61. Physical Coding Sublayer (PCS) type 10PASS-TS, 2BASE-TL, 2PASS-TL

Editors' Notes: *To be removed prior to final publication.*

References:

ITU-T G.993.1
ITU-T G.994.1

Definitions (to be added to 1.4):

None

Abbreviations (to be added to 1.5):

PAF: PMI Aggragation Function
PAFH: PMI Aggragation Function Header

Revision History:

Draft 0.9 June 2002 Preliminary draft outline for IEEE P802.3ah Task Force review.
Draft 1.0 August 2002 Preliminary draft for IEEE P802.3ah Task Force review
Draft 1.1 October 2002 Draft for IEEE P802.3ah Task Force review

61.1 Overview

2BASE-TL/2PASS-TL and 10PASS-TS-DMT/10PASS-TS-QAM are Physical Layer signaling systems for Ethernet in the first mile. These PHYs deliver a minimum of 10 Mb/s over distances of up to 750 meters, and a minimum of 2Mb/s over distances of up to 2700 meters, using a single copper pair. The medium specifications (for delivering Ethernet traffic for distances beyond 2700 meters, or rates higher than 2Mbps and 10Mbps respectively) are aimed to support transmission over multiple copper-pairs. The copper category is based on what is used in the access network according to A~~NS~~TIS T1, ETSI and ITU-T standards. These systems are intended to be used in the public as well as private networks, therefore must be compliant with all the appropriate regulatory, governmental and regional requirements.

Unlike 100BASE-T and 1000BASE-T, the copper networks have channel characteristics that are very diverse and therefore it is conventional to discuss the channel behavior only in terms of averages, standard deviations and small percentage worst case.

61.1.1 Scope

This clause defines the ~~type 10PASS-T~~ Physical Coding Sublayers (PCS) for 2BASE-TL/2PASS-TL and 10PASS-TS, which ~~is~~ have similarities to other 802.3 standards such as 100BASE-T4 but also differs since new sublayers are added within the PCS sublayers to accommodate the operation of Ethernet over copper channel. This clause also defines the common startup and handshaking mechanism used by both PHY's.

~~This clause also defines type 10PASS-T Physical Medium Attachment (PMA) sublayer and type 10PASS-T Medium Dependent Interface (MDI). Within PMA and MDI new sublayers are defined that will corresponds to ITU-T, VDSL definition.~~

61.1.2 Objectives

The following are the objectives for 2BASE-TL/2PASS-TL and 10PASS-TS:

a) To provide ~~10~~100 Mb/s data rate at the MII.
b) To provide full duplex operation.
c) To provide for operating over unshielded voice grade twisted pair ~~TP-2,~~ cable~~, TBD specified, at distances up to 750 m~~.
d) To provide a communication channel with a mean bit error rate of less than one in part in 10^7 with a 6dB noise margin at the PMA service interface..
e) To provide optional support for operation on multiple pairs

61.1.3 Relation of 2BASE-TL/2PASS-TL and 10PASS-TS to other standards

Editor's note: Need figure here showing relationship to other standards.

61.1.4 Summary

61.1.4.1 Summary of Physical Coding Sublayer (PCS) specification

The Physical Coding Sublayers (PCS) for 2BASE-TL/2PASS-TL and 10PASS-TS contains two functions and one subsection. The relationship between the functions and subsection is shown in Figure 61–1

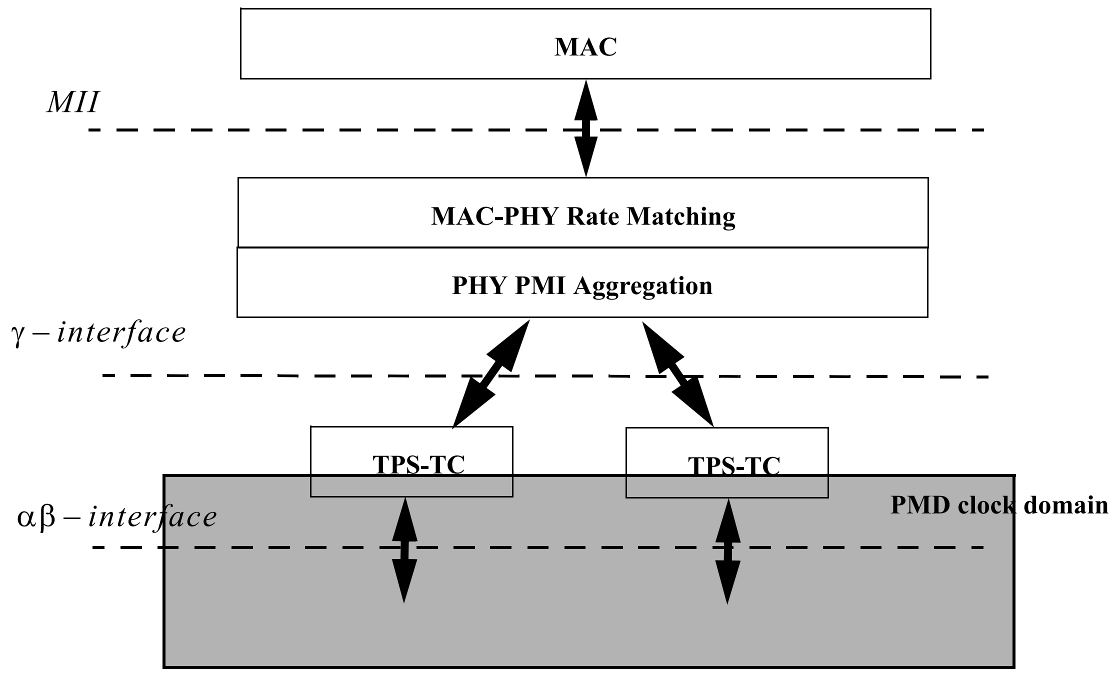


Figure 61–1—Relationship of Physical Coding Sublayer functions

Note that clocks used in the shaded area are derived from and synchronized to the DSL clocks which will be related to the bit rates. Data is transferred across the MII interface and the gamma interface at the speed of the MII clock. The MAC-PHY rate matching allows the inter packet gap to be adjusted so that the net data rate across these interface matches the sum of rates across the alpha/beta interfaces.

In the transmit direction a whole frame is transferred across the MII interface, through the MAC-PHY Rate Matching and PHY PMI Aggregation functions and across the gamma interface at the rate of the MII clock. The TPS-TC(s) will then signal across the gamma interface to prevent further transfer until it is ready to accept another frame. The MAC_PHY Rate Matching function prevents the transfer of another frame across the MII until the TPS-TC is ready.

In the receive direction the TPS-TC(s) signals that a frame is ready for transfer. The frame is passed across the gamma interface and passed up across the MII interface. The MAC-PHY Rate Matching function may delay the transfer of the frame across the gamma interface to avoida collision on the MII interface if required.

61.1.4.1.1 Summary of MAC-PHY Rate Matching specification

The Ethernet in the first mile Physical Layer devices that operate over copper media are specified to work with a MAC operating at 100Mb/s using the MII interface as defined in Clause 22. A function is needed to match the MAC's rate of data transmission to the PHY's slower data rate.

This is achieved using deference as defined in 4.2.3.2.1. For deference to operate the MAC is configured for half duplex operation. It is important to note that Clause 4 allows the MAC to simultaneously receive and transmit data when configured for half duplex operation.

In response to the assertion of tx_en by the MAC the PHY asserts CRS in response (see 4.3.3). The MAC transmits data at a rate of 100Mb/s, which is buffered by the PHY and transmitted onto the medium. In order to prevent the PHY's transmit buffer from overflowing the PHY keeps CRS asserted until it has space to receive a maximum length frame, i.e. 1522 bytes (see 3.5, 4.2.7.1 and 4.4). In half duplex mode the MAC will not transmit another frame as long as CRS is asserted.

The PHY buffers complete receive frames. On reception of a complete frame the PHY sends it to the MAC at 100Mb/s.

It is recognized that some MAC implementations may not allow the simultaneous transmission and reception of data while operating in half duplex mode. To permit operation with these MACs the PHY has an optional operating mode where MAC data transmission is deferred using CRS when received data is sent from the PHY to the MAC.

61.1.4.1.2 Summary of PHY PMI Aggregation specification

An optional PHY PMI Aggregation Function (PAF) allows one or more PHYs to be combined together to form a single logical Ethernet link. The PAF is located between the MAC-PHY Rate Matching function and the TPS-TC function. It interfaces with the PHYs across the gamma interface, and to the MAC-PHY Rate Matching function using an abstract interface. The definition of the PAF is presented in subclause 61.2.2

61.1.4.1.3 Summary of TPS-TC specification

Transport Protocol Specific Transmission Convergence Sublayer (TPS-TC) resides between the γ-interface of the PCS and alpha/beta-interface of the PMA. It is intended to convert the data frame to be sent into the format suitable to be mapped into PMA, and to recognize the received frame at the other end of the link. Since PMA and MII clocks may be unequal, the TPS-TC also provides clock rate matching. The definition of the TPS-TC sublayer is presented in subclause 61.2.3.

61.1.4.2 Summary of handshaking and PHY control specification

Both 2BASE-TL/2PASS-TL and 10PASS-TS use handshake procedures defined in ITU-T G.994.1 at startup. PHY's implementing both 2BASE-TL/2PASS-TL and 10PASS-TS port types can use G.994.1 to perform handshaking.

It is the goal of the ITU-T that all specifications for digital tranceivers for use on public telephone network copper subscriber lines use G.994.1 for startup. G.994.1 procedures allow for a common startup mechanism for identification of available features, exchange of capabilities and configuration information, and selection of operating mode. As the two loop endpoints are usually separated by a large distance (e.g., in separate buildings) and often owned and installed by different entities, G.994.1 also aids in diagnosing interoperability problems. G.994.1 codespaces have been assigned by ITU-T to ATIS T1, ETSI, and IEEE 802.3 in support of this goal.

The description of how G.994.1 procedures are used for Ethernet in the First Mile handshaking and PHY control are contained in subclause 61.3.

61.1.5 Application of 2BASE-TL/2PASS-TL, 10PASS-TS

61.1.5.1 Compatibility considerations

61.1.5.2 Incorporating the 2BASE-TL/2PASS-TL, 10PASS-TS PHY into a DTE

61.1.5.3 Use of PHY Rate Matching

61.1.5.4 Support of PHY PMI Aggregation

61.1.5.5 Use of 2BASE-TL/2PASS-TL, 10PASS-TS PHY for point-to-point communication

61.1.5.6 Support for handshaking

See subclause 61.3.

61.2 PCS Functional Specifications

61.2.1 MAC-PHY Rate Matching functional specifications

61.2.1.1 MAC-PHY Rate Matching functions

The PHY shall use CRS to match the MAC's faster rate of data transmission to the PHY's slower rate.

The PHY shall buffer a receive frame before sending it to the MAC at a rate of 100Mb/s.

The PHY may support a mode of operation where it does not send data to the MAC while the MAC is transmitting.

61.2.1.2 MAC-PHY Rate Matching functional interfaces

61.2.1.2.1 MAC-PHY Rate Matching – MII signals

Reference Table 23.2.2.1.

61.2.1.2.2 MAC-PHY Rate Matching–Management entity signals

The management interface has pervasive connections to all functions. Operation of the management control lines MDC and MDIO, and requirements for managed objects inside the PCS and PMA, are specified in Clauses 22 and 30, respectively.

61.2.1.3 MAC-PHY Rate Matching state diagrams

61.2.1.4 MAC-PHY Rate Matching state diagrams

61.2.1.4.1 MAC-PHY Rate Matching state diagram constants

61.2.1.4.2 MAC-PHY Rate Matching state diagram variables

61.2.1.4.3 MAC-PHY Rate Matching state diagram timer

61.2.1.4.4 MAC-PHY Rate Matching state diagram functions

61.2.1.4.5 MAC-PHY Rate Matching state diagrams

61.2.2 PHY PMI Aggregation functional specifications

This subclause defines an optional PHY PMI Aggregation Function (PAF) for use with CSMA/CD MACs and EFM copper PHYs. PMI Aggregation allows one or more PHYs to be combined together to form a single logical Ethernet link.

The PAF is located between the MAC-PHY Rate Matching function and the TPS-TC function as shown in Figure 61–2. The PAF interfaces with the PHYs across the gamma interface. The PAF interfaces to the MAC-PHY Rate Matching function using an abstract interface whose physical realization is left to the implementor, provided the requirements of this standard, where a applicable, are met.

The PHY PMI Aggregation function has the following characteristics:

a) Supports aggregation of 2 to 32 PHYs
b) Supports individual PHYs having different data rates
c) Ensures low packet latency and preserves packet sequence
d) Scalable and resilient to PHY PMI failure
e) Independent of type of EFM copper PHY
f) Allows vendor discretionary algorithms for fragmentation

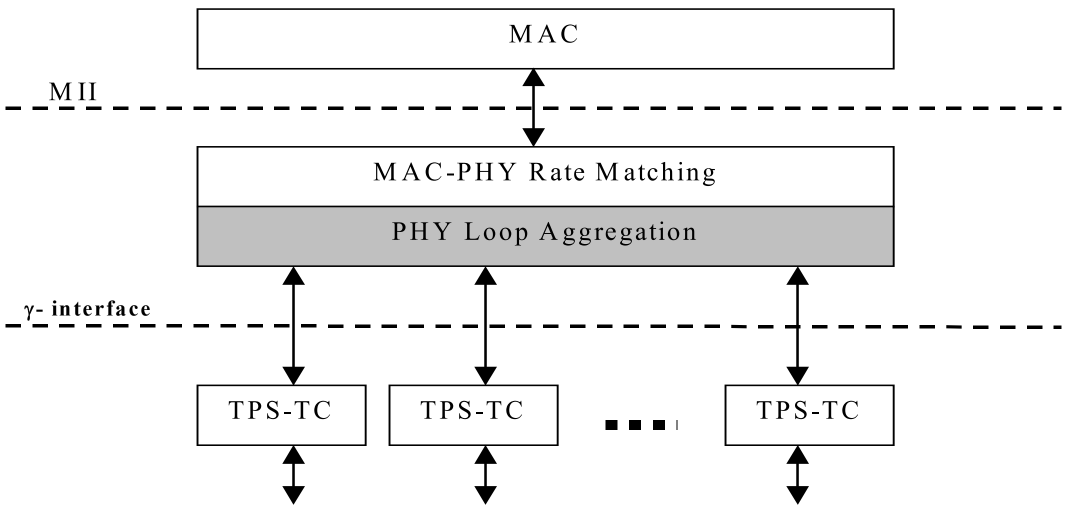


Figure 61–2—Architectural position of PHY PMI Aggregation Sublayer

61.2.2.1 PHY PMI Aggregation functions

The PHY PMI Aggregation functions provide a fragmentation procedure at the transmitter and a reassembly procedure at the receiver. The fragmentation and reassembly procedures take a standard MAC frame and partition it into potentially multiple fragments. Each fragment is given a fragment header and transmitted over a specific TPS-TC. The fragmentation header has the following format:

SeqNum (12 bits)	StartOfPacket (1 bit)	EndOfPacket (1 bit)	Reserved (2 bits)	Fragment Data

Editor's Note: The fragment header may be enhanced with a CRC depending on the outcome of the framing discussions. If HDLC is used as the framing mechanism, then the header does not require its own checksum. If some other encoding is used, then the header may require an 8-bit checksum.

61.2.2.2 PHY PMI AGGREGATION Transmit function

The PHY PMI Aggregation transmit functions uses the following algorithm:

a) Select a loop for the next transmission
b) Select the number of bytes to transmit on that loop (must be greater than minAggBytesPerPHY)
c) Increment and set fragment sequence number in the EFM header
d) Set the start-of-packet and end-of-packet bits in the EFM header as appropriate
e) Transmit fragment to the TPS-TC layer

It is important to note that the selection of the next loop to use in transmission (step (a)) and the number of bytes to transmit (step (b)) is implementation dependent. However, the any implementation must follow the restrictions as outlined in Section 61.2.2.4.

61.2.2.3 PHY PMI Aggregation Receive function

The PHY PMI aggregation receive function requires per-loop queues as well as a per-MAC packet buffer for fragment reassembly. The algorithm assumes only "good" fragments are placed on the per-loop receive queues (fragments detected in error by the TPS-TC are discarded).

During initial bring-up and in the event of certain errors, the receive algorithm has to determine which sequence number is expected next. Initially, the expected sequence number is set to 0. The following algorithm is used to determine the next sequence number:

- a Out of all sequence numbers on the top of the per-loop receive queues, the next sequence number is
  - 1 the smallest sequence number greater than or equal to the expected sequence number if one exists, or
  - 2 the smallest sequence number

The receive function uses the following algorithm:hm

- a Determine the next sequence number via the preceeding algorithm
- b If the next sequence number is the expected sequence number, process that fragment
  - 1 If the fragment is less than minFragmentSize, discard the fragment and count an error (**Note: what kind of error**)
  - 2 If the fragment is a start-of-packet and the packet buffer is not empty, flush the packet buffer and count an error (**Note: what kind of error**)
  - 3 Accept the fragment into the packet buffer
  - 4 If the size of the packet buffer exceeds the maximium frame size, discard the packet buffer and count a frame overrun
  - 5 If that fragment is an end-of-packet, pass the packet buffer to the MAC-PHY Rate Matching layer
  - 6 Increment the expected sequence number
- c If there is data in any receive queue (but not the expected fragment)
  - 1 If the fragmentTimeout is not started, start the fragmentTimeout
  - 2 If the fragmentTimeout expires,
    - i Resynchronize the expected sequence number to the next seqeunce number
    - ii Flush the packet buffer and count an error (**Note: what kind of error**)
- d If any of the per-loop receive queues overflow, then
  - 1 Flush all per-loop receive queues and the packet buffer
  - 2 Resynchronize the expected sequence number
- e Otherwise, repeat without processing a fragment

61.2.2.4 PHY PMI Aggregation Transmit Function Restrictions

There are factors that limit the freedom of the transmission algorithm specified in Section 61.2.2.2.

One factor is the differential latency between multiple loops in an aggregated group. Differential latency measures the variation in the time required to transmit a single bit across different loops. To normalize the latency measurement for high and low speed links, differential latency is measured in bit times. A differential latency of N bit times implies that N bits can be sent across one loop in by the time a single bit makes it across the other. Larger differential latencies imply greater variance in bit delivery times across aggregated loops, which in turn require larger sequence number ranges.

A second factor is the size of the fragments being transmitted across the loops. Very small fragments require larger sequence number ranges as there can be more fragments within the same number of bit times.

The restrictions for the transmission algorithm in Section 61.2.2.2 are:

1. The differential latency between any two loops in an aggregated group can be no more than 64K bit times.
2. Fragments cannot be less than 32B.

These restrictions allow the use of a 12-bit sequence number space.

61.2.2.5 Error-detecting Rules

The receive TPS-TC function passes all valid fragments to the PAF. If a received fragment has a CRC error, it is designated as an “FCS-errored” fragment and the TPS-TC sends the corresponding receive error message (Rx-Err) across the gamma interface to the PAF.

The PAF shall discard fragments that are designated by the TPS-TC as errored or invalid frames based on the Rx-Err signal. All “good” fragments are placed on the appropriate per-loop receive queue.

61.2.2.6 PHY PMI Aggregation functional interfaces

The PAF interfaces with the PHYs across the gamma interface. The PAF interfaces to the MAC-PHY Rate Matching function using an abstract interface whose physical realization is left to the implementor, provided the requirements of this standard, where a applicable, are met.

61.2.2.6.1 PHY PMI AGGREGATION–gamma interface signals

The PAF interfaces with the PHYs across the gamma interface. The gamma interface specification is formally defined in XXX **(*subclause editors note: points to PTM-TC of VDSL standard).*** This subclause specifies the data, synchronization and control signals that are transmitted between the TPS-TC and a PTM entity. In this case, the PAF is the PTM entity.

61.2.2.6.2 PHY PMI AGGREGATION–Management entity signals

The PAF provides the following Management Entity primitives:

<u>FragmentError.indicate</u>: this primitive is passed to the MAC-PHY Rate Matching function to indicate that a PAF fragment was received in error from the TPS-TC and as a result a MAC frame will be discarded by the PAF.

61.2.2.6.3 PHY PMI aggregation register functions

Clause 45 defines 2 registers which relate to the PHY PMI aggregation function: the PMD_Available_register and the PMD_Aggregate_register. Additionally the remote_discovery_register and Aggregation_link_state_register must be implemented.

The PMD_Available_register is a read-only (for LT) register which indicates whether an aggregateable link is possible between this PCS and multiple PMD's. As a minimum, for a device that does not support aggregation, bit zero of this register must be set and all other bits clear. The position of bits indicating aggregateable PMD links correspond to the PMA/PMD sub-address defined in Clause 45.

For NT devices, the PMD_Available_register may optionally be writeable. The reset state of the register must reflect the capabilities of the device. The management entity (through Clause 45 access) may clear bits which are set to limit the mapping between MII and PMI for PMI aggregation. For NT devices, links must not be enabled until the PMD_Available register has been set to limit the connectivity such that each PMI maps to one, and only one MII. Multiple PMI's per MII are allowed.

The PMD_Aggregate_register is defined in Clause 45. For LT devices, access to this register is through Clause 45 register read and write mechanisms. For NT devices the register may be read locally through Clause 45, reads and writes must be allowed from remote devices via the remote access signals passed across the gamma interface from the PMA (through the OC). The operation of the PMD_Aggregate_register for NT devices is defined as follows:

a If the remote_discovery_register is clear then the PMD_aggregate_register must be cleared.

b If write_PMD_Aggregation_reg is asserted, the contents of remote_write_data bit zero is written to PMD_Aggregation_register in the bit location corresponding to the PMA/PMD from which the request was received. Acknowledge_read_write is asserted for one octet clock cycle.

c If read_PMD_Aggregation_reg is asserted, the contents of PMD_Aggregation_register are placed onto remote_read_data bus, bits 31 through 0. Unsupported bits are written as zero if the full width of PMD_Aggregation_register is not supported. Acknowledge_read_write is asserted for one octet clock cycle.

The remote_discovery_register must be implemented for NT devices. The remote_discovery_register may be read locally through Clause 45 register access mechanisms. The remote_access_register must support atomic write operations and reads from remote devices according via the remote access signals passed across the gamma interface from the PMA (through the OC). The operation of the remote_discovery_register for NT devices is defined as follows:

a If read_remote_discovery_reg is asserted, the contents of remote_discovery_register are placed onto remote_read_data bus. Acknowledge_read_write is asserted for one octet clock cycle.

b If write_remote_discovery_reg is asserted, the action depends on the contents of remote_discovery_register:<CR>If the remote_discovery_register is currently clear (no bits asserted), the contents of the remote_write_data bus are placed into the remote_discovery_register. The new contents of remote_discovery_register are placed on the remote_read_data bus. Acknowledge_read_write is asserted for one octet clock cycle.<CR>Else if the remote_discovery_register is not currently clear (any bit asserted), no data is written. The old contents of remote_discovery_register are placed on the remote_read_data bus. NAcknowledge_read_write is asserted for one octet clock cycle.<CR>If multiple write_remote_discovery_reg signals are asserted (from multiple gamma interfaces) they must be acted upon serially.

c If clear_remote_discovery_reg is asserted, the remote_discovery_register is cleared. The new contents of remote_discovery_register are placed on the remote_read_data bus. Acknowledge_read_write is asserted for one octet clock cycle.

d If the logical AND of the Aggregation_link_state_register and the PMD_Aggregate_register is clear then a timeout counter must be started. If this condition continues for 30 seconds (the timeout period) then the remote_discovery_register must be cleared.

Note that a single device may be implemented which has multiple MII interfaces and (therefore) multiple PCS instances. There must be one remote_disovery_register per PCS instance. The PMD_available register must be set prior to the enabling of links so that each PMA/PMD is linked to only one PCS. Access to the remote_discovery_register (read or write) must be restricted to PMA/PMD instances for which the corresponding PMD_available register bit is asserted.

The Aggregation_link_state_register is a pseudo-register corresponding to the PCS_link_state bits from each gamma interface in the appropriate bit positions according to the PMA/PMD from which the signal is received. Bits corresponding to unsupported aggregation connections are zero.

61.2.2.7 Frame structure

Figure 2 shows the frame structure for the PAF fragments. Each fragment includes a PAF Header. The PAF Header (PAFH) contains the following parameters:

a) SeqNum: MAC frame sequence number (12 bits)
b) TotalFrag: number of fragments in the MAC frame (5 bits)
c) FragNum: fragment number for the PAF fragment (5 bits)

Figure 61–3 shows an example of the fragmentation procedure with a MAC frame with 1024 octets, 3 aggegated PHYs with data rates of 1 Mbps, 2 Mbps and 1 Mbps.

SeqNum (10 bits)	TotalFrag (5 bits)	FragNum 5 bits	MAC frame octets

Figure 61–3—Frame structure for a PAS fragment

61.2.2.8 PHY PMI AGGREGATION state diagrams

61.2.2.8.1 PHY PMI AGGREGATION state diagram constants

No constants are defined in the PHY PMI Aggregation state diagrams.

61.2.2.8.2 PHY PMI AGGREGATION state diagram variables

BEGIN
This variable is used when initiating the operation of the function state machine. It is set to true following initialization.
TYPE: boolean
DEFAULT VALUE: true

NumPHYs
This variable indicates the number of PHYs that are currently functional.
TYPE: 5 bit unsigned
VALID VALUES: 1 to 32 (decimal)
DEFAULT VALUE: 1

MACFrameLen
This variable indicates the number of octets in a MAC frame
TYPE: 11 bit unsigned
VALID VALUES: 1 to 1522 (decimal)
DEFAULT VALUE: 1

SeqNum
This variable indicates the MAC frame sequence number.

It is set to 0 during initialization. SeqNum is included in the PAF header.
TYPE: 10 bit unsigned
DEFAULT VALUE: 0

TotalFrag
This variable indicates the number of fragments in the MAC frame.
TotalFrag is included in the PAF header.
TYPE: 5 bit unsigned
DEFAULT VALUE: 0

FragNum
This variable indicates the fragment number for the PAF fragment.
FragNum is included in the PAF header.
TYPE: 5 bit unsigned
DEFAULT VALUE: 0

AllFragReady
This variable is set to true when all fragments are ready for transmission.
TYPE: boolean
DEFAULT VALUE: true

NoBackPressure
This variable is set to true when there is no back pressure from all the aggregated PHYs.
TYPE: boolean
DEFAULT VALUE: true

MACFrameOK
This variable is set to true when a MAC frame is correctly reassembled.
TYPE: boolean
DEFAULT VALUE: true

Rx_Err
This variable is set to true when a Rx_Err signal is asserted by the TPS-TC to indicate an errored frame.
TYPE: boolean
DEFAULT VALUE: true

61.2.2.8.3 PHY PMI AGGREGATION state diagram timer

No timers are defined in the PHY PMI Aggregation state diagrams.

61.2.2.8.4 PHY PMI AGGREGATION state diagram functions

generate_PAFfragments(octets_in_MACframe, number_of_active_PHYs, SeqNum)

This function generates the PAFPAF fragments for transmission over the aggregated PHYs. The function takes as input the number of octets in a MAC frame (*octets_in_MACframe*), the number of PHYs that are currently active (*number_of_active_PHYs*) and the sequence number of the last MAC frame sent to the PHYs (*SeqNum)*. This function updates the sequence number by setting SeqNum=SeqNum+1. This function divides the MAC frame octets into number_of_active_PHYs fragments using vendor discretionary algorithms. This function sets TotalFrag = number_of_active_PHYs-1. This function adds a header to each PAF fragment. The header contains the SeqNum, TotalFrag and FragNum for each PAF fragment. This function sets the FragNum of the first fragment to 0, the FragNum of the second fragment to 1 and so on. The

FraNum of the last fragment is set to TotalFrag. When all fragments are ready for transmission, this function sets AllFragReady = true.

ReassembleMACframe(SeqNum)

This function reassembles the MAC frame from the PAF fragments received from Rate Matching function. The function takes as input the sequence number of the last reassembled MAC frame (*SeqNum*). This function decodes the header of each PAF fragment and reassembles the MAC frame using the information in the SeqNum, TotalFrag and FragNum variables. If the frame is correctly reassembled this function updates the sequence number by setting SeqNum=SeqNum+1 and sets MACFrameOK = true.

61.2.2.8.5 PHY PMI AGGREGATION state diagrams

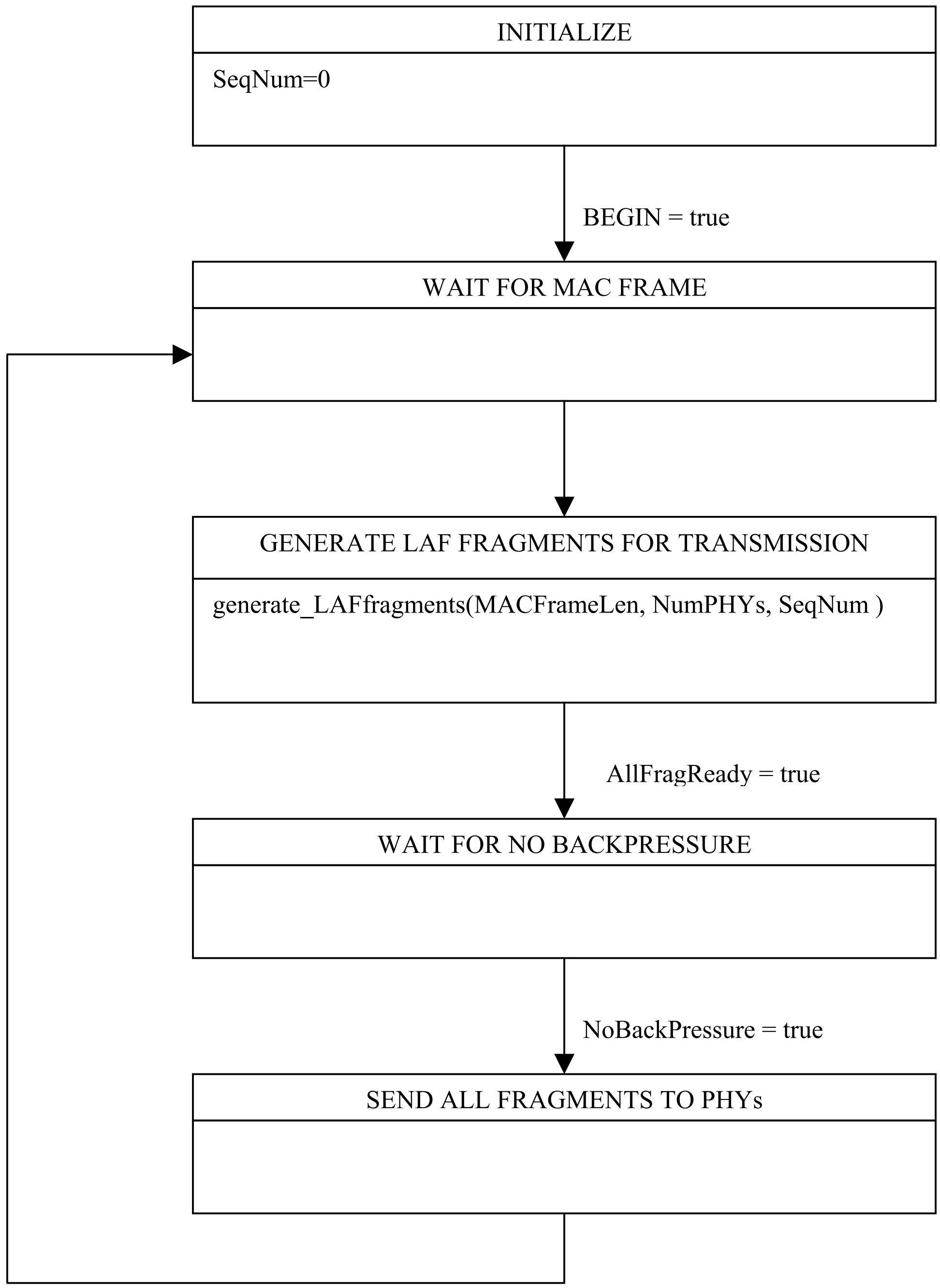


Figure 61–4—PAF Transmitter state diagram

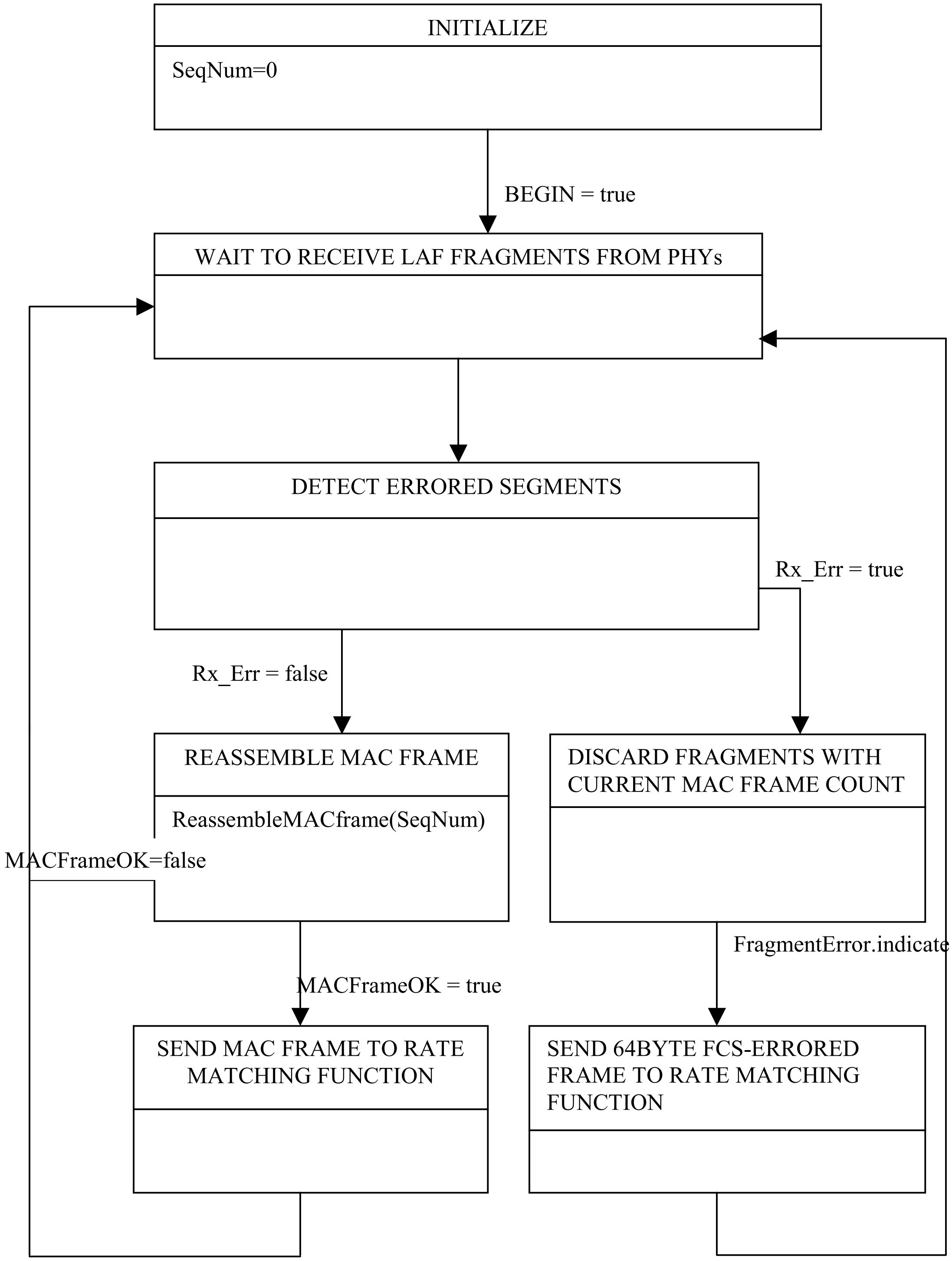


Figure 61–5—PAF Receiver state diagram

61.2.3 TPS-TC functional specifications

The functional model of TPS-TC sublayer is presented in Figure 61–6.

Subclause editor notes*:*

1. *Since in EFM we don't have any definition of Transport protocol (because we use only one), the term "TPS-TC" is actually irrelevant. I suggest to use term "TC = Transmission Convergence sublayer". Even more, dividing TC into TPS-TC and PMS-TC is already done in 802.3 by defining PMA which serves same as PMS-TC in DSL. Without PMS-TC, TPS-TC looks strange. I use TC in further text.*
1. *The current definition for for g.993 includes encapsulation using HDLC. It has yet to be decided whether this or an alternative method of encapsulation will be used.*

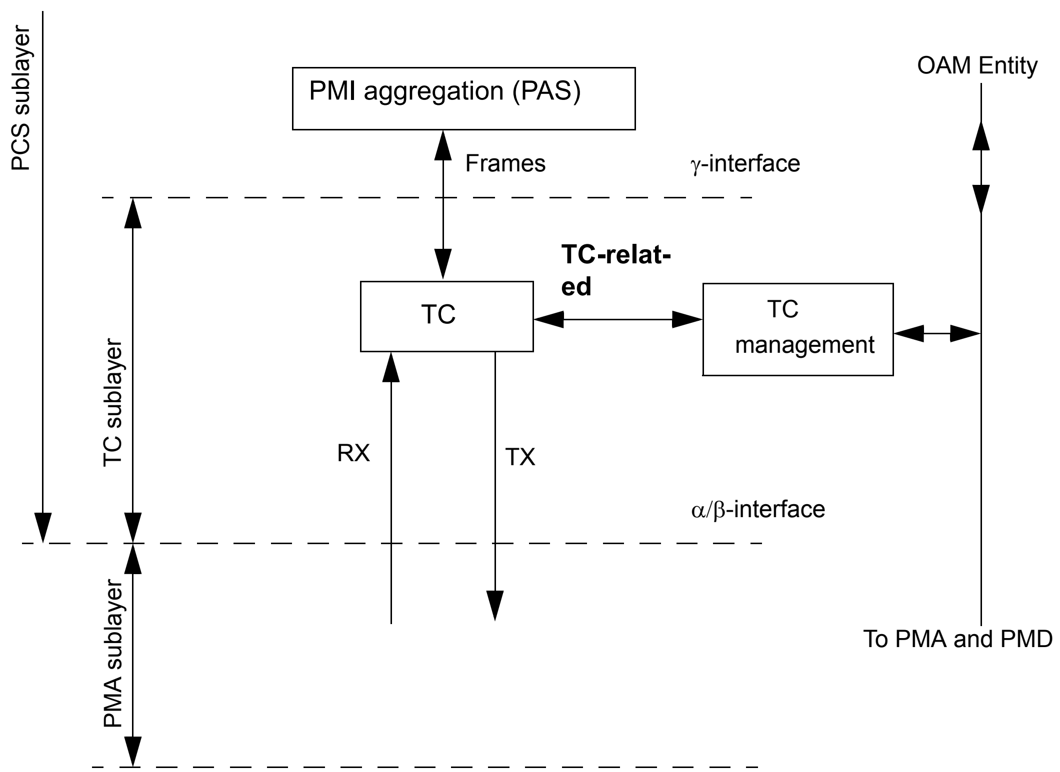


Figure 61–6—Functional model of TC sublayer

61.2.3.1 TC functional intefaces

61.2.3.1.1 The γ-interface: reference Annex H / G.993.1 section H.3.1 and all subsub-sections

Stet.

Additional Paragraph: The PAF shall never assert the TX_Err signal. The PAF shall continually asser the Tx_Avble signal.

Additional Paragraph: OAM Information flow across the gamma interface will support access to the registers defined in Clause 45. Refer to Clause 45 for a complete description of access to TC, PMA adn PMD registers from the MDIO interface.

61.2.3.1.2 The α/β-interface: reference G.993.1 section 7.1

Stet.

Additional Paragraphs:

More detailed description of alpha/beta-interface can be found in 62.1.4.1. All references to dual latency should be ignored. Dual latency is not supported by EFM PHYs, and Ethernet does not suppport virtual-circuit.

The detailed Management flow description is presented in the following sections.

Access to local and remote PMA adn PMD parameters is defined in Clause 45. Refer to Clause 45 for mechanisms to access local and remote registers via the MDIO interface.

Refer to Clauses 62 and 63 for definitions of the G.994 messaging, Operation Channel (OC) and Indicator Bits (IB) mechanisms for accessing remote parameters.

61.2.3.2 TC functions: reference Annex H / G.993.1 section H.4, and all subsections.

Stet, plus additional introductory paragraphs at the top:

The TC shall provide full transparent transfer of data frames between g_O and g_R interfaces (except non-correctable errors caused by the transmission medium). It shall also provide packet integrity and packet error monitoring capability.

In the transmit direction, TC gets the data frame to be sent from the g-interface and passes to the PMA via a/b interface. In the receive direction, TC gets the received data from the PMA via a/b interface, then recovers the transported TC frame, and submits it to the g-interface.

The bit rate of data transport in the upstream and downstream directions may be set independently of each other to any eligible value up to the maximum rate determined by the PMD. Both the upstream and downstream maximum data bit rates are set during the system configuration.

61.3 Handshaking and PHY control specification for type 2BASE-TL/2PASS-TL and 10PASS-TS

61.3.1 Overview

This subclause defines the startup and handshaking procedures by incorporating G.994.1 by reference. The G.994.1 parameter values and options to be used by 2BASE-TL/2PASS-TL and 10PASS-TS are specified here.

61.3.1.1 Scope: reference G.994.1 section 1 Scope, with changes shown

This subclause defines signals, messages, and procedures for exchanging these between 2BASE-TL/2PASS-TL and 10PASS-TS port types, when the modes of operation of the equipment need to be automatically established and selected, but before signals are exchanged which are specific to a particular port type.

The startup procedures defined here are compatible with those used by other equipment on the public access network, such as DSL transceivers compliant with ITU-T Recommendations. For interrelationships of this subclause with ITU-T G.99x-series Recommendations, see Recommendation G.995.1 (informative).

The principal characteristics of this subclause are as follows:

a) use over metallic local loops;

b) provisions to exchange capabilities information between DSL equipment and EFM PHYs to identify common modes of operation;

c) provisions for equipment at either end of the loop to select a common mode of operation or to request the other end to select the mode;

d) provisions for exchanging non-standard information between equipment;

e) provisions to exchange and request service and application related information;

f) support for both duplex and half-duplex transmission modes;

g) support for multi-pair operation;

h) provisions for equipment at the remote end of the loop (xTU-R) to propose a common mode of operation

61.3.1.2 Purpose

It is the goal of the ITU-T that all specifications for digital tranceivers for use on public telephone network copper subscriber lines use G.994.1 for startup. G.994.1 procedures allow for a common mechanism for identification of available features, exchange of capabilities and configuration information, and selection of operating mode. As the two loop endpoints are usually separated by a large distance (e.g., in separate buildings) and often owned and installed by different entities, G.994.1 also aids in diagnosing interoperability problems. G.994.1 codespaces have been assigned by ITU-T to ATIS, ETSI, and IEEE 802.3 in support of this goal.

61.3.2 References: reference G.994.1 section 2, References

Stet

61.3.3 Definitions: reference G.994.1 section 3, Definitions

Stet

61.3.3.1 Acronyms and abbreviations: reference G.994.1 section 4, Abbreviations

Stet

61.3.4 System reference diagram: reference G.994.1 section 5

Subclause editor's note: Globally, change "this Recommendation" to "this sublclause" from here forward. Paragraphs which require only this change will stil be labelled "Stet".

All Paragraphs: Stet.

61.3.5 Signals and modulation

61.3.5.1 Description of signals: reference G.994.1 section 6.1

All Paragraphs prior to NOTE 4: Stet.

NOTE 4 – Not Applicable.

NOTE 5 – Not Applicable.

61.3.5.1.1 4.3125 kHz signalling family: reference G.994.1 section 6.1.1

Paragraph 1: Stet.

Paragraph 2: Stet.

Paragraph 3: The carrier sets in this family are mandatory for the Port Types listed in Table 2. One or more carriers listed in Tables 1 or 3 may be transmitted in addition to the mandatory carrier set listed in Table 2. Carriers not listed in Tables 1 or 3 shall not be transmitted.

Table 61–1—Carrier sets for the 4.3125 kHz signalling family

Table: Stet.

Table 61–2—Mandatory carrier sets

xDSL Recommendation(s)	Carrier set designation
G.992.1 – Annex A, G.992.2 – Annex A/B	A43
G.992.1 – Annex B	B43
G.992.1 – Annex C, G.992.2 – Annex C, G.992.1 – Annex H	C43
2BASE-TL/2PASS-TL	TBD
10PASS-TS	TBD

61.3.5.1.2 4 kHz signalling family: reference G.994.1 section 6.1.2

Paragraph 1: Stet.

Paragraph 2: Stet.

Paragraph 3: The carrier sets in this family are mandatory for the Port Types listed in Table 4. One or more carriers listed in Tables 1 or 3 may be transmitted in addition to the mandatory carrier set listed in Table 4. Carriers not listed in Tables 1 or 3 shall not be transmitted.

Table 61–3—Carrier sets for the 4 kHz signalling family

Table: Stet.

Table 61–4—Mandatory carrier sets

xDSL Recommendation(s)	Carrier set designation
G.991.2	A4
2BASE-TL/PASS-TL	TBD
10PASS-TS	TBD

61.3.5.2 Modulation: reference G.994.1 section 6.2

Stet.

61.3.5.3 Transmit filter characteristics: reference G.994.1 section 6.3

61.3.5.3.1 4.3125 kHz signalling family: reference G.994.1 section 6.3.1

Stet.

61.3.5.3.2 4 kHz signalling family: reference G.994.1 section 6.3.2

Stet.

61.3.6 Description of messages: reference G.994.1 section 7, including all subsections

Stet.

61.3.7 Structure of messages: reference G.994.1 section 8, including all subsections

Stet.

61.3.8 Message coding format: reference G.994.1 section 9

61.3.8.1 General: reference G.994.1 section 9.1

Stet.

61.3.8.2 Coding format for parameters in the I and S fields: reference G.994.1 section 9.2

Stet.

61.3.8.3 Parameter classification: reference G.994.1 section 9.2.1

Stet.

61.3.8.4 Order of transmission of parameters: reference G.994.1 section 9.2.2

Stet.

61.3.8.5 Delimiting and parsing of parameter blocks: reference G.994.1 section 9.2.3

Stet.

61.3.8.6 Identification field (I): reference G.994.1 section 9.3

Stet.

61.3.8.6.1 Message type: reference G.994.1 section 9.3.1

Stet.

61.3.8.6.2 Revision number: reference G.994.1 section 9.3.2

Stet.

Additional Paragraph: Equipment indicating 2BASE-TL/PASS-TL or 10PASS-TS functionality shall indicate Revision Number 2.

61.3.8.6.3 Vendor ID field: reference G.994.1 section 9.3.3

Stet.

61.3.8.6.4 Parameter field: reference G.994.1 section 9.3.4

Paragraph 1: Stet.

Paragraph 2: Stet.

Paragraph 3: Stet

Paragraph 4: The NPars and Spars used by 2BASE-TL/2PASS-TL and 10PASS-TS Ports are listed below, beginning with Table 61-5.

Table 61–5—Identification field – NPar(1) coding

Bits								NPar(1)s
8	7	6	5	4	3	2	1	
x	0	0	0	0	0	0	0	No parameters set in this octet

Tables 9.15-9.31/G.994.1 – Identification field – Relative power level/carrier – NPar(2) coding

Editor's Note: The use of the bits in these tables in EFM is TBD

Table 61–6— Identification field – SPar(1) coding – Octet 1

Bits								SPar(1)s
8	7	6	5	4	3	2	1	
x	0	0	0	0	0	0	0	No parameters set in this octet

Table 61–7—Identification field – SPar(1) coding – Octet 2

Bits								SPar(1)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Relative power level/carrier for upstream carrier set A43[a]
x	x	x	x	x	x	1	x	Relative power level/carrier for downstream carrier set A43*
x	x	x	x	x	1	x	x	Relative power level/carrier for upstream carrier set B43*
x	x	x	x	1	x	x	x	Relative power level/carrier for downstream carrier set B43*
x	x	x	1	x	x	x	x	Relative power level/carrier for upstream carrier set C43*
x	x	1	x	x	x	x	x	Relative power level/carrier for downstream carrier set C43*
x	1	x	x	x	x	x	x	Reserved for allocation by the ITU-T
x	0	0	0	0	0	0	0	No parameters in this octet

[a]The relative power level/carrier reported in a CLR, CL, MP, or MS message indicates the level used during the current G.994.1 session, including the start-up and cleardown procedures. It does not imply any requirements on the transmit power in this or future sessions.
Subclause Editor's Note: The use of these bits in EFM is TBD

61.3.8.7 Standard information field (S): reference G.994.1 section 9.4

Subclause Editor's Note: Philosophy of S Field coding. I propose here to assign a Level 1 bit for each of the two port types ITU-T Q4/15 has agreed to reserve two such bits. This puts the two EFM port types at the same level in the G.994.1 hierarchy as the transceiver standards from ITU-T, ATIS T1, and ETSI.

Even though the EFM-Cu standard is based on the same technology as some of these other standards, it is advantageous to follow this approach, rather than defining EFM as merely an application underneath each of the other transceivers. Advantages of this approach include:

- it avoids giving the IEEE standard the appearance of being in a subserviant role;

-at least one of the EFM-Cu candidate PMD's, does not have Level 2 parameters defined for it , and thus no where to put the "EFM bit";

-Current DSL transceivers have many Level 2 and Level 3 octets, in order to specify a long list of options. For EFM, most of these options will have fixed values, or will not be used. The setting of the Level 1 EFM bits will imply the fixed, EFM-specific values for these parameters, without the need to explicitly specify each and every one of them in lengthy CL and MS messages. The only Level 2 and Level 3 octets needed

in the EFM tree will be those that are still variable in the EFM standard. This can allow G.994.1 messages for EFM to be short and straightforward (for example, >50 pages of the G.994.1 standard are definitions of these bits);

-It gives IEEE more flexibility in implementing any further "primitive mode" functions within G.994.1 that may be deemed necessary, since the indication of EFM functionality is a Level 1 of the tree.

Hopefully, for EFM more of the variables in these remaining table will take on fixed values, in which case the associated octets will not need to be sent.

Paragraphs 1-5: Stet.

Table 61–8—Standard information field – NPar(1) coding

Bits								
8	7	6	5	4	3	2	1	**NPar(1)s**
x	x	x	x	x	x	x	1	Voiceband: V.8[a]
x	x	x	x	x	x	1	x	Voiceband: V.8 *bis*[*]
x	x	x	x	x	1	x	x	Silent period[b]
x	x	x	x	1	x	x	x	G.997.1[c]
x	x	x	1	x	x	x	x	Reserved for allocation by the ITU-T
x	x	1	x	x	x	x	x	Reserved for allocation by the ITU-T
x	1	x	x	x	x	x	x	Reserved for allocation by the ITU-T
x	0	0	0	0	0	0	0	No parameters in this octet

[a]Setting this bit to binary ONE in an MS message initiates the G.994.1 session cleardown procedure specified in 11.3, and requests a V.8 or V.8 *bis* handshake in the voiceband, with the xTU-R taking on the role of a calling station and the xTU-C taking on the role of an answering station.

[b]This bit shall be set to binary ONE in a CLR or CL message. Setting this bit to binary ONE in an MS message initiates the G.994.1 session cleardown procedure specified in 11.3, and requests a silence period at the other transmitter of approximately 1 minute. The station that invoked the silent period by transmitting MS may terminate the silent period prior to the 1 minute by restarting a G.994.1 session.

[c]The use of this bit is for further study and shall be set to binary ZERO in CLR, CL and MS.

Editor's Note: The use of these bits in EFM is TBD

Table 11.1 to Table 11.39: Not Applicable

Table 61–9—Standard information field – SPar(1) coding – Octet 1

Bits								
8	7	6	5	4	3	2	1	SPar(1)s – Octet 1
x	1	x	x	x	x	x	x	2PASS-TL or 2BASE-TL[a]
x	0	0	0	0	0	0	0	No parameters in this octet

[a] *Editor's Note: Final allocation of this bit is pending agreement with ITU-T*

Table 61–10—Standard information field – SPar(1) coding – Octet 2

Bits								
8	7	6	5	4	3	2	1	SPar(1)s – Octet 2
x	1	x	x	x	x	x	x	10PASS-TS[a]
x	0	0	0	0	0	0	0	No parameters in this octet

[a] *Editor's Note: Final allocation of thi bits is pending agreement with ITU-T*

Table 61–11—Standard information field – 10PASS-TS NPar(2) coding – Octet 1

Bits								
8	7	6	5	4	3	2	1	10PASS-TS NPar(2)s
x	x	x	x	x	x	x	1	Band A
x	x	x	x	x	x	1	x	Band B
x	x	x	x	x	1	x	x	Band C
x	x	x	x	1	x	x	x	Upstream use of 25-138 KHz band
x	x	x	1	x	x	x	x	Downstream use of 25-138 KHz band
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Editor's note:The 10PASS-TS Tables assume that the MCM options specified in Levels 2 and 3 of the Committee T1 standard (e.g., Clear EOC, cyclic extension length, RFI bands, etc.), will be fixed (either mandatory or unused) in EFM, and thus do not need to be specified here (since their value will be implied by the setting of the MCM bit). Obviously, the STM and ATM bits are implicitly zero.

Table 61–12—Standard information field – 10PASS-TS NPar(2) coding – Octet 2

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(2)s**
x	x	x	x	x	x	x	1	SCM PMD (10PASS-TS/QAM)
x	x	x	x	x	x	1	x	MCM PMD (10PASS-TS/DMT)
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–13—Standard information field – 10PASS-TS SPar(2) coding – Octet 1

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS SPar(2)s**
x	x	x	x	x	x	x	1	PMI Aggregation Discovery
x	x	x	x	x	x	1	x	Reserved for allocation by IEEE 802.3
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Editor's Note: The following tables for 2BASE-TL/2PASS-TL are derived from G.994.1 tables for G.991.2 and G.992.3 Annex J. Note, however, these are new tables to be added to the G.994.1 tree.

Editor's Note: Bits from Table 11.30.0.2 and 11.30.0.3 not needed, as EFM path is always PTM.

Editor's Note: Only one latency path in EFM, so the fSPAR(2) octets from Tables 11.30.0.4-11.30.0.9 are not needed

Table 61–14—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 1

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 1**
x	x	x	x	x	x	x	1	Clear if same
x	x	x	x	x	x	1	x	Reserved for allocation by IEEE 802.3
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–15—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 2

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 2**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 48 to 43

Table 61–16—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 3

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 3**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 42 to 37

Table 61–17—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 4

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 4**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 36 to 31

Table 61–18—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 5

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 5**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 30 to 25

Table 61–19—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 6

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 6**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 24 to 19

Table 61–20—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 7

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 7**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 18 to 13

Table 61–21—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 8

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 8**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 12 to 7

Table 61–22—Standard information field – 10PASS-TS NPar(3) coding - PMI Aggregation Discovery– Octet 9

Bits								
8	7	6	5	4	3	2	1	**10PASS-TS NPar(3)s - Octet 9**
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 6 to 1

Table 61–23—Standard information field – 2BASE-TL or 2PASS-TL - NPar(2) coding – Octet 1

Bits								
8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(2)s
x	x	x	x	x	x	x	1	2BASE-TL Training mode[a]
x	x	x	x	x	x	1	x	2BASE-TL PMMS mode*
x	x	x	x	x	1	x	x	2BASE-TL Band A Operation
x	x	x	x	1	x	x	x	2BASE-TL Band B Operatiuon
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

[a]Only one of these bits shall be set at any given time.

Table 61–24—Standard information field – 2BASE-TL or 2PASS-TL - NPar(2) coding – Octet 2

Bits								
8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(2)s
x	x	x	x	x	x	x	1	2PASS-TL Capability
x	x	x	x	x	x	1	x	2PASS-TL Short initialization
x	x	x	x	x	1	x	x	2PASS-TL Diagnostics mode
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–25—Standard information field – 2BASE-TL or 2PASS-TL - SPar(2) coding – Octet 1

Bits								
8	7	6	5	4	3	2	1	**2BASE-TL or 2PASS-TL SPar(2)s**
x	x	x	x	x	x	x	1	2BASE-TL Downstream training parameters
x	x	x	x	x	x	1	x	2BASE-TL Upstream training parameters
x	x	x	x	x	1	x	x	2BASE-TL Downstream PMMS parameters
x	x	x	x	1	x	x	x	2BASE-TL Upstream PMMS parameters
x	x	x	1	x	x	x	x	2BASE-TL Downstream framing parameters[a]
x	x	1	x	x	x	x	x	2BASE-TL Upstream framing parameters
x	x	0	0	0	0	0	0	No parameters in this octet

[a]*Editor's note: This assumes TPS-TC parameters will be fixed for EFM. Also, if Sync Words and Stuff bits are fixed for EFM, framing parameter Npar(3) fields will not be needed.*

Table 61–26—Standard information field – 2BASE-TL or 2PASS-TL SPar(2) coding – Octet 2

Bits								
8	7	6	5	4	3	2	1	**2PASS-TL SPar(2)s – Octet 1**
x	x	x	x	x	x	x	1	2PASS-TL Spectrum bounds upstream
x	x	x	x	x	x	1	x	2PASS-TL Spectrum shaping upstream
x	x	x	x	x	1	x	x	2PASS-TL Spectrum bounds downstream
x	x	x	x	1	x	x	x	2PASS-TL Spectrum shaping downstream
x	x	x	1	x	x	x	x	2PASS-TL Transmit signal images above the Nyquist frequency
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Editor's note: This assumes EFM only uses symmetric PSD's. Also, EFM may decide to disallow some lower base rate bits.

Table 61–27—Standard information field – 2BASE-TL or 2PASS-TL SPar(2) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2PASS-TL SPar(2)s – Octet 3
x	x	x	x	x	x	x	1	2PASS-TL Downstream overhead data rate
x	x	x	x	x	x	1	x	2PASS-TL Upstream overhead data rate
x	x	x	x	x	1	x	x	2PASS-TL Downstream PTM TPS-TC #0[a]
x	x	x	x	1	x	x	x	2PASS-TL Upstream PTM TPS-TC #0*
x	x	x	1	x	x	x	x	2PASS-TL Downstream PMS-TC latency path
x	x	1	x	x	x	x	x	2PASS-TL Upstream PMS-TC latency path
x	x	0	0	0	0	0	0	No parameters in this octet

[a] *Editor's Note:Number of TPS-TC fixed at 1 PTM-TC for EFM. Also, if spectrum information and TPS-TC and PMS-TC parameters are fixed for EFM, then the corresponding SPar(2) bits in Octets 2 & 3, and the corresponding NPar(3) fields, are unnecessary.*

Table 61–28—Standard information field – 2BASE-TL or 2PASS-TL SPar(2) coding – Octet 4

Bits 8	7	6	5	4	3	2	1	10PASS-TS SPar(2)s
x	x	x	x	x	x	x	1	PMI Aggregation Discovery
x	x	x	x	x	x	1	x	Reserved for allocation by IEEE 802.3
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–29—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s – Octet 1
x	x	0	x	x	x	x	x	Downstream PBO (dB) (bits 5-1 x 1.0 dB)
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3

Table 61–30—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 2

Bits								2BASE-TL downstream training NPar(3)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate unspecified by terminal
x	x	x	x	x	x	1	x	Reserved for allocation by IEEE 802.3
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Downstream base data rate = 192 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 256 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–31—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 3

Bits								2BASE-TL downstream training NPar(3)s – Octet 3
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate = 320 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 384 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 448 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 512 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 576 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 640 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–32—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 4

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s – Octet 4
x	x	x	x	x	x	x	1	Downstream base data rate = 704 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 768 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 832 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 896 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 960 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 1.024 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–33—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 5

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s – Octet 5
x	x	x	x	x	x	x	1	Downstream base data rate = 1.088 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 1.152 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 1.216 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 1.280 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 1.344 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 1.408 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–34—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 6

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s Octet 6
x	x	x	x	x	x	x	1	Downstream base data rate = 1.472 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 1.536 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 1.600 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 1.664 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 1.728 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 1.792 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–35—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 7

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s – Octet 7
x	x	x	x	x	x	x	1	Downstream base data rate = 1.856 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 1.920 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 1.984 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 2.048 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 2.112 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 2.176 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–36—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 8

Bits								2BASE-TL downstream training NPar(3)s – Octet 8
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate = 2.240 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 2.304 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–37—Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 9

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s – Octet 9
x	x	x	x	x	x	x	1	Downstream sub data rate = 0 kbit/s
x	x	x	x	x	x	1	x	Downstream sub data rate = 8 kbit/s
x	x	x	x	x	1	x	x	Downstream sub data rate = 16 kbit/s
x	x	x	x	1	x	x	x	Downstream sub data rate = 24 kbit/s
x	x	x	1	x	x	x	x	Downstream sub data rate = 32 kbit/s
x	x	1	x	x	x	x	x	Downstream sub data rate = 40 kbit/s
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–38— Standard information field – 2BASE-TL - Downstream training parameters - NPar(3) coding – Octet 10

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream training NPar(3)s – Octet 10
x	x	x	x	x	x	x	1	Downstream sub data rate = 48 kbit/s
x	x	x	x	x	x	1	x	Downstream sub data rate = 56 kbit/s
x	x	x	x	x	1	x	x	Downstream sub data rate unspecified by terminal
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–39—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream training NPar(3)s – Octet 1
x	x	0	x	x	x	x	x	Upstream PBO (dB) (bits 5-1 x 1.0 dB)
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3

Table 61–40—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream training NPar(3)s – Octet 2
x	x	x	x	x	x	x	1	Upstream base data rate unspecified by terminal
x	x	x	x	x	x	1	x	Reserved for allocation by IEEE 802.3
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Upstream base data rate = 192 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 256 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Editor's note: This assumes EFM only uses symmetric PSD's. Also, EFM may decide to disallow some lower base rate bits.

Table 61–41—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream training NPar(3)s – Octet 3
x	x	x	x	x	x	x	1	Upstream base data rate = 320 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 384 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 448 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 512 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 576 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 640 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–42—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 4

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream training NPar(3)s – Octet 4
x	x	x	x	x	x	x	1	Upstream base data rate = 704 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 768 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 832 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 896 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 960 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 1.024 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–43—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 5

Bits								2BASE-TL Upstream training NPar(3)s – Octet 5
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream base data rate = 1.088 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 1.152 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 1.216 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 1.280 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 1.344 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 1.408 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–44—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 6

Bits								2BASE-TL Upstream training NPar(3)s Octet 6
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream base data rate = 1.472 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 1.536 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 1.600 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 1.664 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 1.728 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 1.792 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–45—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 7

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream training NPar(3)s – Octet 7
x	x	x	x	x	x	x	1	Upstream base data rate = 1.856 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 1.920 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 1.984 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 2.048 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 2.112 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 2.176 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–46—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 8

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream training NPar(3)s – Octet 8
x	x	x	x	x	x	x	1	Upstream base data rate = 2.240 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 2.304 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–47—Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 9

Bits								2BASE-TL Upstream training NPar(3)s – Octet 9
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream sub data rate = 0 kbit/s
x	x	x	x	x	x	1	x	Upstream sub data rate = 8 kbit/s
x	x	x	x	x	1	x	x	Upstream sub data rate = 16 kbit/s
x	x	x	x	1	x	x	x	Upstream sub data rate = 24 kbit/s
x	x	x	1	x	x	x	x	Upstream sub data rate = 32 kbit/s
x	x	1	x	x	x	x	x	Upstream sub data rate = 40 kbit/s
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–48— Standard information field – 2BASE-TL - Upstream training parameters - NPar(3) coding – Octet 10

Bits								2BASE-TL Upstream training NPar(3)s – Octet 10
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream sub data rate = 48 kbit/s
x	x	x	x	x	x	1	x	Upstream sub data rate = 56 kbit/s
x	x	x	x	x	1	x	x	Upstream sub data rate unspecified by terminal
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–49—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream PMMS NPar(3)s – Octet 1
x	x	0	x	x	x	x	x	Downstream PBO (dB) (bits 5-1 x 1.0 dB)
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3

Table 61–50—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream PMMS NPar(3)s – Octet 2
x	x	x	x	x	x	x	1	Downstream base data rate unspecified by terminal
x	x	x	x	x	x	1	x	Transmit Silence
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Downstream base data rate = 192 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 256 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–51—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream PMMS NPar(3)s – Octet 3
x	x	x	x	x	x	x	1	Downstream base data rate = 320 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 384 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 448 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 512 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 576 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 640 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–52—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 4

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream PMMS NPar(3)s – Octet 4
x	x	x	x	x	x	x	1	Downstream base data rate = 704 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 768 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 832 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 896 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 960 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 1.024 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–53—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 5

Bits								2BASE-TL downstream PMMS NPar(3)s – Octet 5
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate = 1.088 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 1.152 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 1.216 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 1.280 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 1.344 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 1.408 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–54—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 6

Bits								2BASE-TL downstream PMMS NPar(3)s Octet 6
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate = 1.472 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 1.536 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 1.600 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 1.664 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 1.728 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 1.792 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–55—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 7

Bits								2BASE-TL downstream PMMS NPar(3)s – Octet 7
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate = 1.856 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 1.920 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Downstream base data rate = 1.984 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Downstream base data rate = 2.048 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Downstream base data rate = 2.112 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Downstream base data rate = 2.176 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–56—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 8

Bits								2BASE-TL downstream PMMS NPar(3)s – Octet 8
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Downstream base data rate = 2.240 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Downstream base data rate = 2.304 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–57—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 9

Bits								2BASE-TL downstream PMMS NPar(3)s – Octet 9
8	7	6	5	4	3	2	1	
x	x	0	0	0	0	0	0	Downstream PMMS duration unspecified by terminal
x	x	x	x	x	x	x	x	Downstream PMMS duration (bits 6-1 x 50 ms)
x	x	1	1	1	1	1	1	Reserved for allocation by IEEE 802.3

Table 61–58—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 10

Bits								2BASE-TL downstream PMMS NPar(3)s – Octet 10
8	7	6	5	4	3	2	1	
x	x	0	0	0	0	0	0	Downstream PMMS scrambler polynomial Index (i2, i1, i0)
x	x	1	1	1	1	1	1	Reserved for allocation by IEEE 802.3

Table 61–59—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 11

Bits								2BASE-TL downstream PMMS NPar(3)s – Octet 11
8	7	6	5	4	3	2	1	
x	x	1	x	x	x	x	x	Worst-case PMMS target margin (dB) (bits 5-1 x 1.0 dB - 10 dB)
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–60—Standard information field – 2BASE-TL - Downstream PMMS parameters - NPar(3) coding – Octet 12

Bits 8	7	6	5	4	3	2	1	2BASE-TL downstream PMMS NPar(3)s – Octet 12
x	x	1	x	x	x	x	x	Current-condition PMMS target margin (dB) (bits 5-1 x 1.0 dB - 10 dB)
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–61—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream PMMS NPar(3)s – Octet 1
x	x	0	x	x	x	x	x	Upstream PBO (dB) (bits 5-1 x 1.0 dB)
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3

Table 61–62—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream PMMS NPar(3)s – Octet 2
x	x	x	x	x	x	x	1	Upstream base data rate unspecified by terminal
x	x	x	x	x	x	1	x	Transmit Silence
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Upstream base data rate = 192 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 256 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–63—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream PMMS NPar(3)s – Octet 3
x	x	x	x	x	x	x	1	Upstream base data rate = 320 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 384 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 448 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 512 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 576 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 640 kbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–64—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 4

Bits								2BASE-TL Upstream PMMS NPar(3)s – Octet 4
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream base data rate = 704 kbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 768 kbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 832 kbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 896 kbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 960 kbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 1.024 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–65—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 5

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream PMMS NPar(3)s – Octet 5
x	x	x	x	x	x	x	1	Upstream base data rate = 1.088 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 1.152 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 1.216 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 1.280 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 1.344 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 1.408 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–66—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 6

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream PMMS NPar(3)s Octet 6
x	x	x	x	x	x	x	1	Upstream base data rate = 1.472 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 1.536 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 1.600 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 1.664 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 1.728 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 1.792 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–67—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 7

Bits								2BASE-TL Upstream PMMS NPar(3)s – Octet 7
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream base data rate = 1.856 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 1.920 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Upstream base data rate = 1.984 Mbit/s, symmetric PSD
x	x	x	x	1	x	x	x	Upstream base data rate = 2.048 Mbit/s, symmetric PSD
x	x	x	1	x	x	x	x	Upstream base data rate = 2.112 Mbit/s, symmetric PSD
x	x	1	x	x	x	x	x	Upstream base data rate = 2.176 Mbit/s, symmetric PSD
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–68—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 8

Bits								2BASE-TL Upstream PMMS NPar(3)s – Octet 8
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Upstream base data rate = 2.240 Mbit/s, symmetric PSD
x	x	x	x	x	x	1	x	Upstream base data rate = 2.304 Mbit/s, symmetric PSD
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–69—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 9

Bits								2BASE-TL Upstream PMMS NPar(3)s – Octet 9
8	7	6	5	4	3	2	1	
x	x	0	0	0	0	0	0	Upstream PMMS duration unspecified by terminal
x	x	x	x	x	x	x	x	Upstream PMMS duration (bits 6-1 x 50 ms)
x	x	1	1	1	1	1	1	Reserved for allocation by IEEE 802.3

Table 61–70—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 10

Bits								2BASE-TL Upstream PMMS NPar(3)s – Octet 10
8	7	6	5	4	3	2	1	
x	x	0	0	0	0	0	0	Upstream PMMS scrambler polynomial Index (i2, i1, i0)
x	x	1	1	1	1	1	1	Reserved for allocation by IEEE 802.3

Table 61–71—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 11

Bits								2BASE-TL Upstream PMMS NPar(3)s – Octet 11
8	7	6	5	4	3	2	1	
x	x	1	x	x	x	x	x	Worst-case PMMS target margin (dB) (bits 5-1 x 1.0 dB - 10 dB)
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–72—Standard information field – 2BASE-TL - Upstream PMMS parameters - NPar(3) coding – Octet 12

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream PMMS NPar(3)s – Octet 12
x	x	1	x	x	x	x	x	Current-condition PMMS target margin (dB) (bits 5-1 x 1.0 dB - 10 dB)
x	x	0	0	0	0	0	0	No parameters in this octet

Table 61–73—Standard information field – 2BASE-TL - Downstream framing parameters - NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2BASE-TL Downstream framing NPar(3)s – Octet 1
x	x					x	x	Sync Word (bits 14 and 13)
x	x	x	x	x	x			Stuff Bits (bits 1 to 4)

Table 61–74—Standard information field – 2BASE-TL - Downstream framing parameters - NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2BASE-TL Downstream framing NPar(3)s – Octet 2
x	x	x	x	x	x	x	x	Sync Word (bits 12 to 7)

Table 61–75—Standard information field – 2BASE-TL - Downstream framing parameters - NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2BASE-TL Downstream framing NPar(3)s – Octet 3
x	x	x	x	x	x	x	x	Sync Word (bits 6 to 1)

Editor's note: if sync words and stuff bits are fixed for EFM, the previous six octets are unnessary.

Table 61–76—Standard information field – 2BASE-TL - Upstream framing parameters - NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream framing NPar(3)s – Octet 1
x	x					x	x	Sync Word (bits 14 and 13)
x	x	x	x	x	x			Stuff Bits (bits 1 to 4)

Table 61–77—Standard information field – 2BASE-TL - Upstream framing parameters - NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream framing NPar(3)s – Octet 2
x	x	x	x	x	x	x	x	Sync Word (bits 12 to 7)

Table 61–78—Standard information field – 2BASE-TL - Upstream framing parameters - NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2BASE-TL Upstream framing NPar(3)s – Octet 3
x	x	x	x	x	x	x	x	Sync Word (bits 6 to 1)

Table 61–79—Standard information field – 2PASS-TL - Spectrum bounds upstream NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds upstream NPar(3)s – Octet 1
x	x	0	0	0	x	x	x	NOMPSDus (bits 9 to 7)

Table 61–80—Standard information field – 2PASS-TL - Spectrum bounds upstream NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds upstream NPar(3)s – Octet 2
x	x	x	x	x	x	x	x	NOMPSDus (bits 6 to 1)

Table 61–81—Standard information field – 2PASS-TL - Spectrum bounds upstream NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds upstream NPar(3)s – Octet 3
x	x	0	0	0	x	x	x	MAXNOMPSDus (bits 9 to 7)

Table 61–82—Standard information field – 2PASS-TL - Spectrum bounds upstream NPar(3) coding – Octet 4

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds upstream NPar(3)s – Octet 4
x	x	x	x	x	x	x	x	MAXNOMPSDus (bits 6 to 1)

Table 61–83—Standard information field – 2PASS-TL - Spectrum bounds upstream NPar(3) coding – Octet 5

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds upstream NPar(3)s – Octet 5
x	x	0	0	0	x	x	x	MAXNOMATPus (bits 9 to 7)

Table 61–84—Standard information field – 2PASS-TL - Spectrum bounds upstream NPar(3) coding – Octet 6

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds upstream NPar(3)s – Octet 6
x	x	x	x	x	x	x	x	MAXNOMATPus (bits 6 to 1)

Table 61–85—Standard information field – 2PASS-TL - Spectrum shaping upstream NPar(3) coding – Octet 1

Bits								2PASS-TL Spectrum shaping upstream NPar(3)s – Octet 1
8	7	6	5	4	3	2	1	
x	x	0	0	x	x	x	x	“First” subcarrier index i (bits 9 to 6)

Table 61–86—Standard information field – 2PASS-TL - Spectrum shaping upstream NPar(3) coding – Octet 2

Bits								2PASS-TL Spectrum shaping upstream NPar(3)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x		“First” subcarrier index i (bits 5 to 1)
x							x	“First” log_tss_i (bit 7)

Table 61–87—Standard information field – 2PASS-TL - Spectrum shaping upstream NPar(3) coding – Octet 3

Bits								2PASS-TL Spectrum shaping upstream NPar(3)s – Octet 3
8	7	6	5	4	3	2	1	
x		x	x	x	x	x	x	“First” log_tss_i (bits 6 to 1)

Table 61–88—Standard information field – 2PASS-TL - Spectrum shaping upstream NPar(3) coding – Octet 3(j-1) + 1

Bits								2PASS-TL Spectrum shaping upstream NPar(3)s – Octet 3(j-1) + 1[a]
8	7	6	5	4	3	2	1	
x	x	0	0	x	x	x	x	“Last” subcarrier index i (bits 9 to 6)

[a] j is the number of subcarrier indices used to specify the spectral shape

Table 61–89—Standard information field – 2PASS-TL - Spectrum shaping upstream NPar(3) coding – Octet 3(j-1) + 2

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum shaping upstream NPar(3)s – Octet 3(j-1) + 2
x	x	x	x	x	x	x		"Last" subcarrier index i (bits 5 to 1)
x							x	"Last" log_tss_i (bit 7)

Table 61–90—Standard information field – 2PASS-TL - Spectrum shaping upstream NPar(3) coding – Octet 3(j-1) + 3

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum shaping upstream NPar(3)s – Octet 3(j-1) + 3
x		x	x	x	x	x	x	"Last" log_tss_i (bits 6 to 1)

Table 61–91—Standard information field – 2PASS-TL - Spectrum bounds Downstream NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds Downstream NPar(3)s – Octet 1
x	x	0	0	0	x	x	x	NOMPSDds (bits 9 to 7)

Table 61–92—Standard information field – 2PASS-TL - Spectrum bounds Downstream NPar(3) coding – Octet 2

Bits								2PASS-TL Spectrum bounds Downstream NPar(3)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	NOMPSDds (bits 6 to 1)

Table 61–93—Standard information field – 2PASS-TL - Spectrum bounds Downstream NPar(3) coding – Octet 3

Bits								2PASS-TL Spectrum bounds Downstream NPar(3)s – Octet 3
8	7	6	5	4	3	2	1	
x	x	0	0	0	x	x	x	MAXNOMPSDds (bits 9 to 7)

Table 61–94—Standard information field – 2PASS-TL - Spectrum bounds Downstream NPar(3) coding – Octet 4

Bits								2PASS-TL Spectrum bounds Downstream NPar(3)s – Octet 4
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	MAXNOMPSDds (bits 6 to 1)

Table 61–95—Standard information field – 2PASS-TL - Spectrum bounds Downstream NPar(3) coding – Octet 5

Bits								2PASS-TL Spectrum bounds Downstream NPar(3)s – Octet 5
8	7	6	5	4	3	2	1	
x	x	0	0	0	x	x	x	MAXNOMATPds (bits 9 to 7)

Table 61–96—Standard information field – 2PASS-TL - Spectrum bounds Downstream NPar(3) coding – Octet 6

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum bounds Downstream NPar(3)s – Octet 6
x	x	x	x	x	x	x	x	MAXNOMATPds (bits 6 to 1)

Table 61–97—Standard information field – 2PASS-TL - Spectrum shaping Downstream NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum shaping Downstream NPar(3)s – Octet 1
x	x	0	0	x	x	x	x	“First” subcarrier index i (bits 9 to 6)

Table 61–98—Standard information field – 2PASS-TL - Spectrum shaping Downstream NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum shaping Downstream NPar(3)s – Octet 2
x	x	x	x	x	x	x		“First” subcarrier index i (bits 5 to 1)
x	x						x	“First” log_tss_i (bit 7)

Table 61–99—Standard information field – 2PASS-TL - Spectrum shaping Downstream NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2PASS-TL Spectrum shaping Downstream NPar(3)s – Octet 3
x		x	x	x	x	x	x	“First” log_tss_i (bits 6 to 1)

Table 61–100—Standard information field – 2PASS-TL - Spectrum shaping Downstream NPar(3) coding – Octet 3(j-1) + 1

Bits								2PASS-TL Spectrum shaping Downstream NPar(3)s – Octet 3(j-1) + 1[a]
8	7	6	5	4	3	2	1	
x	x	0	0	x	x	x	x	"Last" subcarrier index i (bits 9 to 6)

[a]j is the number of subcarrier indices used to specify the spectral shape

Table 61–101—Standard information field – 2PASS-TL - Spectrum shaping Downstream NPar(3) coding – Octet 3(j-1) + 2

Bits								2PASS-TL Spectrum shaping Downstream NPar(3)s – Octet 3(j-1) + 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x		"Last" subcarrier index i (bits 5 to 1)
x	x						x	"Last" log_tss$_i$ (bit 7)

Table 61–102—Standard information field – 2PASS-TL - Spectrum shaping Downstream NPar(3) coding – Octet 3(j-1) + 3

Bits								2PASS-TL Spectrum shaping Downstream NPar(3)s – Octet 3(j-1) + 3
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	"Last" log_tss$_i$ (bits 6 to 1)

Table 11.30.8/G.994.1 – Standard information field – 2PASS-TL

Table 61–103—Standard information field – 2PASS-TL - Transmit signal images above the Nyquist frequency NPar(3) coding

Bits 8	7	6	5	4	3	2	1	2PASS-TL transmit signal images above the Nyquist frequency NPar(3)s
x	x	x	x	x	x			IDFT size N
x	x					x	x	IFFT fill

Table 61–104—Standard information field – 2PASS-TL - Downstream overhead data rate NPar(3) coding

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream overhead data rate NPar(3)s
x	x	x	x	x	x	x	x	Minimum overhead data rate ((n+1) * 1 kbit/s, n=3 to 63)

Table 61–105—Standard information field – 2PASS-TL - Upstream overhead data rate NPar(3) coding

Bits 8	7	6	5	4	3	2	1	2PASS-TL upstream overhead data rate NPar(3)s
x	x	x	x	x	x	x	x	Minimum overhead data rate ((n+1) * 1 kbit/s, n=3 to 63)

Table 61–106—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 1
x	x	x	x	x	x	x	x	Net_min (minimum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–107—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 2

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 2
x	x	x	x	x	x	x	x	Net_min (minimum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–108—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 3

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 3
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–109—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 4

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 4
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–110—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 5

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 5
x	x	x	x	x	x	x	x	Net_reserve (Minimum reserved net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–111—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 6

Bits 8	7	6	5	4	3	2	1	2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 6
x	x	x	x	x	x	x	x	Net_reserve (Minimum reserved net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–112—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 7

Bits								2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 7
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Delay_max (Maximum delay) (n milliseconds, n = 0 to 63)

Table 61–113—Standard information field – 2PASS-TL Downstream PTM TPS-TC #0 NPar(3) coding – Octet 8

Bits								2PASS-TL downstream PTM TPS-TC #0 NPar(3)s – Octet 8
8	7	6	5	4	3	2	1	
x	x					x	x	Error_max (Maximum bit error ratio)
x	x		x	x	x			Reserved for allocation by IEEE 802.3
x	x	x						Reserved for allocation by IEEE 802.3

Table 61–114—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 1

Bits								2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 1
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_min (minimum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–115—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 2

Bits								2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_min (minimum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–116—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 3

Bits								2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 3
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–117—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 4

Bits								2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 4
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–118—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 5

Bits								2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 5
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_reserve (Minimum reserved net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–119—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 6

Bits 8	7	6	5	4	3	2	1	2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 6
x	x	x	x	x	x	x	x	Net_reserve (Minimum reserved net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–120—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 7

Bits 8	7	6	5	4	3	2	1	2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 7
x	x	x	x	x	x	x	x	Delay_max (Maximum delay) (n milliseconds, n = 0 to 63)

Table 61–121—Standard information field – 2PASS-TL Upstream PTM TPS-TC #0 NPar(3) coding – Octet 8

Bits 8	7	6	5	4	3	2	1	2PASS-TL Upstream PTM TPS-TC #0 NPar(3)s – Octet 8
x	x					x	x	Error_max (Maximum bit error ratio)
x	x		x	x	x			Reserved for allocation by IEEE 802.3
x	x	x						Reserved for allocation by IEEE 802.3

Table 61–122—Standard information field – 2PASS-TL Downstream PMS-TC latency path #0 NPar(3) coding – Octet 1

Bits 8	7	6	5	4	3	2	1	2PASS-TL Downstream PMS-TC #0 latency path NPar(3)s – Octet 1
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

61.3.8.8 Non-standard information field (NS): reference G.994.1 section 9.5

Add this paragraph: The contents of the NS informtion field are outside the scope of this Standard.

Table 61–123—Standard information field – 2PASS-TL Downstream PMS-TC latency path #0 NPar(3) coding – Octet 2

Bits								2PASS-TL Downstream PMS-TC #0 latency path NPar(3)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–124—Standard information field – 2PASS-TL Upstream PMS-TC latency path #0 NPar(3) coding – Octet 1

Bits								2PASS-TL Upstream PMS-TC #0 latency path NPar(3)s – Octet 1
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 12 to 7)

Table 61–125—Standard information field – 2PASS-TL Upstream PMS-TC latency path #0 NPar(3) coding – Octet 2

Bits								2PASS-TL Upstream PMS-TC #0 latency path NPar(3)s – Octet 2
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	x	Net_max (maximum net data rate) (n * 4 kbit/s, n = 0 to 4095, bits 6 to 1)

Table 61–126—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 1

Bits								2BASE-TL or 2PASS-TL NPar(3)s - Octet 1
8	7	6	5	4	3	2	1	
x	x	x	x	x	x	x	1	Clear if same
x	x	x	x	x	x	1	x	Reserved for allocation by IEEE 802.3
x	x	x	x	x	1	x	x	Reserved for allocation by IEEE 802.3
x	x	x	x	1	x	x	x	Reserved for allocation by IEEE 802.3
x	x	x	1	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	1	x	x	x	x	x	Reserved for allocation by IEEE 802.3
x	x	0	0	0	0	0	0	No parameters in this octet

Stet.

Table 61–127—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 2

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 2
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 48 to 43

Table 61–128—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 3

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 3
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 42 to 37

Table 61–129—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 4

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 4
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 36 to 31

Table 61–130—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 5

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 5
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 30 to 25

Table 61–131—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 6

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 6
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 24 to 19

61.3.8.9 Overall message composition: reference G.994.1 section 9.6

Stet.

Table 61–132—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 7

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 7
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 18 to 13

Table 61–133—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 8

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 8
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 12 to 7

Table 61–134—Standard information field – 2BASE-TL or 2PASS-TL NPar(3) coding - PMI Aggregation Discovery– Octet 9

Bits 8	7	6	5	4	3	2	1	2BASE-TL or 2PASS-TL NPar(3)s - Octet 9
x	x	x	x	x	x	x	1	PMI Aggregation register, bits 6 to 1

61.3.9 G.994.1 transactions: reference G.994.1 section 10, including subsections

Stet.

61.3.10 Start-up/cleardown procedures: reference G.994.1 section 11

61.3.10.1 Duplex start-up procedures: reference G.994.1 section 11.1

Stet.

61.3.10.2 Half-duplex start-up procedures: reference G.994.1 section 11.2

Stet.

Subclause Editor's note: Whether to permit half-duplex startup for EFM is TBD.

61.3.10.3 Cleardown procedure: reference G.994.1 section 11.3

Stet.

61.3.11 Error recovery procedures: reference G.994.1 section 12

Stet.

Annex A / G.994.1 - Support for legacy non-G.994.1 devices - not applicable

Annex B / G.994.1 - operation over multiple wire pairs - not applicable to the multipair operation for EFM

Appendix I / G.994.1 - not applicable

Appendix II / G.994.1 - Provider Code contact Information - Stet.

Appendix III / G.994.1 - support for legacy DMT-based devices - not applicable

Appendix IV / G.994.1 - Procedure for the assignment of additional G.994.1 parameters - not applicable

Appendix V / G.994.1 - Rules for code point table numbering - not applicable

Appendix VI / G.994.1 - Bibliography

61.4 PMA service interface

61.5 Link segment characteristics

61.6 MDI specification

61.7 System considerations

61.8 Environmental specifications

61.9 PHY labeling

61.10 Timing summary

61.11 Protocol Implementation Conformance Statement (PICS) proforma for Clause 61, Physical Coding Sublayer (PCS) type 10PASS-TS, 2BASE-TL, 2PASS-TL

61.11.1 Introduction

61.11.2 Identification

61.11.2.1 Implementation identification

61.11.2.2 Protocol summary

61.11.3 Major capabilities/options

61.11.4 PICS proforma tables for the Physical Coding Sublayer (PCS) type 10PASS-TS, 2BASE-TL, 2PASS-TL

Annex 61A

(informative)

Spectrally compatible band plans and PSDs

Editors's note:

The purpose of this annex is to show how different PSDs and new PSDs can be defined and be shown that they are spectrally compatible with both plan 998 and 997: the only two bandplans approved by ITU-T standards and ANSI standards and the only ones that IEEE are now considering.

The selection of band plans is accomplished using network management tools. There could be a directory of IEEE pre-approved bandplans that short reach port type and long reach port type have to meet. There could be regional bandplans that are not spectrally compatible with plan 998 or 997 and they must be approved by IEEE and in such cases it could lead to a different port type.

In this annex it is shown how a PSD can be selected and be shown to be spectrally compatible with plan 998. This is only an example and its purpose is to show how spectral compatibility in conjunction with network management can be used to achieve new PSDs.

The example_PSD_1 defined here is such that it should meet VDSL compatibility requirements for up to 5000 ft per guidelines of T1E1.4 contribution 159-R2 and other T1.417 documents

Spectral Compatibility Guideline

The spectral compatibility guideline was obtained by assuring that the new service will not disturb the guaranteed data rates for VDSL basis system as shown below.

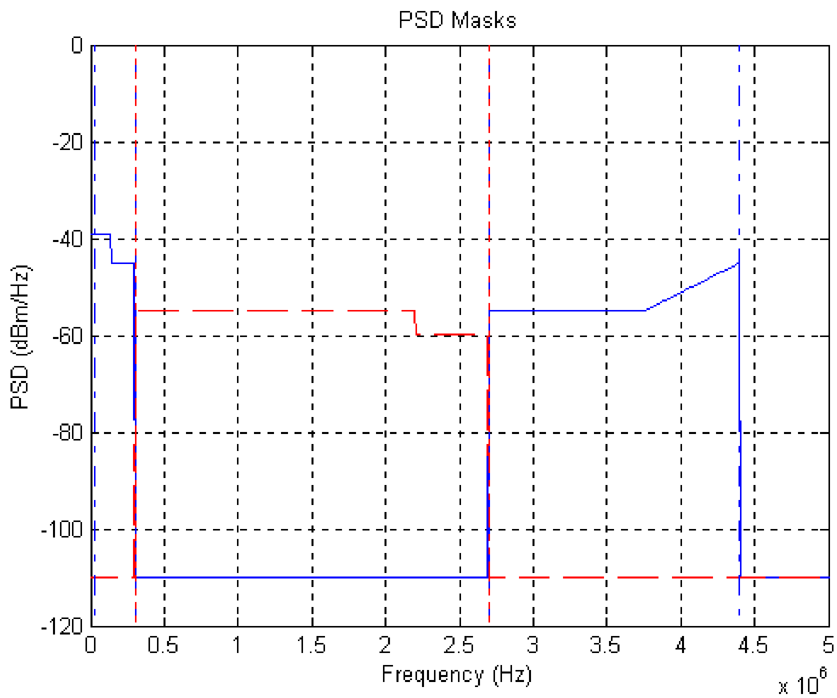
Performance level	Loop length (kft)	Upstream Mbps	Downstream Mbps
A	0.5	15.66	42.29
B	1	14.01	42.29
C	1.5	12.86	38.85
D	2	11.97	36.29
E	2.5	9.08	32.5
F	3	5.47	26.3
G	3.5	3.66	22.12
H	4	1.65	18.70
I	4.5	0.42	15.40
J	5	0.074	11.67

Table 61A–1—Basis VDSL performance level tests.

Example: Spectral compatibility for example_PSD_1

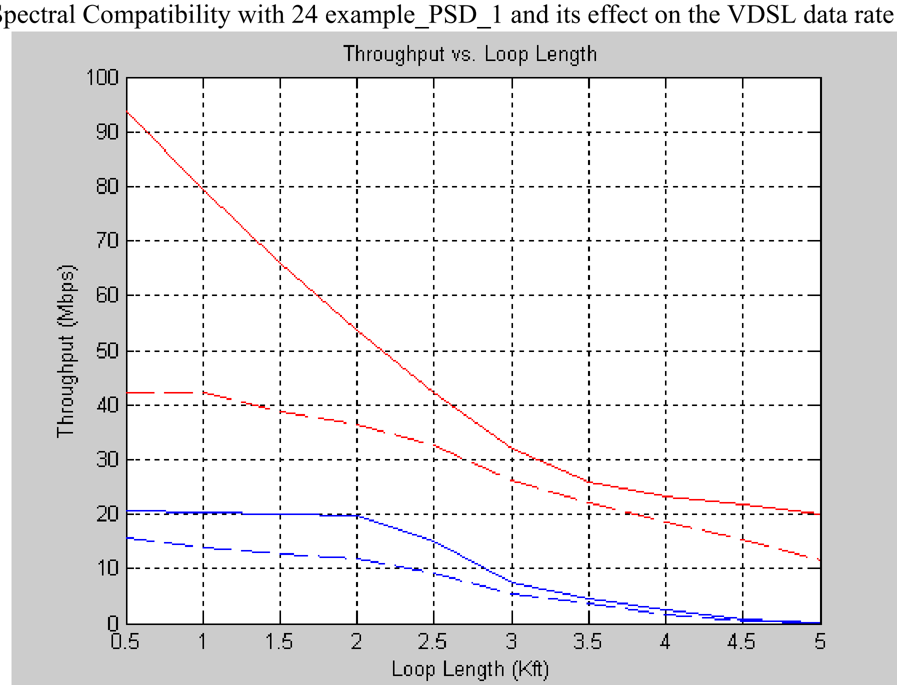
The overall transmission power is assumed to be 14.5 dBm in either direction which is similar to VDSL M2 mask and SHDSL transmit power. Note that in the simulation, none of the modem parameters are important such as coding gain, interleaver, scramblers etc.

This mask or template is defined for loops or installations below 5 kft

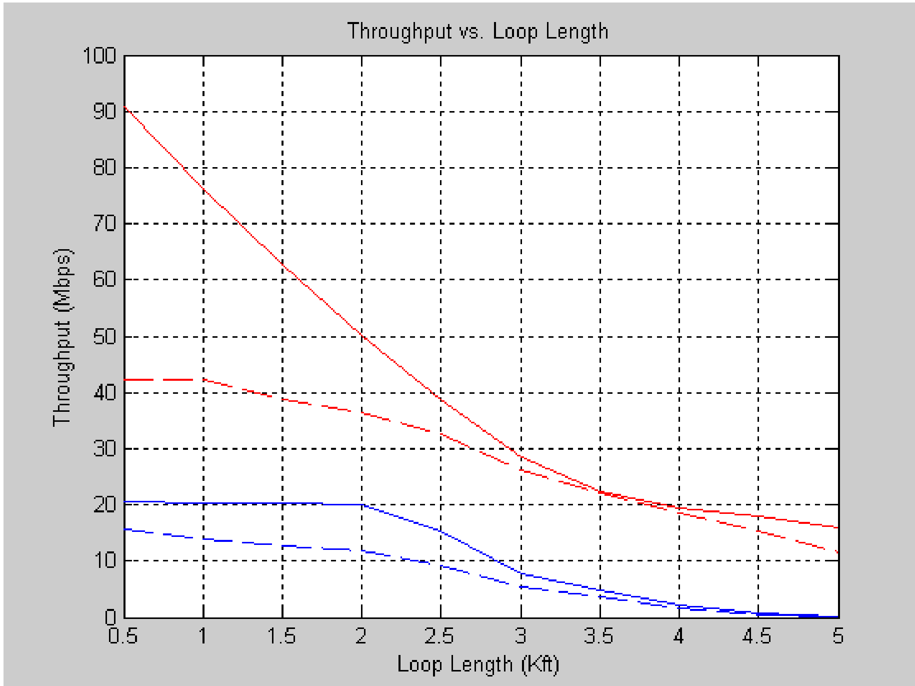


Now we have to use this example_PSD_1 and determine whether in presence and VDSL system it could not harm the VDSL systems. In the next three figures the calculated disturbed VDSL data rate in the presence of example_PSD_1 is calculated. If any of the solid lines cross the dashed lines, then spectral compatibility is not met.

Figure 2: Spectral Compatibility with 24 example_PSD_1 and its effect on the VDSL data rate plan 998



Spectral Compatibility with 12 example_PSD_1 and 12 SM9



Spectral Compatibility with 12 MDSL and 12 SM6