.

  LMI_ENABLED
  : Ready for use, awaiting primitive exchange.

  LMI_DISABLE_PENDING
  : Waiting to send LMI_DISABLE_CON.

  LMI_DETACH_PENDING
  : Waiting for detach.

lmi_max_sdu
: Indicates the maximum size of a Service Data Unit.

lmi_min_sdu
: Indicates the minimum size of a Service Data Unit.

lmi_header_len
: Indicates the amount of header space that should be reserved for placing LMS provider headers.

lmi_ppa_style
: Indicates the PPA style of the LMS provider. This value can be one of the following values:

  `LMI_STYLE1`
  : PPA is implicitly attached by `open(2s)`.

  `LMI_STYLE2`
  : PPA must be explicitly attached using `LMI_ATTACH_REQ`.

lmi_ppa_addr
: This is a variable length field. The length of the field is determined by the length of the `M_PROTO` or `M_PCPROTO` message block.

  For a *Style 2* driver, when *lmi_ppa_style* is `LMI_STYLE2`, and when in an attached state, this field providers the current PPA associated with the stream; the length is typically 4 bytes.

  For a *Style 1* driver, when *lmi_ppa_style* is `LMI_STYLE1`, the length it 0 bytes.

State

This primitive can be issued in any state where a local acknowledgement is not pending.

New State

The new state remains unchanged.

4.1.3 Physical Point of Attachment Service Primitives

These service primitives implement the physical point of attachment service (see Section 3.1.3 [Physical Point of Attachment Service], page 14).

4.1.3.1 LMI_ATTACH_REQ

Description

This LMS user originated primitive requests that the stream upon which the primitive is issued by associated with the specified Physical Point of Attachment (PPA). This primitive is only applicable to *Style 2* LMS provider streams, that is, streams that return `LMI_STYLE2` in the *lmi_ppa_style* field of the `LMI_INFO_ACK`.

Format

This primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_uchar lmi_ppa[0];
} lmi_attach_req_t;
```

Parameters

The attach request primitive contains the following parameters:

lmi_primitive
: Specifies the service primitive type. Always `LMI_ATTACH_REQ`.

lmi_ppa
: Specifies the Physical Point of Attachment (PPA) to which to associated the *Style 2* stream. This is a variable length identifier whose length is determined by the length of the `M_PROTO` message block.

State

This primitive is only valid in state `LMI_UNATTACHED` and when a local acknowledgement is not pending.

New State

Upon success, the new state is `LMI_ATTACH_PENDING`. Upon failure, the state remains unchanged.

Response

The attach request service primitive requires that the LMS provider respond as follows:

- **Successful**: The LMS provider acknowledges receipt of the primitive and successful outcome of the attach service with a `LMI_OK_ACK` primitive. The new state is `LMI_DISABLED`.
- **Unsuccessful (non-fatal errors)**: The LMS provider acknowledges receipt of the primitive and failure of the attach service with a `LMI_ERROR_ACK` primitive containing the reason for failure. The new state remains unchanged.

Reasons for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
: (Not used.)

`[LMI_BADDISPOSAL]`
: Invalid disposal parameter.

`[LMI_BADFRAME]`
: Defective SDU received.

`[LMI_BADPPA]`
: Invalid PPA identifier.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_WRITEFAIL]`
: Unitdata request failed.

`[LMI_CRCERR]`
: CRC or FCS error.

`[LMI_DLE_EOT]`
: DLE EOT detected.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_HDLC_ABORT]`
: Aborted frame detected.

`[LMI_OVERRUN]`
: Input overrun.

`[LMI_TOOSHORT]`
: Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.1.3.2 LMI_DETACH_REQ

Description

This LMS user originated primitive request that the stream upon which the primitive is issued be disassociated from the Physical Point of Appearance (PPA) to which it is currently attached. This primitive is only applicable to *Style 2* LMS provider streams, that is, streams that return `LMI_STYLE2` in the *lmi_ppa_style* field of the `LMI_INFO_ACK`.

Format

The detach request service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
} lmi_detach_req_t;
```

Parameters

The detach request service primitive contains the following parameters:

lmi_primitive
: Specifies the service primitive type. Always `LMI_DETACH_REQ`.

State

This primitive is valid in the `LMI_DISABLED` state and when no local acknowledgement is pending.

New State

Upon success, the new state is `LMI_DETACH_PENDING`. Upon failure, the state remains unchanged.

Response

The detach request service primitive requires that the LMS provider respond as follows:

- **Successful**: The LMS provider acknowledges receipt of the primitive and successful outcome of the detach service with a `LMI_OK_ACK` primitive. The new state is `LMI_UNATTACHED`.
- **Unsuccessful (non-fatal errors)**: The LMS provider acknowledges receipt of the primitive and failure of the detach service with a `LMI_ERROR_ACK` primitive containing the reason for failure. The new state remains unchanged.

Reasons for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
(Not used.)

`[LMI_BADDISPOSAL]`
Invalid disposal parameter.

`[LMI_BADFRAME]`
Defective SDU received.

`[LMI_BADPPA]`
Invalid PPA identifier.

`[LMI_BADPRIM]`
Unrecognized primitive.

`[LMI_DISC]`
Disconnected.

`[LMI_EVENT]`
Protocol-specific event occurred.

`[LMI_FATALERR]`
Device has become unusable.

`[LMI_INITFAILED]`
Link initialization failed.

`[LMI_NOTSUPP]`
Primitive not supported by this device.

`[LMI_OUTSTATE]`
Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
`M_PROTO` block too short.

`[LMI_SYSERR]`
UNIX system error.

`[LMI_WRITEFAIL]`
Unitdata request failed.

`[LMI_CRCERR]`
CRC or FCS error.

`[LMI_DLE_EOT]`
DLE EOT detected.

`[LMI_FORMAT]`
Format error detected.

`[LMI_HDLC_ABORT]`
Aborted frame detected.

`[LMI_OVERRUN]`
Input overrun.

`[LMI_TOOSHORT]`
Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.1.4 Initialization Service Primitives

Initialization service primitives allow the LMS user to enable or disable the protocol service interface. Enabling the protocol service interface may require that some action be taken to prepare the protocol service interface for use or to remove it from use. For example, where the PPA corresponds to a signalling data link identifier as defined in Q.704, it may be necessary to perform switching to connect or disconnect the circuit identification code associated with the signalling data link identifier.
These service primitives implement the initialization service (see Section 3.1.4 [Initialization Service], page 16).

4.1.4.1 LMI_ENABLE_REQ

Description

This LMS user originated primitive request that the LMS provider perform the actions necessary to enable the protocol service interface and confirm that it is enabled. This primitive is applicable to both styles of PPA.

Format

The enable request service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_uchar lmi_rem[0];
} lmi_enable_req_t;
```

Parameters

The enable request service primitive contains the following parameters:

lmi_primitive
: Specifies the service primitive type. Always `LMI_ENABLE_REQ`.

lmi_rem
: Specifies a remote address to which to connect the PPA. The need for and form of this address is provider-specific. The length of the field is determined by the length of the `M_PROTO` message block. This remote address could be a circuit identification code, an IP address, or some other form of circuit or channel identifier.

State

This primitive is valid in the `LMI_DISABLED` state and when no local acknowledgement is pending.

New State

Upon success the new state is `LMI_ENABLE_PENDING`. Upon failure, the state remains unchanged.

Response

The enable request service primitive requires that the LMS provider acknowledge receipt of the primitive as follows:

- **Successful**: When successful, the LMS provider acknowledges successful completion of the enable service with an `LMI_ENABLE_CON` primitive. The new state is `LMI_ENABLED`.
- **Unsuccessful (non-fatal errors)**: When unsuccessful, the LMS provider acknowledges the failure of the enable service wtih an `LMI_ERROR_ACK` primitive containing the error. The new state remains unchanged.

Reasons for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
: (Not used.)

`[LMI_BADDISPOSAL]`
: Invalid disposal parameter.

`[LMI_BADFRAME]`
: Defective SDU received.

`[LMI_BADPPA]`
: Invalid PPA identifier.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_WRITEFAIL]`
: Unitdata request failed.

`[LMI_CRCERR]`
: CRC or FCS error.

`[LMI_DLE_EOT]`
: DLE EOT detected.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_HDLC_ABORT]`
: Aborted frame detected.

`[LMI_OVERRUN]`
: Input overrun.

`[LMI_TOOSHORT]`
: Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.1.4.2 LMI_ENABLE_CON

Description

This LMS provider originated primitive is issued by the LMS provider to confirm the successful completion of the enable service.

Format

The enable confirmation service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_state;
} lmi_enable_con_t;
```

Parameters

The enable confirmation service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_ENABLE_CON`.

lmi_state
: Indicates the state following issuing the enable confirmation primitive. This field can take on one of the following values:

  `LMI_ENABLED`
  : Ready for use, awaiting primitive exchange.

State

This primitive is issued by the LMS provider in the `LMI_ENABLE_PENDING` state.

New State

The new state is `LMI_ENABLED`.

4.1.4.3 LMI_DISABLE_REQ

Description

This LMS user originated primitive requests that the LMS provider perform the actions necessary to disable the protocol service interface and confirm that it is disabled. The primitive is applicable to both styles of PPA.

Format

The disable request service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
} lmi_disable_req_t;
```

Parameters

The disable request service primitive contains the following parameters:

lmi_primitive
: Specifies the service primitive type. Always `LMI_DISABLE_REQ`.

State

The disable request service primitive is valid in the `LMI_ENABLED` state and when no local acknowledgement is pending.

New State

Upon success, the new state is `LMI_DISABLE_PENDING`. Upon failure, the state remains unchanged.

Response

The disable request service primitive requires the LMS provider to acknowledge receipt of the primitive as follows:

- **Successful**: When successful, the LMS provider acknowledges successful completion of the disable service with an `LMI_DISABLE_CON` primitive. The new state is `LMI_DISABLED`.
- **Unsuccessful (non-fatal errors)**: When unsuccessful, the LMS provider acknowledges the failure of the disable service with an `LMI_ERROR_ACK` primitive containing the error. The new state remains unchanged.

Reasons for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
(Not used.)

`[LMI_BADDISPOSAL]`
Invalid disposal parameter.

`[LMI_BADFRAME]`
Defective SDU received.

`[LMI_BADPPA]`
Invalid PPA identifier.

`[LMI_BADPRIM]`
Unrecognized primitive.

`[LMI_DISC]`
Disconnected.

`[LMI_EVENT]`
Protocol-specific event occurred.

`[LMI_FATALERR]`
Device has become unusable.

`[LMI_INITFAILED]`
Link initialization failed.

`[LMI_NOTSUPP]`
Primitive not supported by this device.

`[LMI_OUTSTATE]`
Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
`M_PROTO` block too short.

`[LMI_SYSERR]`
UNIX system error.

`[LMI_WRITEFAIL]`
Unitdata request failed.

`[LMI_CRCERR]`
CRC or FCS error.

`[LMI_DLE_EOT]`
DLE EOT detected.

`[LMI_FORMAT]`
Format error detected.

`[LMI_HDLC_ABORT]`
Aborted frame detected.

`[LMI_OVERRUN]`
Input overrun.

`[LMI_TOOSHORT]`
Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.1.4.4 LMI_DISABLE_CON

Description

This LMS provider originated primitive is issued by the LMS provider to confirm the successful completion of the disable service.

Format

The disable confirmation service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_state;
} lmi_disable_con_t;
```

Parameters

The disable confirmation service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_DISABLE_CON`.

lmi_state
: Indicates the state following issuing the disable confirmation primitive. This field can take on one of the following values:

  `LMI_DISABLED`
  : PPA attached, awaiting `LMI_ENABLE_REQ`.

State

This primitive is issued by the LMS provider in the `LMI_DISABLE_PENDING` state.

New State

The new state is `LMI_DISABLED`.

4.1.5 Options Management Service Primitives

The options management service primitives allow the LMS user to negotiate options with the LMS provider, retrieve the current and default values of options, and check that values specified for options are correct.

The options management service primitive implement the options management service (see Section 3.1.5 [Options Management Service], page 17).

4.1.5.1 LMI_OPTMGMT_REQ

Description

This LMS user originated primitive requests that LMS provider options be managed.

Format

The option management request service primitive consists of one `M_PROTO` or `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_opt_length;
    lmi_ulong lmi_opt_offset;
    lmi_ulong lmi_mgmt_flags;
} lmi_optmgmt_req_t;
```

Parameters

The option management request service primitive contains the following parameters:

lmi_primitive
: Specifies the service primitive type. Always `LMI_OPTMGMT_REQ`.

lmi_opt_length
: Specifies the length of the options.

lmi_opt_offset
: Specifies the offset, from the beginning of the `M_PROTO` message block, of the start of the options.

lmi_mgmt_flags
: Specifies the management flags which determine what operation the LMS provider is expected to perform on the specified options. This field can assume one of the following values:

  `LMI_NEGOTIATE`
  : Negotiate the specified value of each specified option and return the negotiated value.

  `LMI_CHECK`
  : Check the validity of the specified value of each specified option and return the result. Do not alter the current value assumed by the LMS provider.

  `LMI_DEFAULT`
  : Return the default value for the specified options (or all options). Do not alter the current value assumed by the LMS provider.

`LMI_CURRENT`
: Return the current value for the specified options (or all options). Do not alter the current value assumed by the LMS provider.

State

This primitive is valid in any state where a local acknowledgement is not pending.

New State

The new state remains unchanged.

Response

The option management request service primitive requires the LMS provider to acknowledge receipt of the primitive as follows:

- **Successful**: Upon success, the LMS provider acknowledges receipt of the service primitive and successful completion of the options management service with an `LMI_OPTMGMT_ACK` primitive containing the options management result. The state remains unchanged.
- **Unsuccessful (non-fatal errors)**: Upon failure, the LMS provider acknowledges receipt of the service primitive and failure to complete the options management service with an `LMI_ERROR_ACK` primitive containing the error. The state remains unchanged.

Reasons for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
: (Not used.)

`[LMI_BADDISPOSAL]`
: Invalid disposal parameter.

`[LMI_BADFRAME]`
: Defective SDU received.

`[LMI_BADPPA]`
: Invalid PPA identifier.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_WRITEFAIL]`
: Unitdata request failed.

`[LMI_CRCERR]`
: CRC or FCS error.

`[LMI_DLE_EOT]`
: DLE EOT detected.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_HDLC_ABORT]`
: Aborted frame detected.

`[LMI_OVERRUN]`
: Input overrun.

`[LMI_TOOSHORT]`
: Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.1.5.2 LMI_OPTMGMT_ACK

Description

This LMS provider originated primitive is issued by the LMS provider upon successful completion of the options management service. It indicates the outcome of the options management operation requested by the LMS user in a `LMI_OPTMGMT_REQ` primitive.

Format

The option management acknowledgement service primitive consists of one `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_opt_length;
    lmi_ulong lmi_opt_offset;
    lmi_ulong lmi_mgmt_flags;
} lmi_optmgmt_ack_t;
```

Parameters

The option management acknowledgement service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_OPTMGMT_ACK`.

lmi_opt_length
: Indicates the length of the returned options.

lmi_opt_offset
: Indicates the offset of the returned options from the start of the `M_PCPROTO` message block.

lmi_mgmt_flags
: Indicates the returned management flags. These flags indicate the overall success of the options management service. This field can assume one of the following values:

  `LMI_SUCCESS`
  : The LMS provider succeeded in negotiating or returning all of the options specified by the LMS user in the `LMI_OPTMGMT_REQ` primitive.

  `LMI_FAILURE`
  : The LMS provider failed to negotiate one or more of the options specified by the LMS user.

  `LMI_PARTSUCCESS`
  : The LMS provider negotiated a value of lower quality for one or more of the options specified by the LMS user.

  `LMI_READONLY`
  : The LMS provider failed to negotiate one ore more of the options specified by the LMS user because the option is treated as read-only by the LMS provider.

  `LMI_NOTSUPPORT`
  : The LMS provider failed to recognize one or more of the options specified by the LMS user.

State

This primitive is issued by the LMS provider in direct response to an `LMI_OPTMGMT_REQ` primitive.

New State

The new state remains unchanged.

Rules

The LMS provider follows the following rules when processing option management service requests:

— When the *lmi_mgmt_flags* field in the `LMI_OPTMGMT_REQ` primitive is set to `LMI_NEGOTIATE`, the LMS provider will attempt to negotiate a value for each of the options specified in the request.

— When the flags are `LMI_DEFAULT`, the LMS provider will return the default values of the specified options, or the default values of all options known to the LMS provider if no options were specified.

— When the flags are `LMI_CURRENT`, the LMS provider will return the current values of the specified options, or all options.

— When the flags are `LMI_CHECK`, the LMS provider will attempt to negotiate a value for each of the options specified in the request and return the resulg of the negotiation, but will not affect the current value of the option.

4.1.6 Event Reporting Service Primitives

The event reporting service primitives allow the LMS provider to indicate asynchronous errors, events and statistics collection to the LMS user.

These service primitives implement the event reporting service (see Section 3.1.8 [Event Reporting Service], page 19).

4.1.6.1 LMI_ERROR_IND

Description

This LMS provider originated service primitive is issued by the LMS provider when it detects and asynchronous error event. The service primitive is applicable to all styles of PPA.

Format

The error indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_errno;
    lmi_ulong lmi_reason;
    lmi_ulong lmi_state;
} lmi_error_ind_t;
```

Parameters

The error indication service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_ERROR_IND`.

lmi_errno
: Indicates the LMI error number describing the error. This field can have one of the following values:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADADDRESS]`
: Address was invalid.

`[LMI_BADADDRTYPE]`
: Invalid address type.

`[LMI_BADDIAL]`
: (Not used.)

`[LMI_BADDIALTYPE]`
: (Not used.)

`[LMI_BADDISPOSAL]`
: Invalid disposal parameter.

`[LMI_BADFRAME]`
: Defective SDU received.

`[LMI_BADPPA]`
: Invalid PPA identifier.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_WRITEFAIL]`
: Unitdata request failed.

`[LMI_CRCERR]`
: CRC or FCS error.

`[LMI_DLE_EOT]`
: DLE EOT detected.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_HDLC_ABORT]`
: Aborted frame detected.

`[LMI_OVERRUN]`
: Input overrun.

`[LMI_TOOSHORT]`
: Frame too short.

`[LMI_INCOMPLETE]`
: Partial frame received.

`[LMI_BUSY]`
: Telephone was busy.

`[LMI_NOANSWER]`
: Connection went unanswered.

`[LMI_CALLREJECT]`
: Connection rejected.

`[LMI_HDLC_IDLE]`
: HDLC line went idle.

`[LMI_HDLC_NOTIDLE]`
: HDLC link no longer idle.

`[LMI_QUIESCENT]`
: Line being reassigned.

`[LMI_RESUMED]`
: Line has been reassigned.

`[LMI_DSRTIMEOUT]`
: Did not see DSR in time.

`[LMI_LAN_COLLISIONS]`
: LAN excessive collisions.

`[LMI_LAN_REFUSED]`
: LAN message refused.

`[LMI_LAN_NOSTATION]`
: LAN no such station.

`[LMI_LOSTCTS]`
: Lost Clear to Send signal.

`[LMI_DEVERR]`
: Start of device-specific error codes.

lmi_reason

Indicates the reason for failure. This field is protocol-specific. When the *lmi_errno* field is `[LMI_SYSERR]`, the *lmi_reason* field is the UNIX error number as described in `errno(3)`.

lmi_state

Indicates the state of the LMS provider at the time that the primitive was issued. This field can have one of the following values:

`LMI_UNATTACHED`
: No PPA attached, awaiting `LMI_ATTACH_REQ`.

`LMI_ATTACH_PENDING`
: Waiting for attach.

`LMI_UNUSABLE`
: Device cannot be used, STREAM in hung state.

`LMI_DISABLED`
: PPA attached, awaiting `LMI_ENABLE_REQ`.

`LMI_ENABLE_PENDING`
: Waiting to send `LMI_ENABLE_CON`.

`LMI_ENABLED`
: Ready for use, awaiting primitive exchange.

`LMI_DISABLE_PENDING`
: Waiting to send `LMI_DISABLE_CON`.

`LMI_DETACH_PENDING`
: Waiting for detach.

State

This primitive can be issued in any state for which a local acknowledgement is not pending. The LMS provider state at the time that the primitive was issued is indicated in the primitive.

New State

The new state remains unchanged.

4.1.6.2 LMI_STATS_IND

Description

This LMS provider originated primitive is issued by the LMS provider to indicate a periodic statistics collection event. The service primitive is applicable to all styles of PPA.

Format

The statistics indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_interval;
    lmi_ulong lmi_timestamp;
} lmi_stats_ind_t;
```

Following this structure within the `M_PROTO` message block is the provider-specific statistics.

Parameters

The statistics indication service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_STATS_IND`.

lmi_interval
: Indicates the statistics collection interval to which the statistics apply. This interval is specified in milliseconds.

lmi_timestamp
: Indicates the UNIX time (from epoch) at which statistics were collected. The timestamp is given in milliseconds from epoch.

State

This service primitive may be issued by the LMS provider in any state in which a local acknowledgement is not pending.

New State

The new state remains unchanged.

4.1.6.3 LMI_EVENT_IND

Description

This LMS provider originated primitive is issued by the LMS provider to indicate an asynchronous event. The service primitive is applicable to all styles of PPA.

Format

The event indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    lmi_long lmi_primitive;
    lmi_ulong lmi_objectid;
    lmi_ulong lmi_timestamp;
    lmi_ulong lmi_severity;
} lmi_event_ind_t;
```

Following this structure within the `M_PROTO` message block is the provider-specific event information.

Parameters

THe event indication service primitive contains the following parameters:

lmi_primitive
: Indicates the service primitive type. Always `LMI_EVENT_IND`.

lmi_objectid
: Indicates the provider-specific object identifier that identifies the managed object to which the event is associated.

lmi_timestamp
: Indicates the UNIX time from epoch (in milliseconds).

lmi_severity
: Indicates the provider-specific severity of the event.

State

This service primitive can be issued by the LMS provider in any state where a local acknowledgement is not pending. Normally the LMS provider must be in the `LMI_ENABLED` state for event reporting to occur.

New State

The new state remains unchanged.

4.2 Protocol Service Primitives

The protocol service primitives implement the services of the DAEDT, DAEDR, AERM, SUERM/EIM and a provider specific receive congestion function, including power on, initial alignment support, error rate monitoring, receive cnogestion detection, and data transfer.
These service primitives implement the protocol services (see Section 3.2 [Protocol Services], page 19).

4.2.1 Power On Service Primitives

The power on service primitives provide the ability for the SDTS user to power on the DAEDR and DAEDT functions within the SDTS provider.
These service primitives implement the power on service (see Section 3.2.1 [Power On Service], page 19).

4.2.1.1 SDT_DAEDT_START_REQ

Description

The DAEDT start request service primitive is originated by the SDTS user when it wishes to start the transmitters as part of a power-on sequence. Once started, the transmitters cannot be stopped under protocol control.

Format

The DAEDT start request service primitive consists of one `M_PROTO` message block, formatted as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_daedt_start_req_t;
```

Parameters

The DAEDT start request service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_DAEDT_START_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state and is valid when the DAEDT is in the `IDLE` state.

New State

The new DAEDT state is the `IN-SERVICE` state.

Response

This primitive does not require receipt acknowledgement.

- **Successful:** When successful, the primitive does not require receipt acknowledgement. The link state is unchanged.
- **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a `LMI_ERROR_ACK` primitive containing the error and reason for failure. The state remains unchanged.

When the terminal is in the `LMI_ENABLED` management state and the DAEDT is already in the `IN-SERVICE` state, this primitive should be ignored and the SDTS provider should *not* generate a non-fatal error.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.1.2 SDT_DAEDR_START_REQ

Description

The DAEDR start request service primitive is originated by the SDTS user when it wishes to start the receivers as part of a power-on sequence. Once started, the receivers cannot be stopped under protocol control. This primitive is a request from the Reception Control (RC) function in the SDTS user to the DAEDR function in the SDTS provider.

Format

The DAEDR start request service primitive consists of one `M_PROTO` message block, formatted as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_daedr_start_req_t;
```

Parameters

The DAEDR start request service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_DAEDR_START_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state and is valid when the DAEDR is in the `IDLE` state.

New State

The new DAEDR state is the `IN-SERVICE` state.

Response

This primitive does not require receipt acknowledgement.

- **Successful:** When successful, the primitive does not require receipt acknowledgement. The link state is unchanged.
- **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a `LMI_ERROR_ACK` primitive containing the error and reason for failure. The state remains unchanged.

When the terminal is in the `LMI_ENABLED` management state and the DAEDR is already in the `IN-SERVICE` state, this primitive should be ignored and the SDTS provider should *not* generate a non-fatal error.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.2 Data Transfer Service Primitives

The data transfer service primitives provide the means for transfering data between SDTS users across a signalling data link. Data is sent and received in signal units. Signal units are the data contained in frames that occur between flags on the line excluding the checksum octets. These are packets of data that contain an integer number of octets (a multiple of 8 bits). When performing data transfer, signal units that are correctly received on the signalling data link are delivered to the SDTS user as they arrive. Signal units for transmission are delivered to the SDTS provider on demand, however, during quiescent periods it is sometimes advantageous from the point of view of synchronous driver design to request trasnmission of additional signal units in a *pull* arrangement rather than a *push* arrangement. Therefore there is a primitive to allow the SDTS provider to request additional data for trasnsmission.

These service primitives implement the data transfer service (see Section 3.2.2 [Data Transfer Service], page 20).

4.2.2.1 SDT_DAEDT_TRANSMISSION_REQ

Description

The DAEDT transmission request service primitive is originated by the SDTS user to request that the SDTS provider trasnmit a signal unit on the medium. A signal unit is a self-contained packet of data containing an integer number of octets of information. This primitive is a request from the Transmission Control (TXC) function in the SDTS user to the DAEDT function in the SDTS provider.

Format

The DAEDT transmission request service primitive consists of zero or one `M_PROTO` message block, followed by one or more `M_DATA` message blocks containing the signal unit to transmit. The `M_PROTO` mesage block, when present, is structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_daedt_transmission_req_t;
```

Parameters

The DAEDT transmission request service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_DAEDT_TRANSMISSION_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state with the DAEDT in the `IN-SERVICE` state.

New State

The new state is unchanged.

Rules

The SDTS user must observe the following rules when issuing the DAEDT transmission request service primitive:

— This primitive should only be issued by the SDTS provider after the transmitters have been enabled with a `SDT_DAEDT_START_REQ` and the DAEDT is in the `IN-SERVICE` state.

— After the transmitter have been enabled while in the `LMI_ENABLED` management state, the DAEDT state is always appropriate for the SDTS user to issue this primitive.

— The `M_PROTO` message block is optional. The SDTS provider will be prepared to accept `M_DATA` message blocks from the SDTS user, without any `M_PROTO` message block, as service primitive of this type.

— Most narrowband SS7 SDTS providers peform what is known as SU repetition. When SUs that correspond to FISUs (Fill-In Signal Units) or LSSUs (Link Status Signal Units) which are sent continuously on the signalling link, the SDTS user need only send the first such signal unit. The SDTS provider will continuously repeat a FISU or LSSU, when appropriate,[1] until the next signal unit is presented for transmission. To perform this function, a narrowband SS7 SDTS provider must know the protocol options associated with the signalling link (i.e. the size of the sequence numbers and length indicator).

Activate or deactivation of *SU Repeating* is a provider-specific function.

Response

This primitive does not require receipt acknowledgement.

– **Successful:** When successful, the primitive does not require receipt acknowledgement. The link state is unchanged.

– **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a `LMI_ERROR_ACK` primitive containing the error and reason for failure. The state remains unchanged.

When the terminal is in the `LMI_ENABLED` management state, but the DAEDT is still in the `IDLE` state, the primitive should be ignored and the corresponding data discarded without generating a non-fatal error.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

[1] Note that the only LSSU that is not repeated continuously is the SIB.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.2.2 SDT_RC_SIGNAL_UNIT_IND

Description

The RC signal unit indication service primitive is issued by the SDTS provider when a signal unit arrives on the signalling data link and passes error detection. The primitive is named the 'RC' signal unit indication because this signal is normally sent to reception control (RC) within the SS7 Level 2 state machine. This primitive is an indication from the DAEDR function in the SDTS provider to the Reception Control (RC) function in the SDTS user.

Format

The RC signal unit indication service primtive consists of one optional M_PROTO message block followed by one or more M_DATA message blocks containing the receive signal unit. The M_PROTO message block, when present, is structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
    sdt_ulong sdt_count;
} sdt_rc_signal_unit_ind_t;
```

Parameters

The RC signal unit indication service primtive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always SDT_RC_SIGNAL_UNIT_IND.

sdt_count
: When signal unit compression is in effect, this field contains a count of the number of compressed identical signal units (not counting the original). When signal unit compression is not in effect, or the signal unit was not compressed (it was not repeated on the line), this field is set to the value 0.

State

This primitive is only issued from the LMI_ENABLED management state.

New State

The state remains unchanged.

Rules

The SDTS provider observes the following rules when generating the RC signal unit indication primitive:

— The primitive is only issued when the signalling data terminal is in the LMI_ENABLED management state.

— Received signal units are indicated only after the receivers have been enabled using the SDT_DAEDR_START_REQ command and the DAEDR is in the IN-SERVICE state.

— Once the SDTS user is receiving signal units, it will continue to do so until a fatal error occurs, the stream is closed, or the signalling data terminal is disabled with the LMI_DISABLE_REQ primitive.

— The M_PROTO message block is optional and is only really required for indicating the count of compressed signal units. When signal unit compression is not in effect, or when a signal unit

is not compressed (i.e. has a *sdt_count* of zero), the `M_PROTO` message block is unnecessary and SDTS providers are encouraged to not include it. When the `M_PROTO` message block is not included, the signal unit is delivered simply as a chain of one or more `M_DATA` message blocks to the SDTS user. The SDTS user must be prepared to receive RC signal unit indications consisting of only `M_DATA` message blocks.

— Most narrowband SS7 SDTS providers provider for signal unit compression. Under this scheme, the first non-identical signal unit is indicated with a *sdt_count* of zero. Should additional identical signal units be received, the will be counted until another non-identical signal unit is received. At that point, an RC signal unit indication with a *sdt_count* indicating the number of compressed signal units is indicated followed by an indication of the new non-identical signal unit with a *sdt_count* of zero. And the cycle repeats.

  To support this feature, SDTS users must be prepared to accept a compressed frame representing all of the contiguous identical signalling units in this fashion. For example, the SDTS user cannot rely by its design on the third identical signal unit causing a state transsition in a timely manner.

— Invocation and applicability of a signal unit compression feature is provider-specific. So, for example, Q.703 drivers use FISU and LSSU compression techniques, whereas, M2PA (RFC 4165) does not require them.

Response

This primitive does not require a response from the SDTS user.

4.2.2.3 SDT_TXC_TRANSMISSION_REQUEST_IND

Description

The TXC transmission request indication service primitive is originated by the SDTS provider to indicate that if a signal unit is not available for transmission that the signalling terminal will idle the signalling data link. Depending on the specific SDTS provider, idling the signalling data link may consist of idling continuous flags, FISUs or LSSUs. This indication provides timing ques to the SDTS user. This primitive is an indication from the DAEDT function in the SDTS provider to the Transmission Control (TXC) function in the SDTS user.

Format

The TXC transmission request indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_txc_transmission_request_ind_t;
```

Parameters

The TXC transmission request indication service primitive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_TXC_TRANSMISSION_REQUEST_IND`.

State

This primitive is only issued from the `LMI_ENABLED` management state and when the DAEDT is in the `IN-SERVICE` state.

New State

The new state is unchanged.

Rules

The SDTS provider observes the following rules when issuing the TXC transmission request indication service primitive:

- This service primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state.
- This service primitive is only issued when the DAEDT is in the `IN-SERVICE` state; that is, a `SDT_DAEDT_START_REQ` primitive has been received by the SDTS provider for the signalling terminal.
- This service primitive is only issued by the SDTS provider when its transmission queue is empty.
- This service primitive is only issued by the SDTS provider when the provider is configured to generate these indications. Configuration of the SDTS provider is a provider-specific matter.

Response

This primitive does not require a specific response from the SDTS user. Upon receiving this primitive, if the SDTS user does not wish the signalling data link to idle flags, FISUs or LSSUs, it should generate another trasnmission request using the `SDT_DAEDT_TRANSMISSION_REQ` primitive.

4.2.3 Initial Alignment Service Primitives

The initial alignment service primitives peform the functions of the Alignment Error Rate Monitor (AERM). They provide the SDTS user with the ability to start and stop the AERM, set normal or emergency proving periods, and receive correct signal unit indications and indications that the error rate has exceeded the threshold.

Not all SDTS providers implement nor require an AERM function. For example, broadband signalling links can be configured to not perform proving, in which case the AERM function is not necessary. Regardless of whether the AERM function is necessary or not, each SDTS provider should be prepared to handle requests and generate appropriate indications as though an AERM function existed, and without generating non-fatal errors.

Note that some designs do no permit the AERM function and the SUERM or EIM function to be active simultaneously.

These service primitives implement the initial alignment service (see Section 3.2.3 [Initial Alignment Service], page 20).

4.2.3.1 SDT_AERM_START_REQ

Description

The AERM start request service primitive is originated by the SDTS use to request that the Alignment Error Rate Monitor be started. This primitive is a request from the Initial Alignment Control (IAC) function in the SDTS user to the AERM function in the SDTS provider.

Format

The AERM start request service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_aerm_start_req_t;
```

Parameters

The AERM start request service primitive containst the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_AERM_START_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state and valid when the DAEDR function is in the `IN-SERVICE` state and the AERM function is in the `IDLE` state.

New State

The new state of the AERM function is the `IN-SERVICE` state.

Response

This primitive does not require receipt acknowledgement.

- **Successful:** When successful, the primitive does not require receipt acknowledgement. The AERM function is moved to the `IN-SERVICE` state.

– **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a `LMI_ERROR_ACK` primitive containing the error and reason for failure. The state remains unchanged.

When the signalling terminal is in the `LMI_ENABLED` management state, the DAEDR is in the `IN-SERIVCE` state and the AERM is already in the `IN-SERVICE` state, this service primitive should be ignored without generating a non-fatal error. Some STDS providers may generate a non-fatal error when the SUERM/EIM function is not in the `IDLE` state.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.3.2 SDT_AERM_SET_TI_TO_TIN_REQ

Description

The AERM set Ti to Tin request service primitive is originated by the SDTS user to request that the normal proving period be used for the current or next initial alignment error rate monitoring. This primitive is a request from the Initial Alignment Control (IAC) function in the SDTS user to the AERM function in the SDTS provider.

Format

The AERM set Ti to Tin request service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_aerm_set_ti_to_tin_req_t;
```

Parameters

The AERM set Ti to Tin request service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_AERM_SET_TI_TO_TIN_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state but may be issued in any signalling terminal state.

New State

The new state remains unchanged and normal proving is asserted.

Response

This primitive does not require receipt acknowledgement.

- **Successful:** When successful, the primitive does not require receipt acknowledgement. The link state is unchanged.
- **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a `LMI_ERROR_ACK` primitive containing the error and reason for failure. The state remains unchanged.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.3.3 SDT_AERM_SET_TI_TO_TIE_REQ

Description

The AERM set Ti to Tie request service primitive is originated by the SDTS user to request that the emergency proving period be used for the current or next initial alignment error rate monitoring. This primitive is a request from the Initial Alignment Control (IAC) function in the SDTS user to the AERM function in the SDTS provider.

Format

The AERM set Ti to Tie request service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_aerm_set_ti_to_tie_req_t;
```

Parameters

The AERM set Ti to Tie request service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_AERM_SET_TI_TO_TIE_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state but may be issued in any signalling terminal state.

New State

The new state is unchanged and emergency proving is asserted.

Response

This primitive does not require receipt acknowledgement.

- **Successful:** When successful, the primitive does not require receipt acknowledgement. The link state is unchanged.
- **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a `LMI_ERROR_ACK` primitive containing the error and reason for failure. The state remains unchanged.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.3.4 SDT_IAC_CORRECT_SU_IND

Description

The IAC correct SU indication service primitive is issued by the SDTS provider during the intial alignment phase to indicate that a correct signal unit has been received. Some STDS user state machines require this primitive; others can use the `SDT_RC_SIGNAL_UNIT_IND` primitive in its stead. This primitive is an indication from the AERM function in the SDTS provider to the Initial Alignment Control (IAC) function in the SDTS user.

Format

The IAC correct SU indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_iac_correct_su_ind_t;
```

Parameters

The IAC correct SU indication service primitive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_IAC_CORRECT_SU_IND`.

State

This primitive is only issued from the `LMI_ENABLED` management state and when the DAEDR function is in the `IN-SERVICE` state and the AERM function is in the `IN-SERVICE` state. It is only issued for the first correct signal unit received in this total state.

New State

The new state remains unchanged.

Rules

The SDTS provider observes the following rules when issuing the IAC correct SU indication service primitive:

- The primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state.
- The primitive is only issued when the DEADR function is in the `IN-SERVICE` state.
- The primitive is only issued when the AERM function is in the `IN-SERVICE` state.
- The primitive is only issued for the first correct signal unit that is received in the appropriate states.
- Whether the primitive is issued in the appropriate state is SDTS provider-specific. Some SDTS providers may need configuration options set before this primitive will be issued. The SDTS user should be prepared to use a `SDT_RC_SIGNAL_UNIT_IND` primitive in its stead.

Response

This primitive does not require a specific response from the SDTS user.

4.2.3.5 SDT_IAC_ABORT_PROVING_IND

Description

The IAC abort proving indication service primitive is issued by the SDTS provider to indicate that the error rate experience on the signalling data link has exceeded the operating threshold. This primitive is an indication from the AERM function in the SDTS provider to the Initial Alignment Control (IAC) function in the SDTS user.

Format

The IAC abort proving indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_iac_abort_proving_ind_t;
```

Parameters

The IAC abort proving indication service primitive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_IAC_ABORT_PROVING_IND`.

State

This primitive is only issued from the `LMI_ENABLED` management state with the DAEDR function in the `IN-SERIVCE` state and the AERM function in the `IN-SERVICE` state.

New State

The new AERM state is `IDLE`.

Rules

The SDTS provider observes the following rules when issuing the IAC abort proving indication service primitive:

- The primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state.
- The primitive is only issued when the DAEDR function is in the `IN-SERVICE` state.
- The primitive is only issued when the AERM function is in the `IN-SERVICE` state. After issuing the primitive the AERM is placed into the `IDLE` state.
- The primitive is only issued from the appropriate state when the error rate is detected as exceeding the operating threshold. The setting of the operating threshold is a SDTS provider-specific configuration matter.
- Not all SDTS providers have a fully functional AERM. Some providers may never issue this primitive.

Response

This primitive does not require a response from the SDTS user.

4.2.3.6 SDT_AERM_STOP_REQ

Description

The AERM stop request service primitive is originated by the SDTS user to request that the AERM function be stopped (moved to the IDLE state). This primitive is a request from the Initial Alignment Control (IAC) function in the SDTS user to the AERM function in the SDTS provider.

Format

The AERM stop request service primitive consists of one M_PROTO message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_aerm_stop_req_t;
```

Parameters

The AERM stop request service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always SDT_AERM_STOP_REQ.

State

This primitive is only valid in the LMI_ENABLED management state with the DAEDR function in the IN-SERVICE state and the AERM function in the IN-SERVICE state.

New State

The new state of the AERM function is the IDLE state.

Response

This primitive does not require receipt acknowledgement.

- **Successful:** When successful, the primitive does not require receipt acknowledgement. The AERM state is moved to the IDLE state.
- **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider negatively acknowledges the primitive using a LMI_ERROR_ACK primitive containing the error and reason for failure. The state remains unchanged.

When the signalling terminal is in the LMI_ENABLED management state and the AERM function is already in the IDLE state, this primitive should be ignored and no non-fatal error generated.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

[LMI_UNSPEC]
: Unknown or unspecified.

[LMI_BADPRIM]
: Unrecognized primitive.

[LMI_DISC]
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event occurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_INITFAILED]`
: Link initialization failed.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.4 Error Rate Monitoring Service Primitives

The error rate monitoring service primitives perform the functions of the Signal Unit Error Rate Monitor (SUERM) or Errored Interval Monitor (EIM). They provide the SDTS user with the ability to start and stop the SUERM/EIM, and receive indications that the error rate has exceeded the operating threshold.

Not all SDTS providers implement nor require a SUERM/EIM function. Regardless of whether the SUERM/EIM function is necessary or not, each SDTS provider should be prepared to handle requests and generate appropriate indications as though a SUERM or EIM function existed, and without generating non-fatal errors.

Note that some designs do no permit the AERM function and the SUERM or EIM function to be active simultaneously.

These service primitives implement the error rate monitoring service (see Section 3.2.4 [Error Rate Monitoring Service], page 20).

4.2.4.1 SDT_SUERM_START_REQ

Description

This SDTS user originated primitive is used to start the Signal Unit Error Rate Monitor (SUERM) or Errorred Interval Monitor (EIM) service. This primitive is a request from the Link State Control (LSC) function in the SDTS user to the SUERM/EIM function in the SDTS provider.

Format

The SUERM start service primitive consists of one `M_PROTO` or `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_suerm_start_req_t;
```

Parameters

The SUERM start service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_SUERM_START_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state, when the DAEDR is in the `IN-SERVICE` state, when the AERM is in the `IDLE` state and when the SUERM/EIM is in the `IDLE` state.

New State

The new management state remains unchanged. The state of the SUERM is moved to `IN-SERVICE` state.

Response

This service primitive is not acknowledged, but can cause a non-fatal error as follows:

- **Successful:** When successful, the primitive is not acknowledged. The SUERM/EIM function is moved to the `IN-SERVICE` state.

– **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider responds with a `LMI_ERROR_ACK` primitive containing the error.

When the signalling terminal is in the `LMI_ENABLED` state and the SUERM/EIM function is already in the `IN-SERVICE` state, this primitive should be ignored without generating a non-fatal error.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event ocurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.4.2 SDT_LSC_LINK_FAILURE_IND

Description

This SDTS provider originated primitive is issued by the SDTS provider while the SUERM/EIM service is active to indicate that the error rate monitor has detected errors that exceed the configured threshold and that the link should be failed for execessive errors. This primitive is an indication from the SUERM/EIM function in the SDTS provider to the Link State Control (LSC) function in the SDTS user.

Format

The link failure indication service primitive consists of one `M_PROTO` or `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_lsc_link_failure_ind_t;
```

Parameters

The link failure service primitive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_LSC_LINK_FAILURE_IND`.

State

This primitive will only be issued when the signalling terminal is in the `LMI_ENABLED` management state and the SUERM/EIM is in the `IN-SERVICE` state.

New State

The new state for the SUERM is the `IDLE` state.

Rules

The following rules apply to the link failure indication service primitive:

— The SDTS provider will only issue an `SDT_LSC_LINK_FAILURE_IND` primitive while the SUERM or EIM is in the `IN-SERVICE` state and the monitored error rate exceeds the operating threshold configured for the error monitor. After issuing the primitive, the SUERM is placed in the `IDLE` state.

— Not all STDS providers have a fully functional SUERM/EIM. Some providers may never issue this primitive.

Response

This primitive does not require a response from the SDTS user.

4.2.4.3 SDT_SUERM_STOP_REQ

Description

This SDTS user originated primitive is used to stop the Signal Unit Error Rate Monitor (SUERM) or Errorred Interval Monitor (EIM) service. This primitive is a request from the Link State Control (LSC) function in the SDTS user to the SUERM/EIM function in the SDTS provider.

Format

The SUERM stop service primitive consists of one `M_PROTO` or `M_PCPROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_suerm_stop_req_t;
```

Parameters

The SUERM stop service primitive contains the following parameters:

sdt_primitive
: Specifies the service primitive type. Always `SDT_SUERM_STOP_REQ`.

State

This primitive is only valid in the `LMI_ENABLED` management state, and when the SUERM/EIM is in the `IN-SERVICE` state.

New State

The state of the SUERM/EIM is moved to `IDLE` state.

Response

This service primitive is not acknowledged, but can cause a non-fatal error as follows:

- **Successful:** When successful, the primitive is not acknowledged. The SUERM function is moved to the `IDLE` state.
- **Unsuccessful (non-fatal errors):** When unsuccessful, the SDTS provider responds with a `LMI_ERROR_ACK` primitive containing the error. The state remains unchanged.

When the signalling terminal is in the `LMI_ENABLED` management state and the SUERM/EIM is already in the `IDLE` state, this primitive should be ignored without generating a non-fatal error.

Reason for Failure

Non-Fatal Errors: applicable non-fatal errors are as follows:

`[LMI_UNSPEC]`
: Unknown or unspecified.

`[LMI_BADPRIM]`
: Unrecognized primitive.

`[LMI_DISC]`
: Disconnected.

`[LMI_EVENT]`
: Protocol-specific event ocurred.

`[LMI_FATALERR]`
: Device has become unusable.

`[LMI_NOTSUPP]`
: Primitive not supported by this device.

`[LMI_OUTSTATE]`
: Primitive was issued from invalid state.

`[LMI_PROTOSHORT]`
: `M_PROTO` block too short.

`[LMI_SYSERR]`
: UNIX system error.

`[LMI_FORMAT]`
: Format error detected.

`[LMI_DEVERR]`
: Start of device-specific error codes.

4.2.5 Receive Congestion Service Primitives

The receive congestion service primitives provide the SDTS user with the ability to be informed by the SDTS provider when it detects receive congestion conditions and can determine a receive congestion policy. Receive congestion is a provider-specific matter. The SDTS user is also capable of detecting receive congestion without the assistance of these primitives. They are used to indicate receive congestion to the SDTS user that can only be detected within the SDTS provider.

These service primitives implement the receive congestion service (see Section 3.2.5 [Receive Congestion Service], page 21).

4.2.5.1 SDT_RC_CONGESTION_ACCEPT_IND

Description

The RC convestion accept indication service primitive is indicated by the SDTS provider when it is experiencing receive congestion but signal units continue to be delivered by the SDTS provider. This primitive is an indication from a provider-specific function in the SDTS provider to the Reception Control (RC) function in the SDTS user.

Format

The RC congestion accept indication service primtive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_rc_congestion_accept_ind_t;
```

Parameters

The RC congestion accept indication service primtive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_RC_CONGESTION_ACCEPT_IND`.

State

This primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state and the DAEDR function is in the `IN-SERVICE` state.

New State

The receive congestion state is moved to `CONGESTION-ACCEPT`.

Rules

The SDTS provider observes the following rules when issuing the RC congestion accept service primitive:

— This primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state, the DAEDR function is in the `IN-SERVICE` state, and the SDTS provider has detected receive congestion but is not discarding signal units.

— Not all SDTS providers have a fully functional receive congestion function. Some SDTS providers may never generate this primitive.

Response

This primitive does not require a response from the SDTS user.

4.2.5.2 SDT_RC_CONGESTION_DISCARD_IND

Description

The RC convestion discard indication service primitive is indicated by the SDTS provider when it is experiencing receive congestion and signal units are being discarded by the SDTS provider. This primitive is an indication from a provider-specific function in the SDTS provider to the Reception Control (RC) function in the SDTS user.

Format

The RC congestion discard indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_rc_congestion_discard_ind_t;
```

Parameters

The RC congestion discard indication service primitive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_RC_CONGESTION_DISCARD_IND`.

State

This primitive is only issued from the `LMI_ENABLED` management state.

New State

The receive congestion state is moved to `CONGESTION-DISCARD`.

Rules

The SDTS provider observes the following rules when issuing the RC congestion discard service primitive:

— This primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state, the DAEDR function is in the `IN-SERVICE` state, and the SDTS provider has detected receive congestion and is discarding signal units.

— Not all SDTS providers have a fully functional receive congestion function. Some SDTS providers may never generate this primitive.

Response

This primitive does not require a response from the SDTS user.

4.2.5.3 SDT_RC_NO_CONGESTION_IND

Description

This SDTS provider originated primitive This primitive is an indication from a provider-specific function in the SDTS provider to the Reception Control (RC) function in the SDTS user.

Format

The RC no congestion indication service primitive consists of one `M_PROTO` message block, structured as follows:

```
typedef struct {
    sdt_long sdt_primitive;
} sdt_rc_no_congestion_ind_t;
```

Parameters

The RC no congestion indication service primitive contains the following parameters:

sdt_primitive
: Indicates the service primitive type. Always `SDT_RC_NO_CONGESTION_IND`.

State

This primitive is only issued from the `LMI_ENABLED` management state.

New State

The receive congestion state is moved to `NO-CONGESTION`.

Rules

The SDTS provider observes the following rules when issuing the RC no congestion service primitive:

- This primitive is only issued when the signalling terminal is in the `LMI_ENABLED` management state, the DAEDR function is in the `IN-SERVICE` state, and the SDTS provider has detected that receive congestion has abated.
- Not all SDTS providers have a fully functional receive congestion function. Some SDTS providers may never generate this primitive.

Response

This primitive does not require a response from the SDTS user.

5 Diagnostics Requirements

Two error handling facilities should be provided to the SDTS user: one to handle non-fatal errors, and the other to handle fatal errors.

5.1 Non-Fatal Error Handling Facility

These are errors that do not change the state of the SDTS interface as seen by the SDTS user and provide the user with the option of reissuing the SDT primitive with the corrected options specification. The non-fatal error handling is provided only to those primitives that require acknowledgements, and uses the `LMI_ERROR_ACK` to report these errors. These errors retain the state of the SDTS interface the same as it was before the SDT provider received the primitive that was in error. Syntax errors and rule violations are reported via the non-fatal error handling facility.

5.2 Fatal Error Handling Facility

These errors are issued by the SDT provider when it detects errors that are not correctable by the SDT user, or if it is unable to report a correctible error to the SDTS user. Fatal errors are indicated via the STREAMS message type `M_ERROR` with the UNIX system error `EPROTO`. The `M_ERROR` STREAMS message type will result in the failure of all the UNIX system calls on the stream. The SDTS user can recover from a fatal error by having all the processes close the files associated with the stream, and then reopening them for processing.

Appendix A LMI Header File Listing

```
#ifndef __LMI_H__
#define __LMI_H__

#define LMI_PROTO_BASE            16L

#define LMI_DSTR_FIRST          ( 1L + LMI_PROTO_BASE )
#define LMI_INFO_REQ            ( 1L + LMI_PROTO_BASE )
#define LMI_ATTACH_REQ          ( 2L + LMI_PROTO_BASE )
#define LMI_DETACH_REQ          ( 3L + LMI_PROTO_BASE )
#define LMI_ENABLE_REQ          ( 4L + LMI_PROTO_BASE )
#define LMI_DISABLE_REQ         ( 5L + LMI_PROTO_BASE )
#define LMI_OPTMGMT_REQ         ( 6L + LMI_PROTO_BASE )
#define LMI_DSTR_LAST           ( 6L + LMI_PROTO_BASE )

#define LMI_USTR_LAST           (-1L - LMI_PROTO_BASE )
#define LMI_INFO_ACK            (-1L - LMI_PROTO_BASE )
#define LMI_OK_ACK              (-2L - LMI_PROTO_BASE )
#define LMI_ERROR_ACK           (-3L - LMI_PROTO_BASE )
#define LMI_ENABLE_CON          (-4L - LMI_PROTO_BASE )
#define LMI_DISABLE_CON         (-5L - LMI_PROTO_BASE )
#define LMI_OPTMGMT_ACK         (-6L - LMI_PROTO_BASE )
#define LMI_ERROR_IND           (-7L - LMI_PROTO_BASE )
#define LMI_STATS_IND           (-8L - LMI_PROTO_BASE )
#define LMI_EVENT_IND           (-9L - LMI_PROTO_BASE )
#define LMI_USTR_FIRST          (-9L - LMI_PROTO_BASE )

#define LMI_UNATTACHED          1L      /* No PPA attached, awating LMI_ATTACH_REQ */
#define LMI_ATTACH_PENDING      2L      /* Waiting for attach */
#define LMI_UNUSABLE            3L      /* Device cannot be used, STREAM in hung state */
#define LMI_DISABLED            4L      /* PPA attached, awaiting LMI_ENABLE_REQ */
#define LMI_ENABLE_PENDING      5L      /* Waiting to send LMI_ENABLE_CON */
#define LMI_ENABLED             6L      /* Ready for use, awaiting primtiive exchange */
#define LMI_DISABLE_PENDING     7L      /* Waiting to send LMI_DISABLE_CON */
#define LMI_DETACH_PENDING      8L      /* Waiting for detach */

/*
 *  LMI_ERROR_ACK and LMI_ERROR_IND reason codes
 */
#define LMI_UNSPEC              0x00000000      /* Unknown or unspecified */
#define LMI_BADADDRESS          0x00010000      /* Address was invalid */
#define LMI_BADADDRTYPE         0x00020000      /* Invalid address type */
#define LMI_BADDIAL             0x00030000      /* (not used) */
#define LMI_BADDIALTYPE         0x00040000      /* (not used) */
#define LMI_BADDISPOSAL         0x00050000      /* Invalid disposal parameter */
#define LMI_BADFRAME            0x00060000      /* Defective SDU received */
#define LMI_BADPPA              0x00070000      /* Invalid PPA identifier */
#define LMI_BADPRIM             0x00080000      /* Unregognized primitive */
#define LMI_DISC                0x00090000      /* Disconnected */
#define LMI_EVENT               0x000a0000      /* Protocol-specific event ocurred */
#define LMI_FATALERR            0x000b0000      /* Device has become unusable */
#define LMI_INITFAILED          0x000c0000      /* Link initialization failed */
#define LMI_NOTSUPP             0x000d0000      /* Primitive not supported by this device */
#define LMI_OUTSTATE            0x000e0000      /* Primitive was issued from invalid state */
```

```
#define LMI_PROTOSHORT          0x000f0000      /* M_PROTO block too short */
#define LMI_SYSERR              0x00100000      /* UNIX system error */
#define LMI_WRITEFAIL           0x00110000      /* Unitdata request failed */
#define LMI_CRCERR              0x00120000      /* CRC or FCS error */
#define LMI_DLE_EOT             0x00130000      /* DLE EOT detected */
#define LMI_FORMAT              0x00140000      /* Format error detected */
#define LMI_HDLC_ABORT          0x00150000      /* Aborted frame detected */
#define LMI_OVERRUN             0x00160000      /* Input overrun */
#define LMI_TOOSHORT            0x00170000      /* Frame too short */
#define LMI_INCOMPLETE          0x00180000      /* Partial frame received */
#define LMI_BUSY                0x00190000      /* Telephone was busy */
#define LMI_NOANSWER            0x001a0000      /* Connection went unanswered */
#define LMI_CALLREJECT          0x001b0000      /* Connection rejected */
#define LMI_HDLC_IDLE           0x001c0000      /* HDLC line went idle */
#define LMI_HDLC_NOTIDLE        0x001d0000      /* HDLC link no longer idle */
#define LMI_QUIESCENT           0x001e0000      /* Line being reassigned */
#define LMI_RESUMED             0x001f0000      /* Line has been reassigned */
#define LMI_DSRTIMEOUT          0x00200000      /* Did not see DSR in time */
#define LMI_LAN_COLLISIONS      0x00210000      /* LAN excessive collisions */
#define LMI_LAN_REFUSED         0x00220000      /* LAN message refused */
#define LMI_LAN_NOSTATION       0x00230000      /* LAN no such station */
#define LMI_LOSTCTS             0x00240000      /* Lost Clear to Send signal */
#define LMI_DEVERR              0x00250000      /* Start of device-specific error codes */

typedef signed int lmi_long;
typedef unsigned int lmi_ulong;
typedef unsigned short lmi_ushort;
typedef unsigned char lmi_uchar;

/*
 *  LOCAL MANAGEMENT PRIMITIVES
 */

/*
   LMI_INFO_REQ, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_INFO_REQ */
} lmi_info_req_t;

/*
   LMI_INFO_ACK, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_INFO_ACK */
        lmi_ulong lmi_version;
        lmi_ulong lmi_state;
        lmi_ulong lmi_max_sdu;
        lmi_ulong lmi_min_sdu;
        lmi_ulong lmi_header_len;
        lmi_ulong lmi_ppa_style;
        lmi_ulong lmi_ppa_length;
        lmi_ulong lmi_ppa_offset;
        lmi_ulong lmi_prov_flags;       /* provider specific flags */
```

```
        lmi_ulong lmi_prov_state;       /* provider specific state */
        lmi_uchar lmi_ppa_addr[0];
} lmi_info_ack_t;

#define LMI_VERSION_1       1
#define LMI_VERSION_2       2
#define LMI_CURRENT_VERSION LMI_VERSION_2

/*
 *  LMI provider style.
 *
 *  The LMI provider style which determines whether a provider requires an
 *  LMI_ATTACH_REQ to inform the provider which PPA user messages should be
 *  sent/received on.
 */
#define LMI_STYLE1      0x00    /* PPA is implicitly bound by open(2) */
#define LMI_STYLE2      0x01    /* PPA must be explicitly bound via STD_ATTACH_REQ */

/*
   LMI_ATTACH_REQ, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_ATTACH_REQ */
        lmi_ulong lmi_ppa_length;
        lmi_ulong lmi_ppa_offset;
        lmi_uchar lmi_ppa[0];
} lmi_attach_req_t;

/*
   LMI_DETACH_REQ, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_DETACH_REQ */
} lmi_detach_req_t;

/*
   LMI_ENABLE_REQ, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_ENABLE_REQ */
        lmi_ulong lmi_rem_length;
        lmi_ulong lmi_rem_offset;
        lmi_uchar lmi_rem[0];
} lmi_enable_req_t;

/*
   LMI_DISABLE_REQ, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_DISABLE_REQ */
} lmi_disable_req_t;
```

```
/*
   LMI_OK_ACK, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_OK_ACK */
        lmi_long lmi_correct_primitive;
        lmi_ulong lmi_state;
} lmi_ok_ack_t;

/*
   LMI_ERROR_ACK, M_CTL
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_ERROR_ACK */
        lmi_ulong lmi_errno;
        lmi_ulong lmi_reason;
        lmi_long lmi_error_primitive;
        lmi_ulong lmi_state;
} lmi_error_ack_t;

/*
   LMI_ENABLE_CON, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_ENABLE_CON */
        lmi_ulong lmi_state;
} lmi_enable_con_t;

/*
   LMI_DISABLE_CON, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_DISABLE_CON */
        lmi_ulong lmi_state;
} lmi_disable_con_t;

/*
   LMI_OPTMGMT_REQ, M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_OPTMGMT_REQ */
        lmi_ulong lmi_opt_length;
        lmi_ulong lmi_opt_offset;
        lmi_ulong lmi_mgmt_flags;
} lmi_optmgmt_req_t;

/*
   LMI_OPTMGMT_ACK, M_PCPROTO
 */

typedef struct {
```

```
        lmi_long lmi_primitive;         /* LMI_OPMGMT_ACK */
        lmi_ulong lmi_opt_length;
        lmi_ulong lmi_opt_offset;
        lmi_ulong lmi_mgmt_flags;
} lmi_optmgmt_ack_t;

#undef LMI_DEFAULT

#define LMI_NEGOTIATE           0x0004
#define LMI_CHECK               0x0008
#define LMI_DEFAULT             0x0010
#define LMI_SUCCESS             0x0020
#define LMI_FAILURE             0x0040
#define LMI_CURRENT             0x0080
#define LMI_PARTSUCCESS         0x0100
#define LMI_READONLY            0x0200
#define LMI_NOTSUPPORT          0x0400

/*
   LMI_ERROR_IND, M_PROTO or M_PCPROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_ERROR_IND */
        lmi_ulong lmi_errno;
        lmi_ulong lmi_reason;
        lmi_ulong lmi_state;
} lmi_error_ind_t;

/*
   LMI_STATS_IND, M_PROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_STATS_IND */
        lmi_ulong lmi_interval;
        lmi_ulong lmi_timestamp;
} lmi_stats_ind_t;

/*
   LMI_EVENT_IND, M_PROTO
 */

typedef struct {
        lmi_long lmi_primitive;         /* LMI_EVENT_IND */
        lmi_ulong lmi_objectid;
        lmi_ulong lmi_timestamp;
        lmi_ulong lmi_severity;
} lmi_event_ind_t;

union LMI_primitive {
        lmi_long lmi_primitive;
        lmi_ok_ack_t ok_ack;
        lmi_error_ack_t error_ack;
        lmi_error_ind_t error_ind;
        lmi_stats_ind_t stats_ind;
```

```
        lmi_event_ind_t event_ind;
};

union LMI_primitives {
        lmi_long lmi_primitive;
        lmi_info_req_t info_req;
        lmi_info_ack_t info_ack;
        lmi_attach_req_t attach_req;
        lmi_detach_req_t detach_req;
        lmi_enable_req_t enable_req;
        lmi_disable_req_t disable_req;
        lmi_ok_ack_t ok_ack;
        lmi_error_ack_t error_ack;
        lmi_enable_con_t enable_con;
        lmi_disable_con_t disable_con;
        lmi_error_ind_t error_ind;
        lmi_stats_ind_t stats_ind;
        lmi_event_ind_t event_ind;
        lmi_optmgmt_req_t optmgmt_req;
        lmi_optmgmt_ack_t optmgmt_ack;
};

#define LMI_INFO_REQ_SIZE       sizeof(lmi_info_req_t)
#define LMI_INFO_ACK_SIZE       sizeof(lmi_info_ack_t)
#define LMI_ATTACH_REQ_SIZE     sizeof(lmi_attach_req_t)
#define LMI_DETACH_REQ_SIZE     sizeof(lmi_detach_req_t)
#define LMI_ENABLE_REQ_SIZE     sizeof(lmi_enable_req_t)
#define LMI_DISABLE_REQ_SIZE    sizeof(lmi_disable_req_t)
#define LMI_OK_ACK_SIZE         sizeof(lmi_ok_ack_t)
#define LMI_ERROR_ACK_SIZE      sizeof(lmi_error_ack_t)
#define LMI_ENABLE_CON_SIZE     sizeof(lmi_enable_con_t)
#define LMI_DISABLE_CON_SIZE    sizeof(lmi_disable_con_t)
#define LMI_ERROR_IND_SIZE      sizeof(lmi_error_ind_t)
#define LMI_STATS_IND_SIZE      sizeof(lmi_stats_ind_t)
#define LMI_EVENT_IND_SIZE      sizeof(lmi_event_ind_t)

typedef struct lmi_opthdr {
        lmi_ulong level;
        lmi_ulong name;
        lmi_ulong length;
        lmi_ulong status;
        lmi_uchar value[0];
        /*
           followed by option value
         */
} lmi_opthdr_t;

#define LMI_LEVEL_COMMON        '\0'
#define LMI_LEVEL_SDL           'd'
#define LMI_LEVEL_SDT           't'
#define LMI_LEVEL_SL            'l'
#define LMI_LEVEL_SLS           's'
#define LMI_LEVEL_MTP           'M'
#define LMI_LEVEL_SCCP          'S'
#define LMI_LEVEL_ISUP          'I'
#define LMI_LEVEL_TCAP          'T'
```

```
#define LMI_OPT_PROTOCOL        1       /* use struct lmi_option */
#define LMI_OPT_STATISTICS      2       /* use struct lmi_sta */

#endif                          /* __LMI_H__ */
```

Appendix B SDTI Header File Listing

```
#ifndef __SS7_SDTI_H__
#define __SS7_SDTI_H__

 /*
  * The purpose of the SDT interface is to provide a separation between
  * the SL (Signalling Link) interface which provides SS7 Level 2 (LINK)
  * state machine services and the underlying driver which provides
  * essentially HDLC capablities.    In SS7 the entity providing HDLC
  * services is called the Signalling Data Terminal (SDT).  An SDTI
  * implements the AERM/SUERM/EIM and DAEDR/DAEDT capabilities and
  * communicates upstream to the Signalling Link using the primitives
  * provided here.
  *
  * The SDT interface also recognizes Local Management Interface (LMI)
  * primitives defined elsewhere <sys/ss7/lmi.h>.
  */

typedef lmi_long sdt_long;
typedef lmi_ulong sdt_ulong;
typedef lmi_ushort sdt_ushort;
typedef lmi_uchar sdt_uchar;

#define SDT_PROTO_BASE                          48L

#define SDT_DSTR_FIRST                         ( 1L + SDT_PROTO_BASE)
#define SDT_DAEDT_TRANSMISSION_REQ             ( 1L + SDT_PROTO_BASE)
#define SDT_DAEDT_START_REQ                    ( 2L + SDT_PROTO_BASE)
#define SDT_DAEDR_START_REQ                    ( 3L + SDT_PROTO_BASE)
#define SDT_AERM_START_REQ                     ( 4L + SDT_PROTO_BASE)
#define SDT_AERM_STOP_REQ                      ( 5L + SDT_PROTO_BASE)
#define SDT_AERM_SET_TI_TO_TIN_REQ             ( 6L + SDT_PROTO_BASE)
#define SDT_AERM_SET_TI_TO_TIE_REQ             ( 7L + SDT_PROTO_BASE)
#define SDT_SUERM_START_REQ                    ( 8L + SDT_PROTO_BASE)
#define SDT_SUERM_STOP_REQ                     ( 9L + SDT_PROTO_BASE)
#define SDT_DSTR_LAST                          ( 9L + SDT_PROTO_BASE)

#define SDT_USTR_LAST                          (-1L - SDT_PROTO_BASE)
#define SDT_RC_SIGNAL_UNIT_IND                 (-1L - SDT_PROTO_BASE)
#define SDT_RC_CONGESTION_ACCEPT_IND           (-2L - SDT_PROTO_BASE)
#define SDT_RC_CONGESTION_DISCARD_IND          (-3L - SDT_PROTO_BASE)
#define SDT_RC_NO_CONGESTION_IND               (-4L - SDT_PROTO_BASE)
#define SDT_IAC_CORRECT_SU_IND                 (-5L - SDT_PROTO_BASE)
#define SDT_IAC_ABORT_PROVING_IND              (-6L - SDT_PROTO_BASE)
#define SDT_LSC_LINK_FAILURE_IND               (-7L - SDT_PROTO_BASE)
#define SDT_TXC_TRANSMISSION_REQUEST_IND       (-8L - SDT_PROTO_BASE)
#define SDT_USTR_FIRST                         (-8L - SDT_PROTO_BASE)

/*
 *  STATE
 */
#define SDTS_POWER_OFF                  0
#define SDTS_IDLE                       1
#define SDTS_ABORTED_PROVING            2
```

```
#define SDTS_NORMAL_PROVING             3
#define SDTS_EMERGENCY_PROVING          4
#define SDTS_MONITORING_ERRORS          5
#define SDTS_MONITORING                 6

/*
 *  FLAGS
 */
#define SDTF_DAEDT_ACTIVE               (1<<0)
#define SDTF_DAEDR_ACTIVE               (1<<1)
#define SDTF_AERM_ACTIVE                (1<<2)
#define SDTF_SUERM_ACTIVE               (1<<3)

/*
 *  SDT_RC_SIGNAL_UNIT_IND, M_DATA or M_PROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_RC_SIGNAL_UNIT_IND */
        sdt_ulong sdt_count;
} sdt_rc_signal_unit_ind_t;

/*
 *  SDT_DAEDT_TRANSMISSION_REQ, M_DATA or M_PROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_DAEDT_TRANSMISSION_REQ */
} sdt_daedt_transmission_req_t;

/*
 *  SDT_DAEDT_START_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_DAEDT_START_REQ */
} sdt_daedt_start_req_t;

/*
 *  SDT_DAEDR_START_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_DAEDR_START_REQ */
} sdt_daedr_start_req_t;

/*
 *  SDT_IAC_CORRECT_SU_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_IAC_CORRECT_SU_IND */
} sdt_iac_correct_su_ind_t;

/*
 *  SDT_AERM_START_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_AERM_START_REQ */
} sdt_aerm_start_req_t;
```

```
/*
 *  SDT_AERM_STOP_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_AERM_STOP_REQ */
} sdt_aerm_stop_req_t;

/*
 *  SDT_AERM_SET_TI_TO_TIN_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_AERM_SET_TI_TO_TIN_REQ */
} sdt_aerm_set_ti_to_tin_req_t;

/*
 *  SDT_AERM_SET_TI_TO_TIE_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_AERM_SET_TI_TO_TIE_REQ */
} sdt_aerm_set_ti_to_tie_req_t;

/*
 *  SDT_IAC_ABORT_PROVING_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_IAC_ABORT_PROVING_IND */
} sdt_iac_abort_proving_ind_t;

/*
 *  SDT_SUERM_START_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_SUERM_START_REQ */
} sdt_suerm_start_req_t;

/*
 *  SDT_SUERM_STOP_REQ, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_SUERM_STOP_REQ */
} sdt_suerm_stop_req_t;

/*
 *  SDT_LSC_LINK_FAILURE_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_LSC_LINK_FAILURE_IND */
} sdt_lsc_link_failure_ind_t;

/*
 *  SDT_RC_CONGESTION_ACCEPT_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_RC_CONGESTION_ACCEPT_IND */
} sdt_rc_congestion_accept_ind_t;
```

```
/*
 *  SDT_RC_CONGESTION_DISCARD_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_RC_CONGESTION_DISCARD_IND */
} sdt_rc_congestion_discard_ind_t;

/*
 *  SDT_RC_NO_CONGESTION_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_RC_NO_CONGESTION_IND */
} sdt_rc_no_congestion_ind_t;

/*
 *  SDT_TXC_TRANSMISSION_REQUEST_IND, M_PROTO or M_PCPROTO
 */
typedef struct {
        sdt_long sdt_primitive;         /* SDT_TXC_TRANSMISSION_REQUEST_IND */
} sdt_txc_transmission_request_ind_t;

union SDT_primitives {
        sdt_long sdt_primitive;
        sdt_daedt_transmission_req_t daedt_transmission_req;
        sdt_daedt_start_req_t daedt_start_req;
        sdt_daedr_start_req_t daedr_start_req;
        sdt_aerm_start_req_t aerm_start_req;
        sdt_aerm_stop_req_t aerm_stop_req;
        sdt_aerm_set_ti_to_tin_req_t aerm_set_ti_to_tin_req;
        sdt_aerm_set_ti_to_tie_req_t aerm_set_ti_to_tie_req;
        sdt_suerm_start_req_t suerm_start_req;
        sdt_suerm_stop_req_t suerm_stop_req;
        sdt_rc_signal_unit_ind_t rc_signal_unit_ind;
        sdt_rc_congestion_accept_ind_t rc_congestion_accept_ind;
        sdt_rc_congestion_discard_ind_t rc_congestion_discard_ind;
        sdt_rc_no_congestion_ind_t rc_no_congestion_ind;
        sdt_iac_correct_su_ind_t iac_correct_su_ind;
        sdt_iac_abort_proving_ind_t iac_abort_proving_ind;
        sdt_lsc_link_failure_ind_t lsc_link_failure_ind;
        sdt_txc_transmission_request_ind_t txc_transmission_request_ind;
};

#define SDT_DAEDT_TRANSMISSION_REQ_SIZE         sizeof(sdt_daedt_transmission_req_t)
#define SDT_DAEDR_START_REQ_SIZE                sizeof(sdt_daedr_start_req_t)
#define SDT_DAEDT_START_REQ_SIZE                sizeof(sdt_daedt_start_req_t)
#define SDT_AERM_START_REQ_SIZE                 sizeof(sdt_aerm_start_req_t)
#define SDT_AERM_STOP_REQ_SIZE                  sizeof(sdt_aerm_stop_req_t)
#define SDT_AERM_SET_TI_TO_TIN_REQ_SIZE         sizeof(sdt_aerm_set_ti_to_tin_req_t)
#define SDT_AERM_SET_TI_TO_TIE_REQ_SIZE         sizeof(sdt_aerm_set_ti_to_tie_req_t)
#define SDT_SUERM_START_REQ_SIZE                sizeof(sdt_suerm_start_req_t)
#define SDT_SUERM_STOP_REQ_SIZE                 sizeof(sdt_suerm_stop_req_t)
#define SDT_RC_SIGNAL_UNIT_IND_SIZE             sizeof(sdt_rc_signal_unit_ind_t)
#define SDT_RC_CONGESTION_ACCEPT_IND_SIZE       sizeof(sdt_rc_congestion_accept_ind_t)
#define SDT_RC_CONGESTION_DISCARD_IND_SIZE      sizeof(sdt_rc_congestion_discard_ind_t)
#define SDT_RC_NO_CONGESTION_IND_SIZE           sizeof(sdt_rc_no_congestion_ind_t)
#define SDT_IAC_CORRECT_SU_IND_SIZE             sizeof(sdt_iac_correct_su_ind_t)
```

```
#define SDT_IAC_ABORT_PROVING_IND_SIZE          sizeof(sdt_iac_abort_proving_ind_t)
#define SDT_LSC_LINK_FAILURE_IND_SIZE           sizeof(sdt_lsc_link_failure_ind_t)
#define SDT_TXC_TRANSMISSION_REQUEST_IND_SIZE   sizeof(sdt_txc_transmission_request_ind_t)

#endif                          /* __SS7_SDTI_H__ */
```

Glossary

Signalling Data Terminal Service Data Unit
: A grouping of SDT user data whose boundaries are preserved from one end of the signalling data terminal connection to the other.

Data transfer
: The phase in connection and connectionless modes that supports the transfer of data between to signalling data terminal users.

SDT provider
: The signalling data terminal layer protocol that provides the services of the signalling data terminal interface.

SDT user
: The user-level application or user-level or kernel-level protocol that accesses the services of the signalling data terminal layer.

Local management
: The phase in connection and connectionless modes in which a SDT user initializes a stream and attaches a PPA address to the stream. Primitives in this phase generate local operations only.

PPA
: The point at which a system attaches itself to a physical communications medium.

PPA identifier
: An identifier of a particular physical medium over which communication transpires.

Acronyms

AERM	Alignment Error Rate Monitor
CC	Congestion Control
DAEDR	Delimitation Alignment and Error Detection (Receive)
DAEDT	Delimitation Alignment and Error Detection (Transmit)
EIM	Errored Interval Monitor
IAC	Initial Alignment Control
ITU-T	International Telecommunications Union - Telecom Sector
LMS Provider	A provider of Local Management Services
LMS	Local Management Service
LMS User	A user of Local Management Services
LM	Local Management
LSC	Link State Control
PPA	Physical Point of Attachment
RC	Reception Control
SDLI	Signalling Data Link Interface
SDL SDU	Signalling Data Link Service Data Unit
SDLS	Signalling Data Link Service
SDL	Signalling Data Link
SDTI	Signalling Data Terminal Interface
SDTS	Signalling Data Terminal Service
SDT	Signalling Data Terminal
SLI	Signalling Link Interface
SLS	Signalling Link Service
SL	Signalling Link
SL	Signalling Link
SS7	Signalling System No. 7
TXC	Transmission Control

References

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[2] ITU-T Recommendation Q.701, *Functional Description of the Message Transfer Part (MTP) of Signalling System No. 7*, March 1993, (Geneva), ITU, ITU-T Telecommunication Standardization Sector of ITU, (Previously "CCITT Recommendation").

[3] ITU-T Recommendation Q.702, *Signalling System No. 7—Signalling Data Link*, March 1993, (Geneva), ITU, ITU-T Telecommunication Standardization Sector of ITU, (Previously "CCITT Recommendation").

[4] ITU-T Recommendation Q.703, *Signalling System No. 7—Signalling Link*, March 1993, (Geneva), ITU, ITU-T Telecommunication Standardization Sector of ITU, (Previously "CCITT Recommendation").

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[6] Geoffrey Gerrietts; Dave Grothe, Mikel Matthews, Dave Healy, *CDI—Application Program Interface Guide*, March 1999, (Savoy, IL), GCOM, Inc.

[7] ITU-T Recommendation Q.771, *Signalling System No. 7—Functional Description of Transaction Capabilities*, March 1993, (Geneva), ITU, ITU-T Telecommunication Standardization Sector of ITU, (Previously "CCITT Recommendation").

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