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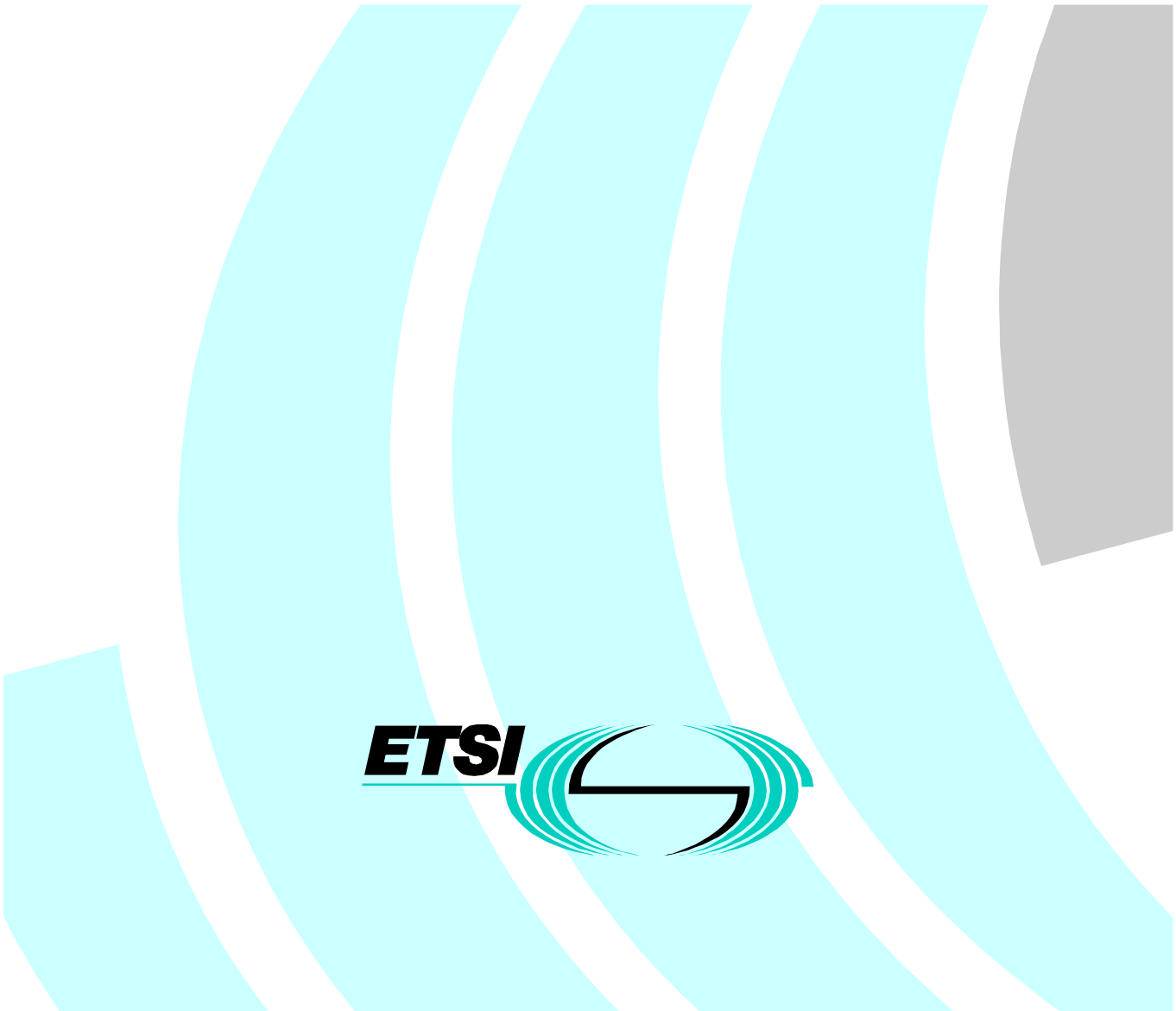
ETSI Standard

Terrestrial Trunked Radio (TETRA); Digital Advanced Wireless Service (DAWS); Physical Layer (PHY) service description



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ETSI

Postal address
F-06921 Sophia Antipolis Cedex - FRANCE

Office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Internet
secretariat@etsi.fr
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Contents

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Foreword

This ETSI Standard (ES) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA), and is now submitted for the ETSI standards Membership Approval Procedure.

An overview of the requirements for DAWS can be found in TR 101 156.

1 Scope

The present document specifies the service requirements for the Digital Advanced Wireless Service (DAWS) Physical (PHY) layer. The document describes the general service characteristics of a DAWS PHY layer which can interwork successfully with a DAWS MAC. Specific service details will be provided in a future version of the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, subsequent revisions do apply.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] TR 101 156: "Terrestrial Trunked Radio (TETRA);Technical requirements specification for Digital Advanced Wireless Service (DAWS)".

[2] TS 101 659: "Digital Advanced Wireless Service (DAWS); Medium Access Control (MAC); service description".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

base station: Piece of equipment providing simultaneous, bi-directional network access to mobile stations.

block: Fixed-length sequence of bytes from a MAC PDU.

downlink: General term meaning "from the base station to the mobile station".

mobile station: Piece of equipment able to create and consume data but only having network access via a base station.

frame: Minimum time period reserved for transmission by a single mobile station on a single frequency.

multiframe: Time period consisting of an integral number of frames between base station broadcasts specifying mobile station bandwidth assignments.

protocol data unit: Set of parameters and/or data passed from peer to peer by a protocol primitive.

protocol primitive: Request, response, or informative message sent from peer to peer.

service data unit: Set of parameters and/or data passed between adjacent layers by a service primitive.

service primitive: Request, response, or informative message sent between adjacent layers.

uplink: General term meaning "from the mobile station to the base station".

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

BS	Base Station
DAWS	Digital Advanced Wireless Service
DL	Downlink
IP	Internet Protocol
LLC	Logical Link Control
MAC	Medium Access Control
MF	Multiframe
MPDU	MAC Protocol Data Unit
MS	Mobile Station
PDU	Protocol Data Unit
PHY	Physical Layer
PHY_LNK	PHY Link Management Service
PHY_TPT	PHY Transport Service
SAP	Service Access Point
SDU	Service Data Unit
UL	Uplink

4 Introduction

The DAWS protocol architecture is provided in TR 101 156 [1]. The Physical Layer (PHY) provides services to the Medium Access Control (MAC) TS 101 659 [2]. The present document provides the requirements the PHY service must satisfy to operate successfully within a Digital Advanced Wireless Service (DAWS) network. The requirements in the present document apply to the integrated DAWS subnet described in TR 101 156 [1].

The prefix PHY will be used when a requirement applies to both the BS and MS PHY layers. The prefix BS_PHY or MS_PHY will be used when a requirement applies only to the BS or MS PHY layers, respectively.

As shown in figure 1, the Medium Access Control (MAC) accesses PHY services via service access points (SAPs) A and B. PHY_SAP_A is for data transfer service primitives and PHY_SAP_B is for local control and status service primitives.

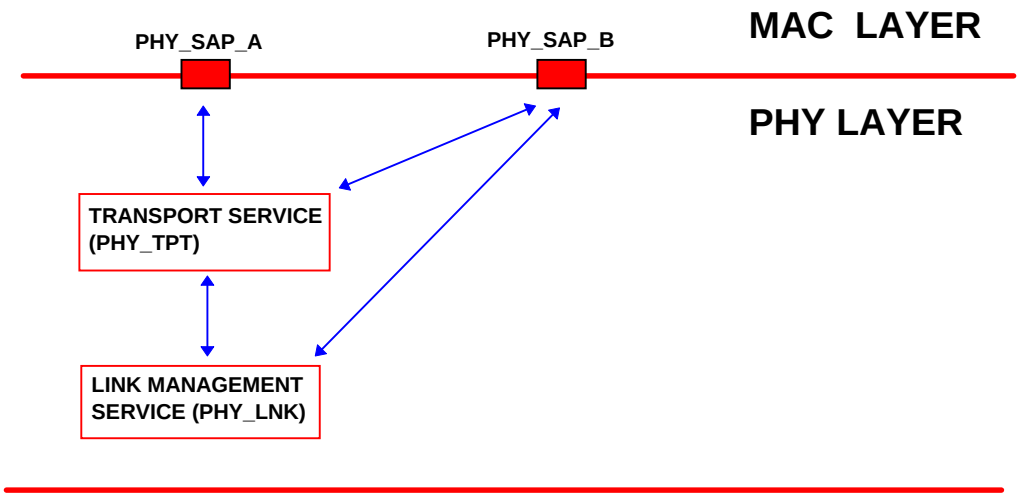

Figure 1: DAWS PHY Architecture

Requirements for the transport and link management services are provided in clauses 5 and 6. Service primitives and associated service data units are provided in clause 7.

5 Link Management Services

The PHY link management service (PHY_LNK) manages the wireless link between the BS and MS, including modulating and demodulating RF carriers with bit patterns (blocks) provided by PHY_TPT.

BS_PHY_LNK is responsible for generating and transmitting the synchronization block and for transmitting any downlink data blocks provided by BS_PHY_TPT. BS_PHY_LNK is also responsible for receiving uplink data blocks and transferring them to BS_PHY_TPT for uplink PDU reconstruction.

MS_PHY_LNK synchronizes with BS_PHY_LNK based on received timing information. MS_PHY_LNK is responsible for sending uplink blocks and receiving downlink blocks. MS_PHY_LNK transfers downlink blocks to MS_PHY_TPT for downlink PDU reconstruction. MS_PHY_LNK performs power management, including support for power-saving modes of operation. MS_PHY_LNK handles MAC hunt requests and cell service requests, and performs channel quality monitoring.

5.1 Downlink MAC PDU transfers over the PHY

Figure 2 provides a flow diagram illustrating the messages exchanged to transfer a downlink MAC PDU using dynamic bandwidth allocation. The message flow can be traced as follows:

1) BS_MAC sends a **PHY_frame_assignment_request** service primitive to BS_PHY during multiframe N containing frame assignments for multiframe N + 2. A frame assignment specifies whether the BS, a particular MS, or all MS are permitted to transmit in the frame;

2) BS_PHY sends the frame assignment information to the MS_PHY during frame 0 of multiframe N + 1. MS_PHY immediately transfers the frame assignment information to MS_MAC;

3) During multiframe N + 1, BS_MAC issues MAC PDU transfer request service primitives to BS_PHY to fill its assigned downlink frames during multiframe N + 2. BS_PHY performs MAC PDU block encoding and any other tasks necessary to prepare the PDU blocks for transfer during multiframe N + 2;

4) BS_PHY transfers PDU blocks to MS_PHY in its assigned frames during multiframe N + 2;

5) MS_PHY reassembles the downlink MAC PDU from the received blocks and sends the resulting MAC PDU to MS_MAC.

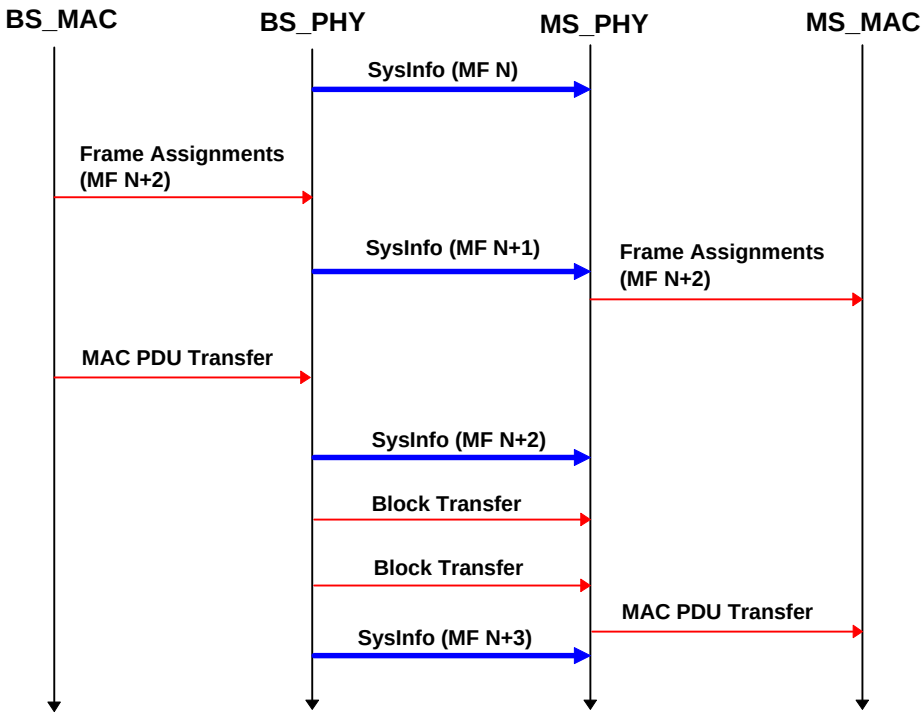

Figure 2: Downlink MAC PDU Transfers Using Dynamic Bandwidth Allocation

5.2 Uplink MAC PDU transfers over the PHY

Figure 3 provides a flow diagram illustrating the messages exchanged to transfer an uplink MAC PDU using dynamic bandwidth allocation. The message flow can be traced as follows:

1) BS_MAC sends a **PHY_frame_assignment_request** service primitive to BS_PHY during multiframe N containing frame assignments for multiframe N + 2. A frame assignment specifies whether the BS, a particular MS, or all MS are permitted to transmit in the frame;

2) BS_PHY sends the frame assignment information to the MS_PHY during frame 0 of multiframe N + 1. MS_PHY immediately transfers the frame assignment information to MS_MAC;

3) During multiframe N + 1, MS_MAC decides how to utilize any uplink multiframe N + 2 frames assigned to it. MS_MAC issues MAC PDU transfer request service primitives to MS_PHY to full its assigned uplink frames during multiframe N + 2. MS_PHY performs MAC PDU block encoding and any other tasks necessary to prepare the PDU blocks for transfer during multiframe N + 2;

4) MS_PHY transfers PDU blocks to the BS_PHY in its assigned frames during multiframe N + 2;

5) BS_PHY reassembles the uplink MAC PDU from the received blocks and sends the resulting MAC PDU to BS_MAC.

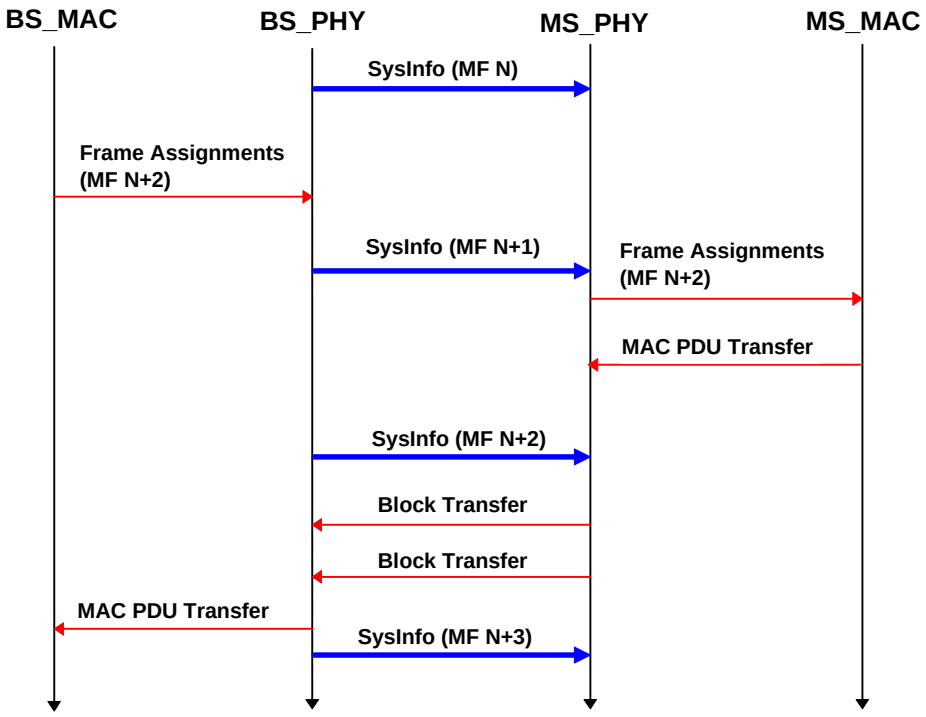

Figure 3: Uplink MAC PDU Transfers Using Dynamic Bandwidth Allocation

6 Transport Services

The PHY transport service (PHY_TPT) performs all of the operations necessary on the send side to prepare the data blocks associated with a PDU for transmission over the physical medium, and performs all of the operations necessary on the receive side to reconstruct the PDU from received data blocks. PHY_TPT may perform operations such as encoding/decoding and interleaving/de-interleaving.

PHY_TPT shall implement an encoding/decoding scheme which permits the detection, but not necessarily the correction, of a bit error in a block. PHY_TPT shall pass received block condition information along with PDU data to the MAC.

7 Service Primitives

7.1 Primitive Definitions

7.1.1 PHY_transfer_request

Table 1

PHY_transfer_request	
Usage	BS and MS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	A
Multiple Outstanding	No
SDU Parameters	*MPDU*
	MPDU_length_blocks
	frame_number

This primitive is used by the MAC layer to pass a MPDU to the PHY layer for transfer to one or more peer PHY SAP As. The frame number specified is in the next multiframe and must have been previously assigned to the requesting entity for uplink or downlink data transfers.

7.1.2 PHY_transfer_confirm

Table 2

PHY_transfer_confirm	
Usage	BS and MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	A
SDU Parameters	*transfer_receipt_ack*

This primitive acknowledges the receipt of the MPDU associated with a PHY_transfer_request. It does not indicate that the MPDU has been transferred to one or more peer SAPs.

7.1.3 PHY_transfer_indication

Table 3

PHY_transfer_indication	
Usage	BS and MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	A
SDU Parameters	*MPDU*
	MPDU_length_blocks

This primitive is used by the PHY to pass a received MPDU to the MAC layer.

7.1.4 PHY_frame_indication

Table 4

PHY_frame_indication	
Usage	BS and MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*frame_number*

This primitive provides the MAC with PHY layer timing information. This primitive is sent at the start of each frame in the multiframe. The MAC uses the **PHY_frame_indication** to properly coordinate its interaction with the PHY layer.

7.1.5 PHY_hunt_request

Table 5

PHY_hunt_request	
Usage	MS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	B
Multiple Outstanding	No
SDU Parameters	-

This primitive tells the PHY to report adjacent cell signal strength and quality.

7.1.6 PHY_hunt_confirm

Table 6

PHY_hunt_confirm	
Usage	MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*hunt_result*

This primitive reports adjacent cell signal strength and quality.

7.1.7 PHY_service_request

Table 7

PHY_service_request	
Usage	MS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	B
Multiple Outstanding	No
SDU Parameters	*base_station_ID*

This primitive tells the PHY to camp on the BS specified by *base_station_ID*.

7.1.8 PHY_service_confirm

Table 8

PHY_service_confirm	
Usage	MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*service_result*

This primitive confirms a service request.

7.1.9 PHY_service_indication

Table 9

PHY_service_indication	
Usage	MS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*service_status*

This primitive is used by the PHY to provide the MAC with the latest service status.

7.1.10 PHY_frame_assignment_request

Table 10

PHY_frame_assignment_request	
Usage	BS
Source	MAC Layer
Destination	PHY Layer
Service Access Point	B
Multiple Outstanding	No
SDU Parameters	*frame_assignments*

This service primitive defines the uplink and downlink frame assignments for a multiframe. If the primitive is issued during multiframe N, then the assignments are for frames in multiframe N + 2.

7.1.11 PHY_frame_assignment_confirm

Table 11

PHY_frame_assignment_confirm	
Usage	BS
Source	PHY Layer
Destination	MAC Layer
Service Access Point	B
SDU Parameters	*frame_assignment_result*

This primitive confirms a frame assignment request.

7.2 Parameter Definitions

7.2.1 *base_station_ID*

This parameter specifies a particular DAWS BS.

7.2.2 *block_condition_array*

This parameter specifies the condition of each block in the MPDU received: good or bad. A bad block has one or more errors and may be retransmitted by the MAC layer.

7.2.3 *frame_assignment_result*

Table 12

frame_assignment_result	
0	success: frames defined
1	failure: could not complete request

7.2.4 *frame_assignments*

This parameter defines for each frame in a multiframe whether the BS, a particular MS, or all MS are permitted to transmit during the frame.

7.2.5 *frame_number*

This parameter specifies a particular frame within the multiframe. Frame number 0 is reserved for the system information broadcast.

7.2.6 *hunt_result*

This parameter contains a list of current and adjacent cell signal strength and quality measurements.

7.2.7 *MPDU*

This parameter will be defined in the DAWS MAC protocol specification document.

7.2.8 *MPDU_length_blocks*

This parameter defines the length of the PDU in blocks.

7.2.9 *service_result*

Table 13

service_result	
0	success: requested service now available
1	failure: could not complete request

7.2.10 *transfer_receipt_ack*

Table 14

transfer_receipt_ack	
0	success: receipt acknowledged
1	failure: transfer request already pending

7.2.11 *transfer_result*

Table 15

transfer_result	
0	success: PDU transferred (although possibly with bad blocks)
1	failure: PDU transfer failed

Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- IETF RFC 1112: "Host Extensions for IP Multicasting".
- IETF RFC 791: "Internet Protocol".
- IETF RFC 2211: "Specification of the Controlled-Load Network Element Service".
- IETF RFC 2205: "Resource Reservation Protocol (RSVP); Version 1 Functional Specification".
- IETF RFC 2215: "General Characterization Parameters for Integrated Service Network Elements".

History

Document history			
V1.1.1	April 1999	Membership Approval Procedure	MV 9926: 1999-04-27 to 1999-06-25