

Service Access Points (SAP)

Current document describes the Service Access Points (SAPs). Services are provided by lower levels and used by upper levels. Every SAP is named after the level whose services it uses (e.g. C_TIME_SAP).

SAPs consist of a number of Primitives that resemble functions called in software. Primitives are typed messages, with an optional parameter list, that are exchanged between state machines. The following naming suffixes are used for the primitives:

- Request primitive – REQ – requests the level to perform some action;
- Indicate primitive – IND – indicates level that some action is performed in the lower levels of on the other end of link.

SpaceWire SAPs place in the stack

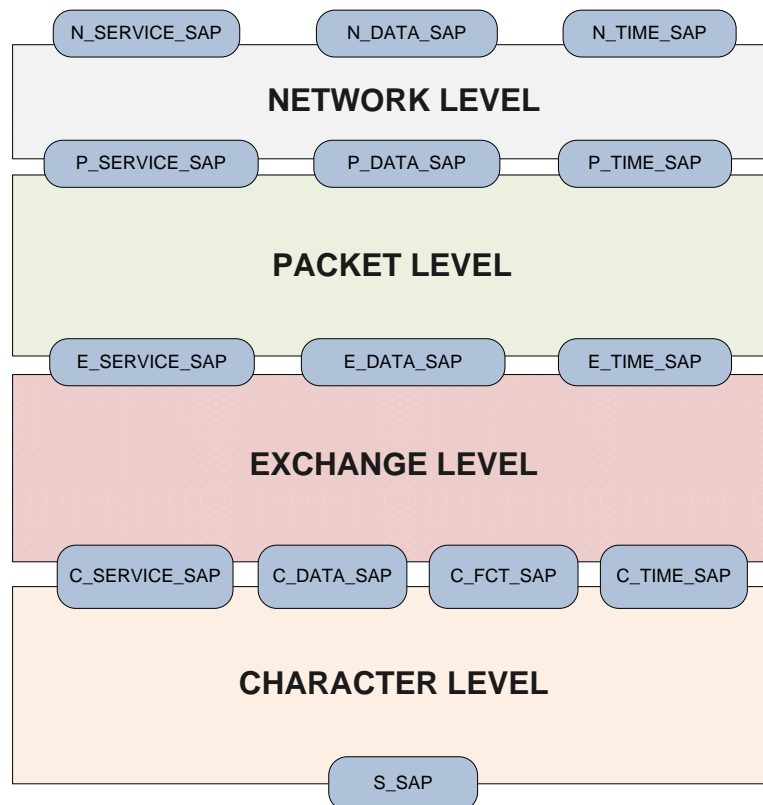


Figure 1. SAPs in a SpaceWire stack (Version 1)

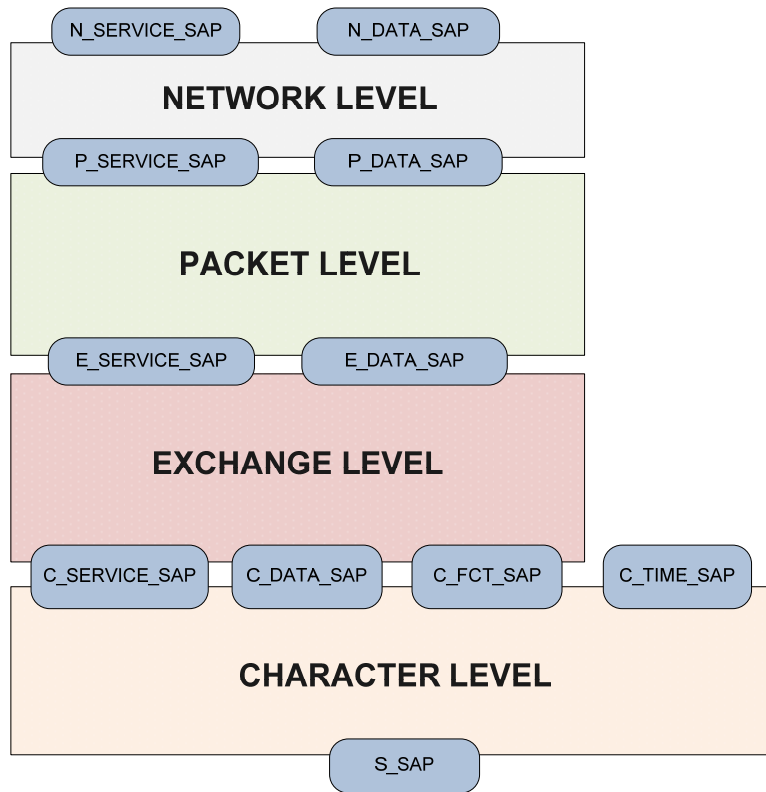


Figure 2. SAPs in a SpaceWire stack (Version 2)

In the current document we use the Version 1. Version 2 is the point for the discussion.

1. C_SAPs

The C_SAPs provide an interconnection between the Character level and the Exchange level by transmitting data from one level to another in both directions. This interconnection is performed by use of primitives, which are used for transmission of the particular data in the corresponding direction

There are four service access points:

- C_TIME_SAP – SAP for transmission of Time-Codes;
- C_DATA_SAP – SAP for transmission of data characters, end of packet markers and NULL codes;
- C_SERVICE_SAP – SAP for transmission of control data and information about errors;
- C_FCT_SAP – SAP for transmission of FCTs.

1.1. C_TIME_SAP

C_TIME_SAP provides Time-Codes transmission between the Character level and the Exchange level in both directions simultaneously. Source application

initiates the transmission of Time-Codes which should be received by the destination application.

C_TIME_SAP Primitives

The primitives covered in this section are listed in Table 1.

Table 1 Summary of C_TIME_SAP Primitive

Name	Request	Indication
C_TimeCode	1.1.1.	1.1.2.

The parameter used for these primitives are defined in Table 2.

Table 2 C_TIME_SAP Primitive Parameter

Name	Type	Value	Description
TimeCode	Byte	0..63	Defines the value of system time to be distributed across the network. Bits number 6 and 7 are control flags

1.1.1. C_TimeCode.req

This primitive is used to send Time-Codes from the Exchange level to the Character level.

The semantics of this primitive are:

C_TimeCode.req (TimeCode)

The parameter used for this primitive is defined in Table 2.

When Generated

The Exchange level shall generate C_TimeCode.req primitive when it has a Time Code to transmit to the Character level.

Effect on receipt

The transmitter of the Character level shall generate a Time-Code and send it on the link. Time-Code shall be formed from ESC followed by a single data character which holds six bit of system time value and two control flags.

1.1.2. C_TimeCode.ind

This primitive is used to send Time-Codes from the Character level to the Exchange level.

The semantics of this primitive are:

C_TimeCode.ind (TimeCode)

The parameter used for this primitive is defined in Table 2.

When Generated

The Character level shall generate C_TimeCode.ind primitive when it has a Time Code to transmit to the Exchange level.

Effect on receipt

If the state machine is in the *Run* state, then the time code shall be passed to the overlying level.

1.2. C_DATA_SAP

C_DATA_SAP provides transmission of data characters, end of packet markers and NULL codes between the Character level and the Exchange level in both directions simultaneously. Source application initiates the transmission of data characters, end of packet markers or NULL codes which should be received by the destination application.

C_DATA_SAP Primitives

The primitives covered in this section are listed in Table 3.

Table 3 Summary of C_DATA_SAP Primitives

Name	Request	Indication
C_Data	1.2.1.	1.2.2.
C_EOP	1.2.3.	1.2.4.
C_EEP	1.2.5.	1.2.6.
C_NULL	1.2.7.	1.2.8.

The parameter used for these primitives is defined in Table 4.

Table 4 C_DATA_SAP Primitive Parameter

Name	Type	Value	Description
Data	Byte	0..255	Data byte

1.2.1. C_Data.req

This primitive is used to send a data character from the Exchange level to the Character level.

The semantics of this primitive are:

C_Data.req (Data)

The parameter used for these primitive is defined in Table 4.

When Generated

The Exchange level shall generate C_Data.req primitive when it has a data character to transmit to the Character level.

Effect on receipt

The Character level shall send a data character on the link if its credit count more than zero. After it the credit count shall be decremented by one.

1.2.2. C_Data.ind

This primitive is used to send a data character from the Character level to the Exchange level.

The semantics of this primitive are:

C_Data.ind (Data)

The parameter used for these primitive is defined in Table 4.

When Generated

The Character level shall generate C_Data.ind primitive when it has data character received from the underlying level.

Effect on receipt

If the state machine is in the *Run* state, then the data character shall be written to the receive buffer.

1.2.3. C_EOP.req

This primitive is used for transmission of an EOP from the Exchange level to the Character level.

The semantics of this primitive are:

C_EOP.req ()

When Generated

The Exchange level shall generate the C_EOP.req primitive to indicate the end of packet.

Effect on receipt

The Character level shall send the EOP on the link if its credit count more than zero. After it the credit count shall be decremented by one.

1.2.4. C_EOP.ind

This primitive is used for transmission of an EOP from the Character level to the Exchange level.

The semantics of this primitive are:

C_EOP.ind ()

When Generated

The Character level shall generate the C_EOP.ind primitive to indicate the end of packet.

Effect on receipt

If the state machine is in the *Run* state, then the EOP shall be written to the receive buffer.

1.2.5. C_EEP.req

This primitive is used for transmission of an EEP from the Exchange level to the Character level.

The semantics of this primitive are:

C_EEP.req ()

When Generated

The Exchange level shall generate the C_EEP.req primitive to indicate the error end of packet.

Effect on receipt

The Character level shall send the EEP on the link if its credit count more than zero. After it the credit count shall be decremented by one.

1.2.6. C_EEP.ind

This primitive is used for transmission of the EEP from the Character level to the Exchange level.

The semantics of this primitive are:

C_EEP.ind ()

When Generated

The Character level shall generate the C_EEP.ind primitive to indicate the error end of packet.

Effect on receipt

If the state machine is in the *Run* state, then the EEP shall be written to the receive buffer.

1.2.7. C_NULL.req

This primitive is used for transmission of a NULL code from the Exchange level to the Character level.

The semantics of this primitive are:

C_NULL.req ()

When Generated

The Exchange level shall generate the C_NULL.req primitive when it has a NULL code to transmit to the Character level.

Effect on receipt

The Character level shall send the NULL on the link.

1.2.8. C_NULL.ind

This primitive is used for transmission of a NULL code from the Character level to the Exchange level.

The semantics of this primitive are:

C_NULL.ind ()

When Generated

The Character level shall generate the C_NULL.ind primitive when it has a NULL code to transmit to the Exchange level.

Effect on receipt

If the state machine is in the *ErrorWait*, *Ready* or *Started* state, then the *gotNULL* condition shall be set.

1.3. C_SERVICE_SAP

C_SERVICE_SAP provides transmission of control data between the Character level and Exchange level in both directions simultaneously. This control data comprises information about errors and disconnection and reset signal.

C_SERVICE_SAP Primitives

The primitives covered in this section are listed in Table 5.

Table 5 Summary of C_SERVICE_SAP Primitives

Name	Request	Indication
C_ParityError		1.3.3.
C_ESCError		1.3.4.
C_Disconnect		1.3.5.
C_ChangeStateRX	1.3.1.	
C_ChangeStateTX	1.3.2.	

The parameters used for these primitives are defined in Table 6.

Table 6 C_SERVICE_SAP Primitive Parameters

Name	Type	Valid range	Value	Description
StateRX	Enumeration	Reset	0	RX does nothing
		Enabled	1	RX is enabled and is waiting for the first bit to arrive
StateTX	Enumeration	Reset	0	TX does nothing
		Started	1	TX sends NULLs on the link
		Connecting	2	TX sends FCTs or NULLs
		Run	3	TX sends NULLs,

				FCTs, Time-Codes and N-Chars
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1.3.1. C_ChangeStateRX.req

This primitive requests to change state of the receiver.

The semantics of this primitive are:

C_ChangeStateRX.req (StateRX)

The parameter used for these primitive is defined in Table 6.

When Generated

This primitive is generated by the Exchange level in order to change state of the receiver.

Effect on Receipt

The receiver shall move to the required state and start to operate accordingly to the state description.

1.3.2. C_ChangeStateTX.req

This primitive requests to change state of the transmitter.

The semantics of this primitive are:

C_ChangeStateTX.req (StateTX)

The parameter used for these primitive is defined in Table 6.

When Generated

This primitive is generated by the Exchange level in order to change state of the transmitter.

Effect on Receipt

The transmitter shall move to the required state and start to operate accordingly with the state description.

1.3.3. C_ParityError.ind

This primitive reports about a parity error to the Exchange.

The semantics of this primitive are:

C_ParityError.ind ()

When Generated

This primitive is generated by the Character level when the parity error is detected.

Effect on receipt

If a parity error occurs after the first NULL is received, then the link interface shall follow the error recovery procedure. If the parity error occurs in the *Run* state then the parity error shall be flagged up to the network level as a link error.

1.3.4. C_ESCError.ind

This primitive reports about an escape error to the Exchange.

The semantics of this primitive are:

C_ESCError.ind ()

When Generated

This primitive is generated by the Character level when the escape error is detected.

Effect on receipt

If an escape error occurs, then the link interface shall follow the error recovery procedure. If the escape error occurs in the *Run* state then the escape error shall be flagged up to the network level as a link error.

1.3.5. C_Disconnect.ind

This primitive reports about the disconnect error to the Exchange.

The semantics of this primitive are:

C_Disconnect.ind ()

When Generated

This primitive is generated by the Character level when the link disconnection is detected.

Effect on receipt

If a disconnection error occurs, then the link interface shall follow the error recovery procedure. If the disconnection error occurs in the *Run* state then the escape error shall be flagged up to the network level as a link error.

1.4. C_FCT_SAP

C_FCT_SAP provides transmission of FCTs between the Character level and Exchange level in both directions simultaneously.

C_FCT_SAP Primitives

The primitive covered in this section are listed in Table 7.

Table 7 Summary of C_FCT_SAP Primitives

Name	Request	Indication
C_FCT	1.4.1.	1.4.2.

1.4.1. C_FCT.req

This primitive is used for transmission of an FCT from the Exchange level to the Character level to signify the availability of reception some more data.

The semantics of this primitive are:

C_FCT.req ()

When Generated

The Exchange level shall generate C_FCT.req primitive when it is ready to receive eight more N-Chars.

Effect on receipt

The Character level shall generate an FCT and send it on the link.

1.4.2. C_FCT.ind

This primitive reports to the Exchange level that the other end of a link is ready to receive data.

The semantics of this primitive are:

C_FCT.ind ()

When Generated

The Character level shall generate the C_FCT.ind primitive when it has an FCT to transmit.

Effect on receipt

If the state machine is in the *Connecting* state, then the *gotFCT* condition shall be set.

2. E_SAPs

E_SAPs provide interconnection between the Exchange level and the Packet level by transmitting data from one level to another in both directions. This interconnection is performed by use of primitives, which are used for transmission of the particular data in the corresponding direction.

There are three service access points between the Exchange level and the Packet level:

- E_TIME_SAP – SAP for transmission of Time-Codes;
- E_DATA_SAP – SAP for transmission of end of packet markers and NULL codes;
- E_SERVICE_SAP – SAP for transmission of control data and information about errors;

2.1. E_TIME_SAP

E_TIME_SAP provides Time-Codes transmission between the Exchange level and the Packet level in both directions simultaneously. Source application initiates the transmission of Time-Codes which should be received by the destination application.

E_TIME_SAP Primitives

The primitives covered in this section are listed in Table 8.

Table 8 Summary of E_TIME_SAP Primitives

Name	Request	Indication
E_TimeCode	2.1.1.	2.1.2.

The parameter used for these primitives is defined in Table 9.

Table 9 E_TIME_SAP Primitive Parameter

Name	Type	Value	Description
TimeCode	Byte	0..63	Defines the value of system time to be distributed across the network. Bits number 6 and 7 are control flags

2.1.1. E_TimeCode.req

This primitive is used to send Time-Codes from the Packet level to the Exchange level.

The semantics of this primitive are:

E_TimeCode.req (TimeCode)

The parameter used for this primitive is defined in Table 9.

When Generated

The Packet level shall generate E_TimeCode.req primitive when it has a Time-Code to transmit to the Exchange level.

Effect on receipt

If the state machine is in the *Run* state, then the time code shall be sent to the Character level.

2.1.2. E_TimeCode.ind

This primitive is used to send Time-Codes from the Exchange level to the Packet level.

The semantics of this primitive are:

E_TimeCode.ind (TimeCode)

The parameter used for this primitive is defined in Table 9.

When Generated

The Exchange level shall generate E_TimeCode.ind primitive when it has a Time-Code to transmit to the Packet level.

Effect on receipt

If the state machine is in the *Run* state, then the time code shall be sent to the Packet level.

2.2. E_DATA_SAP

E_DATA_SAP provides transmission of data characters and end of packet markers between the Exchange level and the Packet level in both directions simultaneously. Source application initiates the transmission of data characters, end of packet markers or NULL codes which should be received by the destination application.

E_DATA_SAP Primitives

The primitives covered in this section are listed in Table 10.

Table 10 Summary of E_DATA_SAP Primitives

Name	Request	Indication
E_Data	2.2.1.	2.2.2.
E_EOP	2.2.3.	2.2.4.
E_EEP		2.2.5.

The parameter used for these primitives is defined in Table 11.

Table 11 E_DATA_SAP Primitive Parameter

Name	Type	Value	Description
Data	Byte	0..255	Data Byte

2.2.1. E_Data.req

This primitive is used to send a data character from the Packet level to the Exchange level.

The semantics of this primitive are:

E_Data.req (Data)

The parameter used for this primitive is defined in Table 11.

When Generated

The Packet level shall generate E_Data.req primitive when it has a data character to transmit to the Exchange level.

Effect on receipt

The data shall be written to the transmit buffer.

2.2.2. E_Data.ind

This primitive is used to send a data character from the Exchange level to the Packet level.

The semantics of this primitive are:

E_Data.ind (Data)

The parameter used for this primitive is defined in Table 11.

When Generated

The Exchange level shall generate E_Data.ind primitive when it has data character received from the underlying level.

Effect on receipt

The received data shall be sent to the Packet level

2.2.3. E_EOP.req

This primitive is used for transmission of an EOP from the Packet level to the Exchange level.

The semantics of this primitive are:

E_EOP.req ()

When Generated

The Packet level shall generate the E_EOP.req primitive to indicate the end of packet.

Effect on receipt

The end-of-packet marker EOP shall be written to the transmit buffer.

2.2.4. E_EOP.ind

This primitive is used for transmission of an EOP from the Exchange level to the Packet level.

The semantics of this primitive are:

E_EOP.ind ()

When Generated

The Exchange level shall generate the E_EOP.ind primitive to indicate the end of packet.

Effect on receipt

The reception of the end-of-packet marker EOP shall be reported to the overlying level.

2.2.5. E_EEP.ind

This primitive is used for transmission of the EEP from the Exchange level to the Packet level.

The semantics of this primitive are:

E_EEP.ind ()

When Generated

The Exchange level shall generate the E_EEP.req primitive to indicate the error end of packet.

Effect on receipt

The reception of the end-of-packet marker EEP shall be reported to the overlying level.

2.3. E_SERVICE_SAP

E_SERVICE_SAP provides transmission of control data between the Exchange level and the Packet level in both directions simultaneously. This control data comprises information about errors and disconnection and reset signal.

E_SERVICE_SAP Primitives

The primitives covered in this section are listed in Table 12.

Table 12 Summary of E_SERVICE_SAP Primitives

Name	Request	Indication
E_Reset	2.3.1.	
E_LinkSetting	2.3.2.	
E_LinkError		2.1.3

The parameters used for these primitives are defined in Table 13.

Table 13 E_SERVICE_SAP Primitive Parameters

Name	Type	Valid range	Value	Description
FlagCode	Enumeration	LinkDisabled	0	Corresponds to the [Link Disabled] condition
		LinkStart	1	Causes the transition from the <i>Ready</i> state to the <i>Started</i> state
		AutoStart	2	Request the link to start automatically on receipt of a NULL
FlagValue	Boolean		True	
			False	

2.3.1. E_Reset.req

This primitive requests to reset the Exchange level.

The semantics of this primitive are:

E_Reset.req ()

When Generated

This primitive shall be generated by the Packet level in order to reset the Exchange level.

Effect on receipt

The receive buffer and the transmit buffer shall be emptied, the state machine shall move to the *ErrorReset* state.

2.3.2. E_LinkSetting.req

This primitive requests to change the link settings.

The semantics of this primitive are:

E_LinkSetting.req (FlagCode, FlagValue)

The parameter used for this primitive is defined in Table 13.

When Generated

The Packet level shall generate E_Link_Setting.req primitive in order to change the state of a link interface flag.

Effect on receipt

The flag indicated by *FlagCode* parameter shall be set in accordance with *FlagValue* parameter.

2.3.3 E_LinkError.ind

This primitive reports a link error to the Packet level.

The semantics of this primitive are:

E_LinkError.ind ()

When Generated

The Exchange level shall generate E_LinkError.ind primitive whenever any of the following errors occur while a link interface is in the Run state: disconnect error, parity error, escape sequence error or credit error.

Effect on receipt

The occurrence of the link error shall be reported to the overlying level.

3. P_SAPs

P_SAPs provide an interconnection between the Packet level and the Network level and a transmission of different kinds of data from the one level to another in both directions simultaneously. The interconnection is performed by use of primitives, which are used for transmission of the particular data in the corresponding direction.

There are three service access points (SAP):

- P_TIME_SAP – SAP for transmission of Time-Codes;
- P_DATA_SAP – SAP for transmission of different kinds of data;
- P_SERVICE_SAP – SAP for transmission of control data, including error indication.

3.1. P_TIME_SAP

P_TIME_SAP provides Time-Codes transmission between the Packet level and the Network level in both directions simultaneously. The source application

initiates the transmission of Time-Codes which should be received by the destination application.

P_TIME_SAP Primitives

The primitives covered in this section are listed in Table 14.

Table 14 P_TIME_SAP Primitives

Name	Request	Indication
P_TimeCode	3.1.1.	3.1.2.

The parameter used for these primitives is defined in Table 15.

Table 14 P_TIME_SAP Primitive Parameter

Name	Type	Value	Description
TimeCode	Byte	0..63	Defines the value of system time to be distributed across the network. Bits number 6 and 7 are control flags

3.1.1. P_TimeCode.req

This primitive is used to send Time-Codes from the Network level to the Packet level.

The semantics of this primitive are:

P_TimeCode.req(TimeCode)

The parameter used for this primitive is defined in Table 15.

When Generated

The Network level shall generate P_TimeCode.req primitive when it has a Time-Code to transmit to the Packet level.

Effect on receipt

The time code shall be passed to the underlying level.

3.1.2. P_TimeCode.ind

This primitive is used to send Time-Codes from the Packet level to the Network level.

The semantics of this primitive are:

P_TimeCode.ind(TimeCode)

The parameter used for this primitive is defined in Table 15.

When Generated

The Packet level shall generate P_TimeCode.ind primitive when it has a Time-Code to transmit to the Network level.

Effect on receipt

The time code shall be reported to the overlying level.

3.2. P_DATA_SAP

P_DATA_SAP provides transmission of data characters and end-of-packet markers (EOP and EEP) between the Packet level and the Network level in both directions simultaneously. Source application initiates the transmission of data characters and end-of-packet markers, which should be received by the destination application.

P_DATA_SAP Primitives

The primitives covered in this section are listed in Table 16.

Table 16 P_DATA_SAP Primitives

Name	Request	Indication
P_Data	3.2.1.	3.2.2.
P_EOP	3.2.3.	3.2.4.
P_EEP		3.2.5.

The parameter used for these primitives is defined in Table 17.

Table 17 P_DATA_SAP Primitive Parameter

Name	Type	Value	Description
Data	Byte	0..255	Data byte

3.2.1. P_Data.req

This primitive is used to send a data character from the Network level to the Packet level.

The semantics of this primitive are:

P_Data.req(Data)

The parameter used for this primitive is defined in Table 17.

When Generated

The Network level shall generate P_Data.req primitive when it has a data character to transmit to the Packet level.

Effect on receipt

The data character shall be passed to the underlying level.

3.2.2. P_Data.ind

This primitive is used to send a data character from the Packet level to the Network level.

The semantics of this primitive are:

P_Data.ind(Data)

The parameter used for this primitive is defined in Table 17.

When Generated

The Packet level shall generate P_Data.ind primitive when it has a data character received from the underlying level.

Effect on receipt

The received address shall be checked. In case of error the address shall be regarded as an invalid address and, consequently, the invalid destination address error shall be flagged.

3.2.3. P_EOP.req

This primitive is used for transmission of an EOP from the Network level to the Packet level.

The semantics of this primitive are:

P_EOP.req()

When Generated

The Network level shall generate the P_EOP.req primitive to indicate the end of packet.

Effect on receipt

The EOP notification shall be passed to the underlying level.

3.2.4. P_EOP.ind

This primitive is used for transmission of an EOP from the Packet level to the Network level.

The semantics of this primitive are:

P_EOP.ind()

When Generated

The Packet level shall generate the P_EOP.ind primitive to indicate the end of packet.

Effect on receipt

The reception shall be regarded as end of packet.

3.2.5. P_EEP.ind

This primitive is used for transmission of an EEP from the Packet level to the Network level.

The semantics of this primitive are:

P_EEP.ind()

When Generated

The Packet level shall generate the P_EEP.ind primitive to indicate the error end of packet.

Effect on receipt

The reception shall be regarded as error end of packet.

3.3. P_SERVICE_SAP

P_SERVICE_SAP provides transmission of control data between the Packet level and the Network level in both directions simultaneously. This control data comprises information about link errors and disconnection and reset signal.

P_SERVICE_SAP Primitives

The primitives covered in this section are listed in Table 18.

Table 18 P_SERVICE_SAP Primitives

Name	Request	Indication
P_LinkError		3.3.3.
P_Reset	3.3.1.	
P_LinkSetting	3.3.2.	

The parameters used for these primitives are defined in Table 19.

Table 19 PACK_SERVICE_SAP Primitive Parameters

Name	Type	Valid range	Value	Description
FlagCode	Enumeration	LinkDisabled	0	Corresponds to the [Link Disabled] condition
		LinkStart	1	Causes the transition from the <i>Ready</i> state to the <i>Started</i> state
		AutoStart	2	Request the link to start automatically on receipt of a NULL
FlagValue	Boolean		True	
			False	

3.3.1. P_Reset.req

This primitive requests to reset the Packet level.

The semantics of this primitive are:

P_Reset.req()

When Generated

This primitive shall be generated by the Network level in order to reset the Packet level.

Effect on receipt

The reset of the Exchange level shall be required.

3.3.2. P_LinkSetting.req

This primitive requests to change the link settings.

The semantics of this primitive are:

P_LinkSetting.req(FlagCode, FlagValue)

The parameters used for this primitive is defined in Table 19.

When Generated

This primitive shall be generated by the Network level in order to change the state of a link interface flag.

Effect on receipt

The change of the indicated flag shall be passed to the Exchange level.

3.3.3. P_LinkError.ind

This primitive reports the occurrence of a link error to the Network level.

The semantics of this primitive are:

P_LinkError.ind()

When Generated

This primitive shall be generated by the Packet level when a link error notification is received from the underlying level.

Effect on receipt

The link error recovery procedure shall be performed.

4. N_SAPs

N_SAPs provide an interconnection between the Network level and the overlying level (i.e. transport level) and a transmission of different kinds of data from the one level to another in both directions simultaneously. The interconnection is performed by use of primitives, which are used for transmission of the particular data in the corresponding direction.

There are three service access points (SAP):

- N_TIME_SAP – SAP for transmission of Time-Codes;
- N_DATA_SAP – SAP for transmission of different kinds of data;

- N_SERVICE_SAP – SAP for transmission of control data, including error indication.

4.1. N_TIME_SAP

N_TIME_SAP provides Time-Codes transmission between the Network level and the overlying level in both directions simultaneously. The source application initiates the transmission of Time-Codes which should be received by the destination application.

N_TIME_SAP Primitives

The primitive covered in this section is listed in Table 20.

Table 20 N_TIME_SAP Primitives

Name	Request	Indication
N_TimeCode	4.1.1.	4.1.2.

The parameter used for this primitive is defined in Table 21.

Table 21 N_TIME_SAP Primitive Parameter

Name	Type	Value	Description
TimeCode	Byte	0..63	Defines the value of system time to be distributed across the network. Bits number 6 and 7 are control flags

4.1.1. N_TimeCode.req

This primitive is used to send Time-Codes from the overlying level to the Network level.

The semantics of this primitive are:

N_TimeCode.req(TimeCode)

The parameter used for this primitive is defined in Table 21.

When Generated

The overlying level shall generate N_TimeCode.req primitive when it has a Time-Code to transmit to the Network level.

Effect on receive

The time code shall be passed to the underlying level.

4.1.2. N_TimeCode.ind

This primitive is used to send Time-Codes from the Packet level to the overlying level.

The semantics of this primitive are:

N_TimeCode.ind(TimeCode)

The parameter used for this primitive is defined in Table 21.

When Generated

The Network level shall generate N_TimeCode.ind primitive when it has a Time-Code to transmit to the overlying level.

Effect on receipt

The time code shall be processed in accordance with overlying level algorithm.

4.2. N_DATA_SAP

N_DATA_SAP provides transmission of data characters and end-of-packet markers (EOP and EEP) between the Network level and the overlying level in both directions simultaneously. Source application initiates the transmission of data characters and end-of-packet markers, which should be received by the destination application.

N_DATA_SAP Primitives

The primitives covered in this section are listed in Table 22.

Table 22 N_DATA_SAP Primitives

Name	Request	Indication
N_Data	4.2.1.	4.2.2.
N_EOP	4.2.3.	4.2.4.
N_EEP		4.2.5.

The parameter used for these primitives is defined in Table 23.

Table 23 N_DATA_SAP Primitive Parameter

Name	Type	Value	Description
Data	Byte	0..255	Data byte

4.2.1. N_Data.req

This primitive is used to send a data character from the overlying level to the Network level.

The semantics of this primitive are:

N_Data.req(Data)

The parameter used for this primitive is defined in Table 23.

When Generated

The overlying level shall generate N_Data.req primitive when it has a data character to transmit to the Network level.

Effect on receipt

The data character shall be passed to the underlying level.

4.2.2. N_Data.ind

This primitive is used to send a data character from the Network level to the overlying level.

The semantics of this primitive are:

N_Data.ind(Data)

The parameter used for this primitive is defined in Table 23.

When Generated

The Network level shall generate N_Data.ind primitive when it has a data character received from the underlying level.

Effect on receipt

The data character shall be processed in accordance with overlying level algorithm.

4.2.3. N_EOP.req

This primitive is used for transmission of an EOP from the overlying level to the Network level.

The semantics of this primitive are:

N_EOP.req()

When Generated

The overlying level shall generate the N_EOP.req primitive to indicate the end of packet.

Effect on receipt

The EOP notification shall be passed to the underlying level.

4.2.4. N_EOP.ind

This primitive is used for transmission of an EOP from the Network level to the overlying level.

The semantics of this primitive are:

N_EOP.ind()

When Generated

The Network level shall generate the N_EOP.ind primitive to indicate the end of packet.

Effect on receipt

The reception shall be regarded as end of packet.

4.2.5. N_EEP.ind

This primitive is used for transmission of an EEP from the Network level to the overlying level.

The semantics of this primitive are:

N_EEP.ind()

When Generated

The Network level shall generate the N_EEP.ind primitive to indicate the error end of packet.

Effect on receipt

The reception shall be regarded as error end of packet.

4.3. N_SERVICE_SAP

N_SERVICE_SAP provides the transmission of control data between the Network level and the overlying level in both directions simultaneously. This control data comprises information about errors and disconnection and reset signal.

N_SERVICE_SAP Primitives

The primitives covered in this section are listed in Table 24.

Table 24 Summary of N_SERVICE_SAP Primitives

Name	Request	Indication
N_Reset	4.3.1.	
N_LinkSetting	4.3.2.	
N_LinkError		4.3.3.
N_InvalidDestinationAddress		4.3.4.

The parameter used for these primitives is defined in Table 25.

Table 25 N_SERVICE_SAP Primitive Parameter

Name	Type	Valid range	Value	Description
FlagCode	Enumeration	LinkDisabled	0	Corresponds to the [Link Disabled] condition
		LinkStart	1	Causes the transition from the <i>Ready</i> state to the <i>Started</i> state
		AutoStart	2	Request the link to start automatically on receipt of a NULL
FlagValue	Boolean		True	
			False	
DestinationAddress	Byte		0..255	Address byte

4.3.1. N_Reset.req

This primitive requests to reset the Network level.

The semantics of this primitive are:

N_Reset.req ()

When Generated

This primitive is generated by the overlying level in order to reset the Network level.

Effect on receipt

The reset of the Packet level shall be required.

4.3.2. N_LinkSetting.req

This primitive requests to change the link settings.

The semantics of this primitive are:

N_LinkSetting.req(FlagCode, FlagValue)

The parameters used for this primitive is defined in Table 25.

When Generated

This primitive shall be generated by the overlying level in order to change the state of a link interface flag.

Effect on receipt

The change of the indicated flag shall be passed to the Packet level.

4.3.3 N_LinkError.ind

This primitive reports the occurrence of a link error to the overlying level.

The semantics of this primitive are:

N_LinkError.ind()

When Generated

This primitive shall be generated by the Network level when a link error notification is received from the underlying level.

Effect on receipt

The link error information can be processed in accordance with overlying level algorithm.

4.3.4. N_InvalidDestinationAddress.ind

This primitive is used to report reception of a packet with invalid destination address.

The semantics of this primitive are:

`N_InvalidDestinationAddress.ind(DestinationAddress)`

The parameter used for this primitive is defined in Table 25.

When Generated

This primitive shall be generated by the Network level when the received packet has an invalid destination address.

Effect on receipt

Information about the invalid destination address can be processed in accordance with overlying level algorithm.