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Broadcast-Multicast Upper Layer for Ultra Mobile Broadband (UMB) Air Interface Specification

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FOREWORD

(This foreword is not part of this Standard)

This Standard was prepared by Technical Specification Group C of the Third Generation Partnership Project 2 (3GPP2). This Standard is the Broadcast-Multicast Upper Layers part of the Ultra Mobile Broadband™ (UMB™)[1] air interface. Other parts of this Standard are:

- Overview for Ultra Mobile Broadband (UMB) Air Interface Specification
- Physical Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- MAC Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- Radio Link Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- Application Layer for Ultra Mobile Broadband (UMB) Air Interface Specification
- Security Functions for Ultra Mobile Broadband (UMB) Air Interface Specification
- Connection Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification
- Session Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification
- Route Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification

Other Standards may be required to implement this system and are listed in the References section of each part.

This standard provides a specification for land mobile wireless systems based upon cellular principles. This Standard is one part of the IMT-2000 CDMA Multi-Carrier, IMT-2000 CDMA MC, also known as cdma2000®[2].

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[1] Ultra Mobile Broadband™ and (UMB™) are trade and service marks owned by the CDMA Development Group (CDG).

[2] cdma2000® is the trademark for the technical nomenclature for certain specifications and standards of the Organizational Partners (OPs) of 3GPP2. Geographically (and as of the date of publication), cdma2000® is a registered trademark of the Telecommunications Industry Association (TIA-USA) in the United States.

FOREWORD

No text.

REFERENCES

The following documents contain provisions, which, through reference in this text, constitute provisions of this 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, the latest version applies. In the case of a reference to a 3GPP2 document, a non-specific reference implicitly refers to the latest version of that document in the same Release as the present document.

[1] C.S0084-000-0, Overview for Ultra Mobile Broadband (UMB) Air Interface Specification.

[2] C.S0084-001-0, Physical Layer for Ultra Mobile Broadband (UMB) Air Interface Specification.

[3] C.S0084-002-0, MAC Layer for Ultra Mobile Broadband (UMB) Air Interface Specification.

[4] C.S0084-003-0, Radio Link Layer for Ultra Mobile Broadband (UMB) Air Interface Specification.

[5] C.S0084-004-0, Application Layer for Ultra Mobile Broadband (UMB) Air Interface Specification.

[6] C.S0084-005-0, Security Functions for Ultra Mobile Broadband (UMB) Air Interface Specification.

[7] C.S0084-006-0, Connection Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification.

[8] C.S0084-007-0, Session Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification.

[9] C.S0084-008-0, Route Control Plane for Ultra Mobile Broadband (UMB) Air Interface Specification.

[10] Reserved.

[11] C.R1001, Administration of Parameter Value Assignments for cdma2000 Spread Spectrum Standards. (Informative)

[12] 3GPP2 S.S0078, Common Security Algorithms.

REFERENCES

No text.

1 INTRODUCTION

Broadcast-Multicast Upper Layer consists of following protocols:

- Broadcast Control Protocol
- Broadcast Packet Consolidation Protocol
- Broadcast Security Protocol
- Broadcast Inter-Route Tunneling Protocol
- Broadcast MAC Protocol

No text.

2 BASIC BROADCAST PROTOCOL SUITE

2.1 Overview

The broadcast packet data system provides a packet stream that can be used to carry higher layer packets from the access network to multiple access terminals. The Forward Broadcast and Multicast Services Channel carries packets containing content generated by a content server. The Forward Broadcast and Multicast Services Channel can carry Forward Link signaling messages generated by the Broadcast Protocol Suite. The Forward Broadcast and Multicast Services Channel can also carry payload from other Routes. The Forward Broadcast and Multicast Services Channel has a Forward Link, but does not have a Reverse Link. Forward Link messages are sent for transmission directly on the Forward Broadcast and Multicast Services Channel or are tunneled through the Inter-Route Tunneling Protocol of a unicast Route. Reverse Link messages are tunneled through the Inter-Route Tunneling Protocol of a unicast Route. The Forward Broadcast and Multicast Services Channel consists of Broadcast Physical Channels and Broadcast Logical Channels. Broadcast-Multicast Flows (also called BCMCS Flows) as well as the signaling messages destined to the Forward Broadcast and Multicast Services Channel are associated with Broadcast Logical Channels and are transmitted over Broadcast Physical Channels.

The Broadcast Physical Channels consist of several sub-channels called interlace-multiplex pairs. The structure of the interlace-multiplex pairs may be different across sectors. The Basic Broadcast Protocol Suite specifies a Broadcast MAC Protocol and a Broadcast Physical Layer Protocol which describe the structure of Broadcast Physical Channels.

A Broadcast Logical Channel (also called a logical channel) refers to a set of one or more interlace-multiplex pairs of the Broadcast Physical Channel associated with a sector over which broadcast content is transmitted. Each logical channel carries one or more BCMCS Flows. An interlace-multiplex pair associated with a sector can be assigned to at most one logical channel.

A logical channel is identified by a pair of the form (sector, BCIndex) where a sector is identified by the pair (SectorId, BCMCS Channel). BCMCS Channel refers to the frequency assignment associated with a single Channel. BCIndex refers to the value corresponding to the first PHY frame, among the set of all PHY frames of the set of interlace-multiplex pairs associated with the logical channel, which occurs on or after frame index zero.

A Broadcast-Multicast Service Flow identifier (BCMCSFlowID) identifies a Broadcast-Multicast flow (also called a BCMCS Flow). The content of a given BCMCS Flow may change with time. A BCMCS Flow is analogous to a single multimedia flow. The contents of a BCMCS Flow are not divided across multiple logical channels.

The Basic Broadcast Protocol Suite contains the following protocols:

- Broadcast Control Protocol: The Broadcast Control Protocol defines procedures used to control various aspects of the operation of the broadcast packet data system, such as BCMCS Flow registration requirements. The Broadcast Control Protocol also defines the BroadcastParameters message. The Broadcast Control Protocol is defined in 2.2.

- Broadcast Inter-Route Tunneling Protocol: The Broadcast Inter-Route Tunneling Protocol performs tunneling of packets generated by the unicast Routes on the Broadcast Physical Channel. The Broadcast Inter-Route Tunneling Protocol is defined in 2.5.
- Broadcast Packet Consolidation Protocol: The Broadcast Packet Consolidation Protocol performs framing of higher layer packets and multiplexes higher layer packets and signaling messages. The Broadcast Packet Consolidation Protocol is defined in 2.3.
- Broadcast Security Protocol: The Broadcast Security Protocol provides encryption of Broadcast Packet Consolidation Protocol payload. The Broadcast Security Protocol is defined in 2.4.
- Broadcast MAC Protocol: The Broadcast MAC Protocol defines procedures used to transmit via the Forward Broadcast and Multicast Services Channel. The Broadcast MAC Protocol also provides Forward Error Correction (FEC) and multiplexing to reduce the radio link error rate as seen by the higher layers. The Broadcast MAC Protocol is defined in 2.6.
- Broadcast Physical Layer Protocol: The Broadcast Physical Layer Protocol provides the channel structure for the Forward Broadcast and Multicast Services Channel. The Broadcast Physical Layer Protocol is defined in [2].

The relationship between the protocols in the Basic Broadcast Protocol Suite is shown in Figure 2-1.

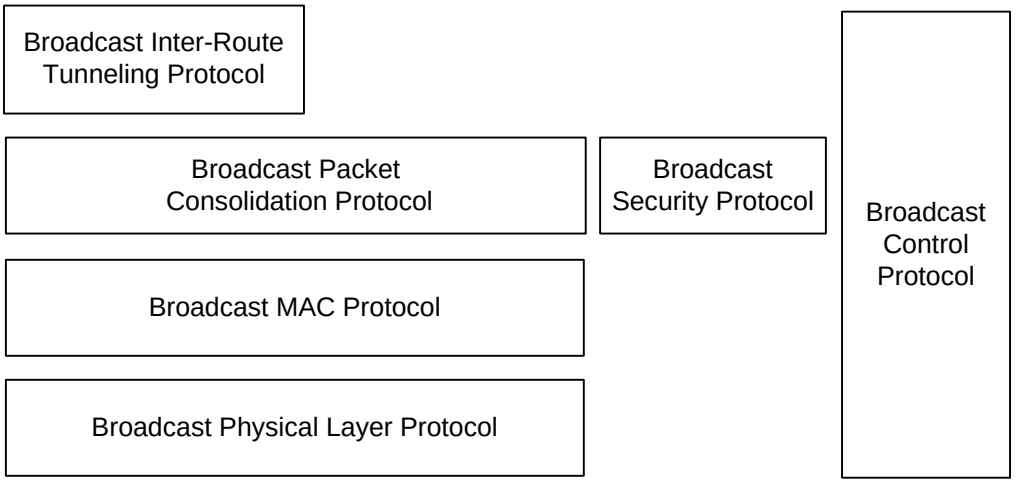

Figure 2-1. Basic Broadcast Protocol Suite

The Broadcast MAC Protocol described in 2.6 and the Broadcast Physical Layer Protocol described in [2] specifies the rules governing the transmission of logical channels on the Forward Broadcast and Multicast Services Channel.

The data path for each type of packets handled by the Basic Broadcast Protocol Suite is shown in Figure 2-2.

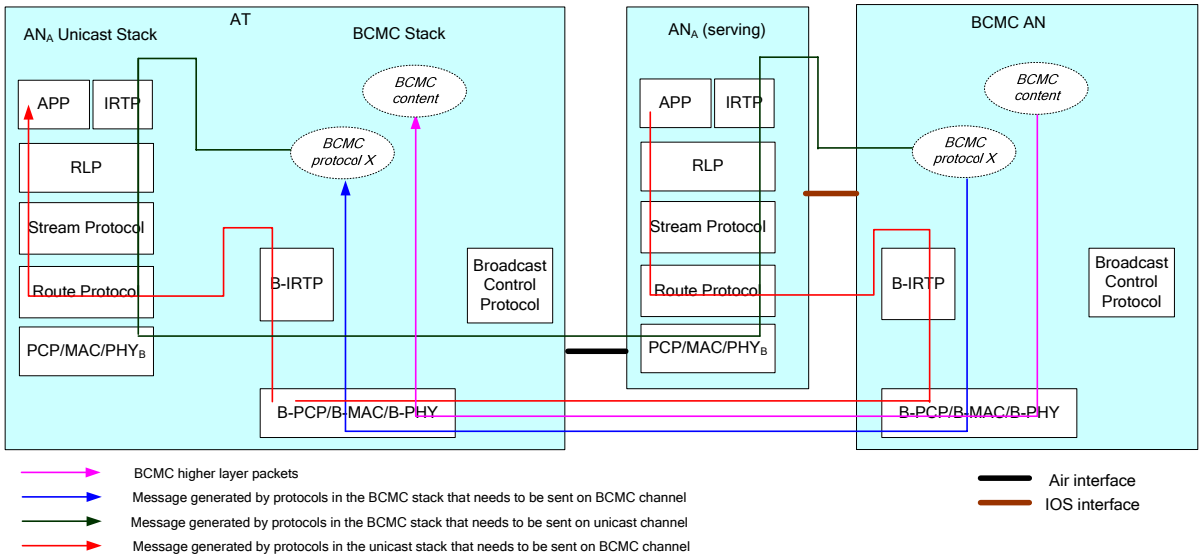

Figure 2-2. Data Path in Basic Broadcast Protocol Suite

2.1.1 Basic Protocol Numbers

The Subtype field for the Basic Broadcast Protocol Suite is two octets, set to $N_{BroadcastBasicSubtype}$.

2.1.2 Primitives, Local Common Data, and Public Data

2.1.2.1 Commands

This protocol does not define any commands.

2.1.2.2 Return Indications

This protocol does not return any indications.

2.1.2.3 Local Common Data

This protocol does not define any Local Common Data.

2.1.2.4 Public Data

This protocol shall make the following data public:

- Subtype for the Basic Broadcast Protocol Suite.
- Contents of the BroadcastParameters message

2.1.3 Messages

Messages generated by all the protocols in the Basic Broadcast Protocol Suite are always an integer number of octets in length. The sender shall include reserved bits at the end of the message, if necessary, to make the message an integer number of octets in length. The

sender shall set the reserved bits to '0'. The receiver shall ignore the value of the reserved bits.

2.1.4 Basic Broadcast Protocol Suite Initialization

2.1.4.1 Protocol Initialization for the InConfiguration Protocol Instance

This protocol does not define an InConfiguration instance.

2.1.4.2 Protocol Initialization for the InUse Protocol Instance

- Upon creation, the InUse instance of this protocol in the access terminal and access network shall perform the following:
- The Broadcast Protocol Stack shall be created with a personality corresponding to the value of the InitialProtocolSetIdentifier parameter.

2.1.5 Procedures and Messages for the InConfiguration Instance of the Basic Broadcast Protocol Suite

This protocol does not define an InConfiguration instance.

2.1.6 Procedures and Messages for the InUse Instance of the Protocol

2.1.6.1 Procedures

The procedures associated with the InUse instance of this protocol is specified within each of the sub-protocols of the Basic Broadcast Protocol Suite.

2.1.6.1.1 Command Processing

The list of events that causes an *Activate* or *Deactivate* command to be sent to this protocol is outside the scope of this specification.

2.1.6.2 Message Formats

The messages associated with the InUse instance of this protocol is specified within each of the sub-protocols of the Basic Broadcast Protocol Suite.

2.2 Broadcast Control Protocol

2.2.1 Overview

The access terminal is required to notify the access network of the BCMCS Flows that the access terminal is interested in monitoring. This is accomplished using BCMCS Flow registration. The Broadcast Control Protocol provides procedures related to BCMCS Flow registration.

2.2.2 Protocol Data Unit

The transmission unit of this protocol is a message. This is a control protocol; and, therefore, it does not carry payload on behalf of other layers or protocols.

2.2.3 Procedures

2.2.3.1 BCMCS Flow Identifier

A BCMCSFlowID identifies each Broadcast-Multicast flow. The BCMCSFlowID may be 16, 24, or 32 bits long.

2.2.3.2 Access Network Requirements

In order for the access terminal to discover and monitor broadcast content successfully, various broadcast-related parameters need to be signaled over the air interface. The access network broadcasts these parameters over the Control Channel in the form of BroadcastParameters message.

The BroadcastParameters message transmitted by a sector contains the logical to physical channel mapping information for that sector. A BroadcastParameters message transmitted with the CompleteListInd field set to '1' includes all available BCMC flows; a BroadcastParameters message transmitted with the CompleteListInd field set to '0' includes only those BCMC flows added since the last BroadcastParameters was transmitted.

The access network shall comply with the following requirements when transmitting BroadcastParameters message CompleteListInd field set to '1':

- The access network shall transmit the BroadcastParameters message with the broadcast MACID as a unicast message over every superframe j such that j mod $N_{BCIPeriod} = N_{BCIPeriod}-1$.
- The location of this message shall be between the PHY Frames 2 and 7 inclusive of the corresponding superframe.

The access network shall comply with the following requirements when transmitting BroadcastParameters message CompleteListInd field set to '0':

- The access network shall transmit the BroadcastParameters message only in a superframe with an odd superframe index.

The access network may send QPCH block to notify the targeted access terminals before sending a BroadcastParameters message CompleteListInd field set to '0'.

The access network may use timer-based BCMCS Flow registration to keep track of which BCMCS Flows the access terminal may be monitoring, so that the access network may send messages to the access terminal using the appropriate channel(s). The access network may use the BCMCS Flow registration to determine which BCMCS Flows to transmit over the air interface.

The access network shall send a BroadcastReset message when it detects that the access terminal has entered a zone where the access terminal must refresh parameters (such as BCMCS Flow IDs, Broadcast Access Keys etc.) related to the broadcast packet data service.

The access network may send a BroadcastReject message when it detects that one or more BCMCS Flows requested by the access terminal are not available.

If the IncludeAuthSignature field of the BroadcastParameters message is '1', then the access network may verify that the access terminal registering the BCMCS Flows has the

BroadcastAccessKey required to be able to decrypt the broadcast content. The access network shall perform this verification by computing an AuthSignature using the BroadcastAccessKey corresponding to the BAKSequenceNumber included by the access terminal in the BCMCSFlowRegistration message. The access network shall compute TimeStampLong as follows:

- If RTCTimeStampShortLength is zero, then the access network shall set TimeStampLong to the TimeStampLongLength least significant bits of the system time corresponding to the time when the access terminal began transmission of the BCMCSFlowRegistration message in units of $2^{\text{TimeStampUnits}}$ Superframes[3]. Otherwise, if RTCTimeStampShortLength is not zero, the access network shall derive TimeStampLong from the TimeStampShort field included in the BCMCSFlowRegistration message using the equation:

$$\text{TimeStampLong} = (\text{SystemTime} - (\text{SystemTime}[\text{RTCTimeStampShortLength}-1:0] - \text{TimeStampShort}) \bmod 2^{\text{RTCTimeStampShortLength}}) \bmod 2^{\text{TimeStampLongLength}},$$

  where SystemTime is the current System Time in units of $2^{\text{TimeStampUnits}}$ Superframes, TimeStampShort is a field included in the BCMCSFlowRegistration message, and SystemTime[n-1:0] represents the n least significant bits of the SystemTime.

2.2.3.3 Access Terminal Requirements

2.2.3.3.1 BroadcastParameters Message Processing

The access terminals receiving broadcast content shall monitor the BroadcastParameters message. Other access terminals may ignore this message.

2.2.3.3.2 BCMCS Flow Registration

BCMCS Flow registration for paging assists the access network in determining on which ChannelBand (s) to send messages to the access terminal. BCMCS Flow registration for dynamic broadcast assists the access network in determining which BCMCS Flows should be assigned and de-assigned to appropriate physical channels.

The access terminal shall maintain a timer called RegistrationTimer with time increments of 80 ms. The access terminal shall maintain an indicator of BCMCS Flow registration enable status, called RegistrationEnabled. If PagingRegistrationPeriod is zero, and DynamicBroadcastRegistrationPeriod is zero, the access terminal shall set RegistrationEnabled to NO. Otherwise, the access terminal shall set RegistrationEnabled to YES. Whenever the access terminal initializes RegistrationEnabled to YES, or changes RegistrationEnabled from NO to YES, it shall set RegistrationTimer to a pseudorandom number (See [2]) between zero and Max($2^{\text{PagingRegistrationPeriod}}$, $2^{\text{DynamicBroadcastRegistrationPeriod}}$)×80ms. The access terminal shall increment RegistrationTimer whenever RegistrationEnabled is YES.

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[3] The access network derives the time when the access terminal began transmission of the BCMCSFlowRegistration message from the time when the BCMCSFlowRegistration message is received.

The access terminal performs BCMCS Flow registration by sending a BCMCSFlowRegistration message. The access terminal shall not include in a BCMCSFlowRegistration message any BCMCS Flows that were included in any BCMCS Flow registration during the past NumPeriods $\times$ $2^{\text{MonitorPeriod}}$ $\times$ 80ms interval and were not monitored by the access terminal during the past $2^{\text{MonitorPeriod}} \times$ 80ms interval.

A BCMCS Flow registration transmitted shall be considered successful when the BCMCSFlowRegistration message is transmitted on the Reverse Traffic Channel. The access terminal shall not send a BCMCSFlowRegistration message containing zero BCMCS Flows. If there are no BCMCS Flows to be registered, the BCMCS Flow registration shall be considered successful without sending a BCMCSFlowRegistration message.

If PagingRegistrationPeriod is set to zero, the access terminal shall not perform BCMCS Flow registration for paging. Otherwise, the access terminal shall perform BCMCS Flow registration for paging as defined in 2.2.3.3.2.1.

If DynamicBroadcastRegistrationPeriod is set to zero, the access terminal shall not perform BCMCS Flow registration for dynamic broadcast. Otherwise, the access terminal shall perform BCMCS Flow registration for dynamic broadcast as defined in 2.2.3.3.2.2.

If the BCMCS Flow registration for paging procedures in 2.2.3.3.2.1, and the BCMCS Flow registration for dynamic broadcast procedures defined in 2.2.3.3.2.2 trigger a BCMCS Flow registration at the same time, then the access terminal shall combine all requested BCMCS Flows in one BCMCS Flow registration.

The access terminal may send a BCMCSFlowRegistration message even when the BCMCS Flow registration is not triggered by the BCMCS Flow registration for paging procedures in 2.2.3.3.2.1, or by the BCMCS Flow registration for dynamic broadcast procedures defined in 2.2.3.3.2.2. However, the access terminal shall not send a BCMCSFlowRegistration message containing any BCMCS Flow that was included in the last successful BCMCS Flow registration unless this BCMCS Flow registration is triggered by the BCMCS Flow registration for paging procedures in 2.2.3.3.2.1, or unless this BCMCS Flow registration is triggered by the BCMCS Flow registration for dynamic broadcast procedures defined in 2.2.3.3.2.2, or unless this BCMCS Flow registration is performed on a sector different than the last successful BCMCS Flow registration.

2.2.3.3.2.1 BCMCS Flow Registration for Paging

The access terminal shall compute and store a timer expiration value (PagingRegistrationTimerMax) as

$$\text{PagingRegistrationTimerMax} = 2^{\text{PagingRegistrationPeriod}} \times 80 \text{ ms}.$$

The access terminal shall perform BCMCS Flow registration when the RegistrationTimer reaches a positive integer multiple of PagingRegistrationTimerMax. The access terminal shall include in the BCMCSFlowRegistration message all BCMCS Flows for which the RegisterForPaging field of the last BroadcastParameters message is ‘1’ and that it has monitored during the past $2^{\text{MonitorPeriod}} \times$ 80ms interval.

If PagingRegistrationPeriod is greater than or equal to DynamicBroadcastRegistrationPeriod, then the access terminal shall reset RegistrationTimer to zero after each successful BCMCS Flow registration for paging.

The access terminal may monitor the following ChannelBands for receiving transmissions from the access network:

- The ChannelBand selected by the access terminal using the hash function
- The ChannelBands associated with the BCMCS Flows included in the last successful BCMCS Flow registration.

The access terminal shall assume that the access network will not transmit to the access terminal on ChannelBands other than the above ChannelBands.

2.2.3.3.2.2 BCMCS Flow Registration for Dynamic Broadcast

The access terminal shall compute and store a timer expiration value (DynamicBroadcastRegistrationTimerMax) as

DynamicBroadcastRegistrationTimerMax = $2^{\text{DynamicBroadcastRegistrationPeriod}} \times 80$ ms. The access terminal shall perform BCMCS Flow registration when the RegistrationTimer reaches a positive integer multiple of DynamicBroadcastRegistrationTimerMax. The access terminal shall include in the BCMCSFlowRegistration message all BCMCS Flows for which the RegisterForDynamicBroadcast field of the last BroadcastParameters message is '1' and that it has monitored during the past $2^{\text{MonitorPeriod}} \times 80$ms interval.

If the access terminal includes in the BCMCSFlowRegistration message a BCMCS Flow that is not being transmitted by the access network, then the access terminal should monitor the BroadcastParameters messages transmitted during the (4 × BroadcastOverheadPeriod × 256) PHY frame interval following the transmission of the BCMCSFlowRegistration message to determine if the access network has added the requested BCMCS Flow to the BroadcastParameters message.

If DynamicBroadcastRegistrationPeriod is greater than PagingRegistrationPeriod, then the access terminal shall reset RegistrationTimer to zero after each successful BCMCS Flow registration for dynamic broadcast.

2.2.3.3.2.3 Computation of Authorization Signature

If the IncludeAuthSignature parameter of the BroadcastParameters message is '0', the BCMCS Flow included in the BCMCSFlowRegistration message does not use a BroadcastAccessKey, or the access terminal is not directed to add AuthSignature by the upper layers, then the access terminal shall omit the AuthSignature from the BCMCSFlowRegistration message if any of the following conditions is true:

- IncludeAuthSignature parameter of the BroadcastParameters message is '0',
- the BCMCS Flow included in the BCMCSFlowRegistration message does not use a BroadcastAccessKey,
- the access terminal is not directed to add AuthSignature by the upper layers.

Otherwise, the access terminal shall include in the BCMCSFlowRegistration message an AuthSignature value computed for the BCMCS Flow included in the message. The access terminal shall compute the AuthSignature value as follows:

- The access terminal shall create an *EHMACSHA256-Message* input working buffer as shown in Table 2-1.

Table 2-1. Subfields of the EHMACSHA256-Message Input Working Buffer

Subfield	Length (bits)
TimeStampLong	TimeStampLongLength

TimeStampLong — If RTCTimeStampShortLength is zero, then the access terminal shall set this field to the TimeStampLongLength LSBs of the System Time, in units of 2TimeStampUnits Superframes, corresponding to the time when the access terminal will begin transmission of the BCMCSFlowRegistration message. Otherwise, the access terminal shall set this field to the TimeStampLongLength LSBs of the System Time, in units of 2TimeStampUnits Superframes, corresponding to a time that is not later than when the access terminal will begin transmission of the BCMCSFlowRegistration message that will carry this AuthSignature[4]. The access terminal shall use the same TimeStampLong field for computing the AuthSignature parameters for all BCMCS Flows included in a BCMCSFlowRegistration message.

- The access terminal shall perform the EHMACSHA256 procedure as specified in [12] with the following input parameters:
  - The KEY parameter of EHMACSHA256 shall be set to the Broadcast Access Key.
  - The L_KEY parameter of EHMACSHA256 shall be set to 16, identifying the length of the Broadcast Access Key in octets.
  - The MESSAGE parameter of EHMACSHA256 shall be set to the pointer to the most significant bit of the EHMACSHA256 Message input working buffer.
  - The MESSAGE_OFFSET parameter of EHMACSHA256 shall be set to 0.
  - The MESSAGE_LENGTH parameter of EHMACSHA256 shall be set to the number of bits of data in the EHMACSHA256 Message input working buffer.
  - The HMAC parameter of EHMACSHA256 shall be set to the pointer to the most significant bit of the output buffer that will contain the computed MAC value.
  - The L_HMAC parameter of EHMACSHA256 shall be set to 4, identifying the length of the output in octets.
- The access terminal shall set the AuthSignature to the contents of the output buffer indicated by HMAC.

[4] For example, the access terminal may choose the current CDMA System time as TimeStampLong.

2.2.3.4 Message Formats

2.2.3.4.1 BroadcastParameters Message

The access network sends the BroadcastParameters message to provide the access terminal with the mapping between logical channels and Broadcast Physical Channels.

Field	Length (bits)
MessageID	8
ProtocolSubtype	16
BroadcastParametersSignature	16
CompleteListInd	1
QCISignature	20
AllReservedInterlaces	1
BCMCSReservedInterlaces	0 or 4
RotationalAngleIncluded	1
RotationalAngle	0 or 4
NumBOC	2

NumBOC occurrences of the following field:

BCMCSFlowIDLength	2
BCMCSOverheadFields	Variable Length

Reserved	0 – 7 (as needed)

MessageID The access network shall set this field to 0x00.

ProtocolSubtype The access network shall set this field to the Protocol Subtype corresponding to this BCMCS Protocol Suite as specified in [1].

BroadcastParametersSignature
The access network shall increment this field if any of the other fields in the BroadcastParameters message changes.

CompleteListInd The access network shall set this field to '1' if this message includes all the available BCMC flows; otherwise, the access network shall set this field to '0'.

QCISignature The access network shall set this field to the QCISignature public data of the Overhead Messages protocol.

AllReservedInterlaces

The access network shall set this field to '1' to indicate that all the subbands of all the reserved interlaces are being used for BCMCS; otherwise, the access network shall set this field to '0'.

BCMCSReservedInterlaces

If the AllReservedInterlaces field is set to '1', then the access network shall omit this field; otherwise, the access network shall include this field and set it according to Table 2-2. All the subbands in these interlaces shall be used for BCMCS.

Table 2-2. Interpretation of BCMCSReservedInterlaces

Value	Reserved BCMCS Interlaces
0000	0
0001	0, 1
0010	0, 1, 2
0011	0, 1, 2, 3
0100	0, 1, 2, 3, 4
0101	0, 1, 2, 3, 4, 5
0110	0, 1, 2, 3, 4, 5, 6
0111	3
1000	6
1001	0, 2
1010	0, 4
1011	0, 6
1100	2, 4
1101	2, 6
1110	4, 6
1111	2, 4, 6

RotationalAngleIncluded

The access network shall set this field to '0' if all ModulationLayer fields in the BCMCSOverheadFields are set to '0'; otherwise, the access network shall set this field to '1'.

RotationalAngle

If the RotationalAngleIncluded field is set to '0', the access network shall omit this field; otherwise, the access network shall include this field and set it as follows: the access network shall set this field to indicate the initial reference phase for the enhancement-layer signal constellation of the enhanced hierarchical modulation in units of

degree. The procedure of the enhanced hierarchical modulation is detailed in [2]. The value of this parameter shall be interpreted as specified in to Table 2-3.

Table 2-3. Interpretation of RotationalAngle

Field value	Interpretation
	Unit: degree
0000	0.0
0001	2.81
0011	5.63
0010	8.44
0110	11.25
0111	14.06
0101	16.88
0100	19.69
1100	22.50
1101	25.31
1111	28.13
1110	30.94
1010	33.75
1011	36.56
1001	39.38
1000	42.19

NumBOC

The access network shall set this field to indicate the number of different Broadcast Overhead Channels (and hence Physical Channel groups) present in each BCMCS ultraframe.

BCMCSFlowIDLength

The access network shall set this field to one less than the length of the BCMCS Flow Identifier in units of octets. The access network shall not set this field to '00'.

BCMCSOverheadFields

The access network shall set this as defined in 2.2.3.4.1.1. This field specifies the logical to physical channel mapping for the logical channels transmitted on the Forward Broadcast and Multicast Services Channel.

Reserved

The access network shall add reserved bits in order to make the length of the entire message equal to an integer number of octets. The access network shall set these bits to '0'. The access terminal shall ignore these bits.

2.2.3.4.1.1 BCMCSOverheadFields

BCMCSFlowCount	8
PagingRegistrationPeriod	8
DynamicBroadcastRegistrationPeriod	8
MonitorPeriod	8
NumPeriods	8
BroadcastChannelSaltLength	8
BroadcastChannelSalt	BroadcastChannelSaltLength × 8
EncryptionKeyEntropy	8
IncludeAuthSignature	1
RTCTimeStampShortLength	0 or 8
TimeStampLongLength	0 or 8
TimeStampUnit	0 or 4
NumOuterFrames	2
NumOffsets	4
BOCTransmissionFormat	3
BOCPDRParametersIncluded	0 or 1
BOCPilotToDataRatioRecord	0 or Variable
FDSSeedNumMSBs	0 or 4
FDSSeedMSBs	0 or FDSSeedNumMSBs
NumOffsets occurrences of the following fields:	
Offset*j*	4
Period*j*	4
BCMCSFlowCount occurrences of the following variable-length record:	

BCMCSFlowID	(BCMCSFlowIDLength+1) × 8
RegisterForPaging	1
RegisterForDynamicBroadcast	1
LogicalChannelSameAsPreviousBCMCSFlow	1
NumGuardSubcarriers	6
StartLocation	0 or 8
Duration	0 or 4
BCMCSTransmissionFormat	0 or 6
OuterCode	0 or 4
Period	0 or 3
PilotStaggerIndex	0 or 3
BCMCSPilotToDataRatioRecord	0 or Variable
FDSSeedSameAsPreviousLogCh	0 or 1
FDSSeedLSBs	0 or 10 - FDSSeedNumMSBs
ModulationLayer	0 or 1

BCMCSFlowCount The access network shall set this field to the number of BCMCS Flow identifiers included in the BCMCSOverheadFields record of this message.

PagingRegistrationPeriod

The access network shall set this field such that the desired timer value for timer based BCMCS Flow registration for paging is $2^{\text{PagingRegistrationPeriod}} \times 80$ ms.

The access network shall not set this field to a value larger than 0x15.

DynamicBroadcastRegistrationPeriod

The access network shall set this field such that the desired timer value for Timer based BCMCS Flow registration for dynamic assignment of BCMCS Flows to physical channels is $2^{\text{PagingRegistrationPeriod}} \times 80$ ms.

The access network shall not set this field to a value larger than 0x15.

MonitorPeriod The access network shall set this field such that the desired timer value is $2^{\text{MonitorPeriod}} \times 80$ ms.

The access network shall not set this field to a value larger than 0x0f.

NumPeriods — The access network shall set this field to the desired value for NumPeriods.

The access network shall not set this field to a value larger than 0x04.

BroadcastChannelSaltLength

The access network shall set this field to the length of the BroadcastChannelSalt field in octets.

BroadcastChannelSalt

The access network shall set this field to the value of the *Salt* input parameter that is to be used in the KeyStrengthRedAlg procedure specified in [3] for generating Short Term Keys.

EncryptionKeyEntropy

The access network shall set this field to the value of the *KeyEntropy* parameter that is to be used in the KeyStrengthRedAlg procedure specified in [3] for generating Short Term Keys. Valid values for this field are 0 through 16 inclusive.

IncludeAuthSignature

The access network shall set this field to '1' if the access terminal is required to include authorization signature for BCMCS Flows registered in a BCMCSFlowRegistration message. Otherwise, the access network shall set this field to '0'.

RTCTimeStampShortLength

If IncludeAuthSignature is '0', the access network shall omit this field. Otherwise, the access network shall set this field to the length in units of bits of the TimeStampShort field to be included in a BCMCSFlowRegistration message which will be transmitted on the Reverse Traffic Channel.

TimeStampLongLength

If IncludeAuthSignature is '0', the access network shall omit this field. Otherwise, the access network shall set this field to the length in units of bits of the TimeStampLong field to be used in the computation of the AuthSignature included in a BCMCSFlowRegistration Message.

TimeStampUnit — If IncludeAuthSignature is '0', the access network shall omit this field. Otherwise, the access network shall set this field to specify the unit of the TimeStampLong field. The unit of the TimeStampLong field in slots shall be 2 to the power of the value of this field.

NumOuterFrames The access network shall set this field to the number of outerframes per ultraframe as indicated in Table 2-4.

Table 2-4. Description of NumOuterFrames Field

NumOuterFrames field	Number of outerframes per ultraframe
'00'	1
'01'	2
'10'	4
'11'	8

NumOffsets The access network shall set this field to the number of offsets that the assigned to the outerframes as described in 2.6.3.1.3.

BOCTransmissionFormat
The access network shall set this field to the packet format index of the Broadcast Overhead Channel as specified in 2.6.3.1.6.4.

BOCPDRParametersIncluded
If the BCMCSFlowCount field is set to zero, the access network shall omit this field. Otherwise, the access network shall include this field and set it as follows:

If the pilot to data ratio of the Broadcast Overhead Channel is not the same as PDRBOCDefault, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'.

BOCPilotToDataRatioRecord
If the BOCPDRParametersIncluded field is set to '0', then the access network shall omit this field. Otherwise, the access network shall include this field and set it according to 2.2.3.4.1.2.

FDSSeedNumMSBs If BCMCSFlowCount field is set to zero, the access network shall omit this field. Otherwise, the access network shall include this field and set it to the unsigned binary representation of a value between 0 to 10, inclusive, to indicate the length of the FDSSeedMSBs field. FDSSeedNumMSBs shall be such that the FDSSeedNumMSBs MSBs of the 10-bit FDSSeed parameters of all logical channels defined after this field for which NumOffsets is greater than zero shall be the same.

FDSSeedMSBs If BCMCSFlowCount field is set to zero, the access network shall omit this field. Otherwise, the access network shall include this field and set it to the common FDSSeedNumMSBs MSBs of the FDSSeed

parameters of all logical channels defined after this field for which the NumOffsets is greater than zero.

Offset*j* The access network shall set this field to the value offset*j* – 1 as described in 2.6.3.1.3.

Period*j* The access network shall set this field to the value period*j* – 1 as described in 2.6.3.1.3.

BCMCSFlowID The access network shall set this field to the BCMCS Flow identifier of this BCMCS Flow.

RegisterForPaging The access network shall set this field to '1' if the access terminal is required to include this BCMCS Flow in a BCMCSFlowRegistration message to allow the access network to send messages to the access terminal on the appropriate channel(s). Otherwise, the access network shall set this field to '0'.

RegisterForDynamicBroadcast

The access network shall set this field to '1' if the access terminal is required to include this BCMCS Flow in a BCMCSFlowRegistration message to allow the access network to dynamically assign and de-assign BCMCS Flows to physical channels. Otherwise, the access network shall set this field to '0'.

LogicalChannelSameAsPreviousBCMCSFlow

If this BCMCS Flow is transmitted using the same logical channel as the previous BCMCS Flow listed in the BCMCSOverheadFields field of this message, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'. If this is the first BCMCS Flow listed in the BCMCSOverheadFields field of this message, then the access network shall set this field to '0'.

Records for all BCMCS Flow IDs that share the same logical channel shall be placed consecutively in the BroadcastParameters message.

NumGuardSubcarriers

This field shall be set to the number of GuardSubcarriers, in units of 2.

StartLocation If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', then the access network shall omit this field; otherwise, the access network shall include this field and set this field to the starting location of the logical channel in number of Subbands*i* as specified in 2.6.3.1.3.

Duration If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', then the access network shall omit this field; otherwise, the access network

shall include this field and set this field to the number of number of consecutive BCMCS subbands that the logical channel occupies as specified in Table 2-22.

BCMCSTransmissionFormat

If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', then the access network shall omit this field. Otherwise, the access network shall set this field to the TransmissionFormat parameter of this logical channel according to Table 2-19 to indicate the Broadcast transmission format of this logical channel.

OuterCode

If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', or if NumOffsets is zero, then the access network shall omit this field. Otherwise, the access network shall set this field to indicate which Reed-Solomon outer code is used to form an error control block for this logical channel according to Table 2-5.

Table 2-5. Description of OuterCode Field

OuterCode	(N, K, R) Reed-Solomon outer code
'0000'	(1, 1, 0) Reed-Solomon code (No outer code)
'0001'	(16, 12, 4) Reed-Solomon code
'0010'	(16, 13, 3) Reed-Solomon code
'0011'	(16, 14, 2) Reed-Solomon code
'0100'	(32, 24, 8) Reed-Solomon code
'0101'	(32, 26, 6) Reed-Solomon code
'0110'	(32, 28, 4) Reed-Solomon code
All other values are reserved	

Period

If LogicalChannelSameAsPreviousBCMCSFlow field is set to '1', then the access network shall omit this field. Otherwise, the access network shall set this field to the 2-bit representation of the Period parameter associated with this logical channel as shown in Table 2-6.

Table 2-6. Description of Period Field

Period Field	Number of Transmissions
'000'	1
'001'	2
'010'	3
'011'	Reserved

PilotStaggerIndex — If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', or if NumOffsets is zero, then the access network shall omit this field. Otherwise, the access network shall set this field to indicate the content dependent PilotStagger parameter according to Table 2-7. For different contents broadcast at the same time the access network should assign different PilotStaggerIndex.

Table 2-7. Description of PilotStaggerIndex Field

PilotStaggerIndex	PilotStagger
'000'	0
'001'	1
'010'	2
'011'	3
'100'	4
'101'	5
'110'	6
'111'	7

BCMCSPilotToDataRatioRecord

If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', or if NumOffsets is zero, or if the BOCPDRParametersIncluded field is set to '0', then the access network shall omit this field. Otherwise, the access network shall include this field and set it according to 2.2.3.4.1.1.3.

FDSSeedSameAsPreviousLogCh

If LogicalChannelSameAsPreviousBCMCSFlow is set to '1', or if NumOffsets is zero, or if (10 – FDSSeedNumMSBs) is zero, the access network shall omit this field. Otherwise, the access network shall include this field and set it as follows:

If there exists an occurrence of a non-empty FDSSeedLSBs field prior to this field and the last such occurrence is set equal to the (10 - FDSSeedMSBs) LSBs of the FDSSeed parameter of this logical channel, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'.

FDSSeedLSBs — If the FDSSeedSameAsPreviousLogCh is included and set to '0', the access network shall include this field and set it to the (10 – FDSSeedNumMSBs) LSBs of the FDSSeed parameter for this logical channel. Otherwise, the access network shall omit this field.

ModulationLayer If the logical channel is transmitted on the base layer, the access network shall set this field to '0'. If the logical channel is transmitted on the enhancement layer, the access network shall set this field to '1'.

2.2.3.4.1.2 BCMCSPilotToDataRatioRecord

Field	Length (bits)
BCMCSPDRProvidedForThisLogicalCh	1
BCMCSPDRSameAsBefore	0 or 1
BCMCSPilotToDataRatio	0 or 4
PilotToDataRatio	0 or 4

BCMCSPDRProvidedForThisLogicalCh

The access network shall set this field to '1' if the pilot to data ratio of the Broadcast packet is different from the PDRBOCDefault.

BCMCSPDRSameAsBefore

If the BCMCSPDRProvidedForThisLogicalCh field is set to '0', the access network shall omit this field. Otherwise, the access network shall include this field and set it as follows:

If the BCMCSOverheadFields field of the BroadcastParameters message specifies at least one logical channel prior to this logical channel which includes a non-empty BCMCSPDRProvidedForThisLogicalCh field and has the same BCMCS Transmission Format as this logical channel, and if the last one of such logical channels has the same values for all in-use pilot-to-data-ratio parameters described in 2.6.3.1.6.6.1 as this logical channel, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'.

BCMCSPilotToDataRatio

The access network shall set this field as described in 2.6.3.1.6.6.1. The method by which the access network sets the BCMCSPilotToDataRatio parameter is beyond the scope of this specification.

PilotToDataRatio The access network shall set this field as described in 2.6.3.1.6.6.1. The method by which the access network sets the PilotToDataRatio parameter is beyond the scope of this specification.

Channels	FTC			
Addressing	Broadcast			

RLP		Best Effort
AuthTag	Not Applicable	

2.2.3.4.2 BCMCSFlowRegistration Message

The access terminal sends the BCMCSFlowRegistration message to notify the access network of the list of BCMCS Flows that the access terminal intends to monitor.

Field	Length (bits)
MessageID	8
TimeStampShortIncluded	1
TimeStampShortLength	0 or 8
TimeStampShort	0 or TimeStampShortLength
BCMCSFlowIDLength	2
Zero or one occurrence of the following record:	
BCMCSFlowCount	6
BCMCSFlowCount occurrences of the following four fields:	
BCMCSFlowID	(BCMCSFlowIDLength+1) × 8
AuthSignatureIncluded	1
BAKSequenceNumber	0 or 4
AuthSignature	0 or 32
Reserved	0 – 7 (as needed)

MessageID The access terminal shall set this field to 0x01.

TimeStampShortIncluded
The access terminal shall set this field to '1' if an AuthSignature, AuthSignature1, or AuthSignature2 field is included in this message.

TimeStampShortLength
If TimeStampShortIncluded is '0', the access terminal shall omit this field. If TimeStampShortIncluded is '1', then the access terminal shall set this field to the value of the RTCTimeStampShortLength field received in the BroadcastParameters message.

TimeStampShort If TimeStampShortIncluded is '0', the access terminal shall omit this field. Otherwise, , the access terminal shall set this field to the RTCTimeStampShortLength least significant bits of the TimeStampLong parameter used to generate the AuthSignature parameters included in this message.

BCMCSFlowIDLength
: The access terminal shall set this field to the BCMCSFlowIDLength received in the BroadcastParameters message.

BCMCSFlowCount
: The access terminal shall set this field to the number of BCMCS Flow identifiers that follow this field in the message. The access terminal shall not set this field to zero.

BCMCSFlowID
: The access terminal shall set this field to the identifier of the BCMCS Flow.

AuthSignatureIncluded
: The access terminal shall set this field as follows:
The access terminal shall set this field to '1' if authorization signature is included for this BCMCS Flow. Otherwise, the access terminal shall set this field to '0'.

BAKSequenceNumber
: The access terminal shall set this field to the sequence number of the BroadcastAccessKey that is used to generate the AuthSignature for this BCMCS Flow.

AuthSignature
: If AuthSignatureIncluded is '0', the access terminal shall omit this field. Otherwise, the access terminal shall set this field to the AuthSignature value that is computed as described in 2.2.3.3.2.3.

Reserved
: The access terminal shall add reserved bits in order to make the length of the entire message equal to an integer number of octets. The access terminal shall set these bits to '0'. The access terminal shall ignore these bits.

The access terminal shall use the following values for the message information fields when transmitting the BCMCSFlowRegistration message:

Channels		RTC	**RLP**	Reliable
Addressing	Unicast		**AuthTag**	Not Applicable

2.2.3.4.3 BroadcastReject Message

The access network can send a BroadcastReject message to inform the access terminal that one or more BCMCS Flows requested by the user are rejected.

Field	Length
MessageID	8
BCMCSFlowIDLength	2

Zero or one occurrence of the following record:

BCMCSFlowCount	6

BCMCSFlowCount occurrences of the following three fields:

BCMCSFlowID	(BCMCSFlowIDLength+1) × 8
SameAsPreviousBCMCSFlow	1
RejectReason	0 or 4

Reserved	0 – 7 (if needed)

MessageID The access network shall set this field to 0x02.

BCMCSFlowIDLength The access network shall set this field to the BCMCSFlowIDLength field of the BroadcastParameters message.

BCMCSFlowCount The access network shall set this field to the number of BCMCS Flow identifiers included in this message. The access network shall not set this field to zero.

BCMCSFlowID The access network shall set this field to the BCMCS Flow identifier of the BCMCS Flow.

SameAsPreviousBCMCSFlow
If this is the first BCMCS Flow in this message, the access network shall set this field to '0'. If the RejectReason field is the same for this BCMCS Flow as for the previous BCMCS Flow in this message, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'.

RejectReason If the SameAsPreviousBCMCSFlow field is set to '1', then the access network shall omit this field. Otherwise, the access network shall include this field and shall set it as specified in Table 2-8.

Table 2-8. Reject Reason

Value	RejectReason
'0000'	BCMCS Flow ID not available
'0001'	BCMCS Flow ID not transmitted
'0010'	Invalid authorization signature
'0011' – '1111'	Reserved

Reserved — The access network shall add reserved bits in order to make the length of the entire message equal to an integer number of octets. The access network shall set these bits to zero. The access terminal shall ignore these bits.

The access network shall use the following values for the message information fields when transmitting the BroadcastReject message:

Channels	FTC				**RLP**		Best Effort
Addressing	Broadcast			Unicast	**AuthTag**	Not Applicable	

2.2.3.4.4 BroadcastReset Message

The access network sends the BroadcastReset message to inform the access terminal that it must refresh parameters (such as BCMCS Flow ID, Broadcast Access Key etc.) for BCMCS Flows it intends to monitor.

Field	Length
MessageID	8

MessageID — The access network shall set this field to 0x03.

The access network shall use the following values for the message information fields when transmitting the BroadcastReset message:

Channels	FTC				**RLP**		Best Effort
Addressing	Unicast				**AuthTag**	Not Applicable	

2.2.3.5 Interfaces to Other Protocols

2.2.3.5.1 Indications

This protocol registers to receive the following indications:

2.3 Broadcast Packet Consolidation Protocol

2.3.1 Overview

The Broadcast Packet Consolidation Protocol performs the following functions:

- Framing of higher layer packets
- Multiplexing of Broadcast content packets, Broadcast signaling messages, and tunneled unicast Route packets

2.3.2 Protocol Data Unit

The transmission unit of this protocol is a Broadcast Packet Consolidation Protocol Packet. In the transmit direction, the Broadcast Packet Consolidation Protocol fragments the higher layer packet, if necessary, and forms Broadcast Packet Consolidation Protocol packets. A Broadcast Packet Consolidation Protocol packet contains a one octet or two-octet long header. Figure 2-3 shows the Broadcast Packet Consolidation Protocol encapsulation for 2-octet PCP header and 5 shows the Broadcast Packet Consolidation Protocol encapsulation for 1-octet PCP header.

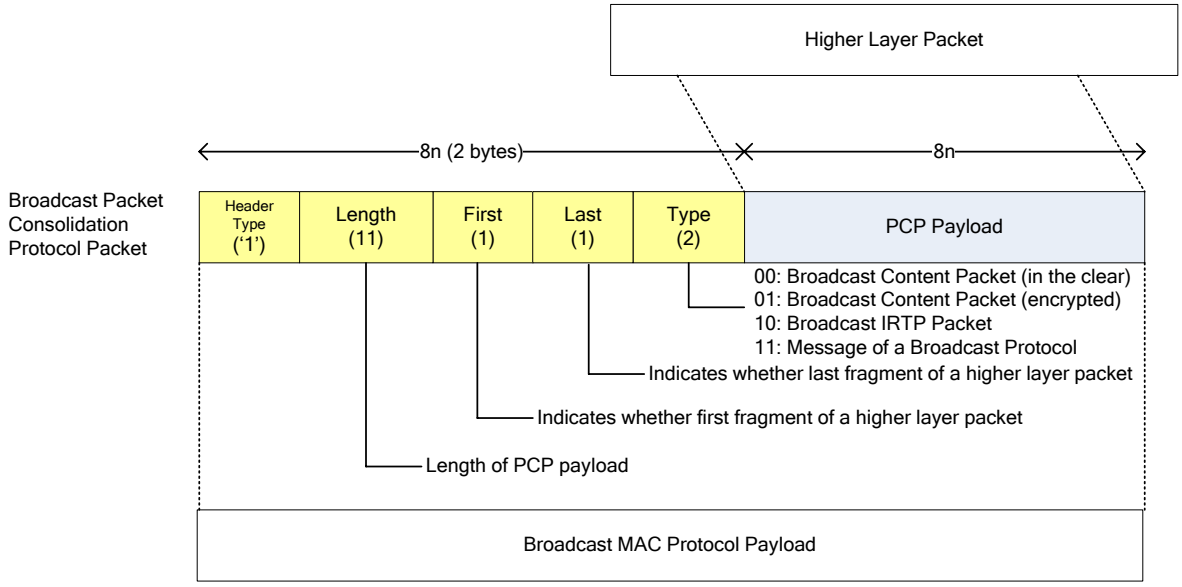

Figure 2-3. Broadcast Packet Consolidation Protocol Encapsulation for 2-octet header

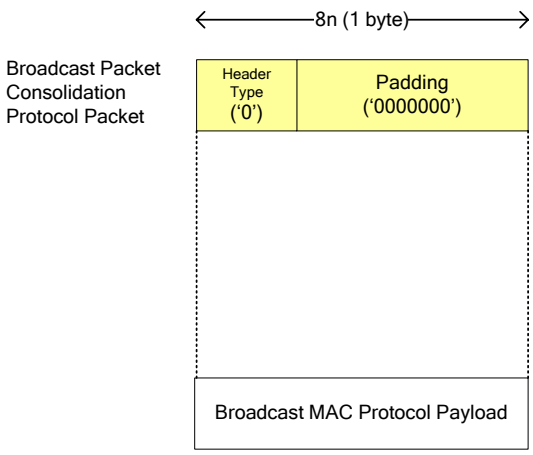

Figure 2-5. Broadcast Packet Consolidation Protocol Encapsulation for 1-octet header

2.3.3 Procedures

2.3.3.1 Access Network Requirements

The access network shall fragment the higher layer packets if necessary, to create a Broadcast Packet Consolidation Protocol packet payload.

- The access network shall add the Broadcast Packet Consolidation Protocol header defined in 2.3.3.2 in front of every Broadcast Packet Consolidation Protocol packet payload to create a Broadcast Packet Consolidation Protocol packet.

The length of the resulting Broadcast Packet Consolidation Protocol packet shall not exceed the length of the payload available in the Broadcast MAC Layer packet that will carry the Broadcast Packet Consolidation Protocol packet.

If the PayloadType field of the Broadcast Packet Consolidation Protocol packet is set to '01', the access network shall invoke the Broadcast Security Protocol to encrypt the payload of this Broadcast Packet Consolidation Protocol packet.

The access network shall forward the Broadcast Packet Consolidation Protocol packet for transmission to the Broadcast MAC protocol.

2.3.3.2 Broadcast Packet Consolidation Protocol Header Format

The access network shall place the following header at the beginning of every fragment of a higher layer packet.

Field	Length (bits)
HeaderType	1
Padding	0 or 7
Length	0 or 11
First	0 or 1
Last	0 or 1
PayloadType	0 or 2

HeaderType — The access network shall set this field to '0' if the Header is 1-octet long; the access network shall set this field to '1' if the Header is 2-octets long

Padding — The access network shall omit this field if the HeaderType field is set to '1'; otherwise, the access network shall include this field and set it to '0000000'.

Length — The access network shall omit this field if the HeaderType field is set to '0'; otherwise, the access network shall include this field and set this field to the number of octets in the payload field of this Broadcast Packet Consolidation Protocol packet If this is a fill packet, the length shall be set to zero.

First — The access network shall omit this field if the HeaderType field is set to '0'; otherwise, the access network shall include this field and set it as follows: If the payload field of this Broadcast Packet Consolidation Protocol packet is the first fragment of a higher layer packet or the Length field is set to zero, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'.

Last — The access network shall omit this field if the HeaderType field is set to '0'; otherwise, the access network shall include this field and set it as follows: If the payload field of this Broadcast Packet Consolidation Protocol packet is the last fragment of a higher layer packet or the Length field is set to zero, then the access network shall set this field to '1'. Otherwise, the access network shall set this field to '0'.

PayloadType — The access network shall omit this field if the HeaderType field is set to '0'; otherwise, the access network shall include this field and set it as follows: If the Length field is set to zero, then the access network shall set this field to '00'; otherwise, the access network shall set this field as specified in Table 2-9 to indicate the type of payload carried in this Broadcast Packet Consolidation Protocol packet.

Table 2-9. PayloadType

Value	PayloadType
'00'	BCMC content (un-encrypted)
'01'	BCMC content (encrypted)
'10'	Broadcast Inter-Route Tunneling Protocol Packet
'11'	Signaling message from a protocol in the Broadcast Protocol Suite

2.4 Broadcast Security Protocol

The Broadcast Security Protocol provides the procedures for encrypting Broadcast Packet Consolidation Protocol packet payload of PayloadType '01' (i.e., contains BCMC content that is to be encrypted). If such a payload is to be encrypted, the Broadcast Security protocol generates a Short Term Key and a cryptosync, and uses the Short Term Key, the cryptosync, and other parameters (if any) to encrypt the payload. The access network encrypts the payload using the AES (also known as Rijndael) encryption procedures defined in [12].

2.4.1.1 Access Network Requirements

The access network shall transmit SecurityParameters messages using requirements specified in 2.4.1.1.1.5.

If the Broadcast Packet Consolidation Protocol packet payload is to be encrypted, the access network shall perform the following:

- If this is the first Broadcast Packet Consolidation Protocol packet in an error control block (See [3] for description of error control block), the access network shall generate an encryption mask for the error control block as described in 2.4.1.1.1.
- The access network shall encrypt the Broadcast Packet Consolidation Protocol packet payload by exclusive-ORing the corresponding bits of the encryption mask with the Broadcast Packet Consolidation Protocol packet payload as described in 2.4.

2.4.1.1.1 Constructing the Encryption Mask

The access network shall generate the encryption mask as follows:

- The access network shall generate a RandomSeed as described in 2.4.1.1.1.1 for encrypting the error control block.
- The access network shall generate the Short Term Key for the error control block as described in 2.4.1.1.1.2.
- The access network shall generate a cryptosync for the error control block as described in 2.4.1.1.1.3.
- The access network shall generate the encryption mask for the error control block by calling the ESP_AES procedure specified in [12] with its inputs set as follows:

- Set the *key* to the Short Term Key for the error control block under consideration.
- Set *fresh* to the value of the cryptosync for the error control block under consideration.
- Set the *freshsize* to 8.
- Set the *buf* to the address of the beginning of a memory space that contains (K × MACPacketSize × 8) bits, all set to zero, where K and MACPacketSize are parameters of the error control block for the logical channel under consideration (see [3]).
- Set the *bit_offset* to zero.
- Set the *bit_count* to (K × MACPacketSize × 8) bits.

• After the ESP_AES procedure is returned, the access network shall set the encryption mask to the output of the ESP_AES procedure, which starts at the memory space specified by *buf* and of size (K × MACPacketSize × 8) bits.

2.4.1.1.1.1 Generating the RandomSeed

If this error control block is to be encrypted using the same Short Term Key as the previous error control block belonging to the logical channel under consideration, then the access network shall not generate a RandomSeed. Otherwise, the access network shall generate the RandomSeed by invoking the algorithmic function *f0* as specified in [12]. The access network shall set the input parameters of *f0* as follows:

• Set the *K* parameter to a randomly chosen seed.

• Set the *fi* parameter to 0x41.

• Set the *Fmk* parameter to 0x4243474B.

The access network shall set RandomSeed to the least significant 32 bits of the 64-bit output of *f0*.

2.4.1.1.1.2 Constructing the Short Term Key

If this error control block is to be encrypted using the same Short Term Key as the previous error control block belonging to the logical channel under consideration, then the access network shall set the Short Term Key to the Short Term Key corresponding to the previous error control block. Otherwise, the access network shall generate the Short Term Key as follows:

• The access network shall invoke the algorithmic function *f3* as specified in [12]. The access network shall set the input parameters of *f3* as follows:

- Set the *K* parameter to the Broadcast Access Key for the logical channel under consideration.
- Set the *fi* parameter to 0x45.
- Set the *RAND* parameter to RandomSeed | RandomSeed | RandomSeed | RandomSeed.

- Set the *Fmk* parameter to 0x4243474B.

- The access network shall set the Short Term Key to the 128-bit output of *f3*.
- If key strength reduction is required, the access network shall call the KeyStrengthRedAlg procedure specified in [12] with its inputs set as follows:
  - Set the *KeyLength* to 16.
  - Set the *OriginalKey* to the value of the Short Term Key.
  - Set *SaltLength* to the value of the BroadcastChannelSaltLength[5].
  - Set *Salt* to the value of the BroadcastChannelSalt[5].
  - Set the *KeyEntropy* to the value of the EncryptionKeyEntropy parameter.
- When the KeyStrengthRedAlg returns, the access network shall set the Short Term Key to *RedStrengthKey*, which is the output of the KeyStrengthRedAlg procedure.

The steps for generating the Short Term Key are shown in Figure 2-4.

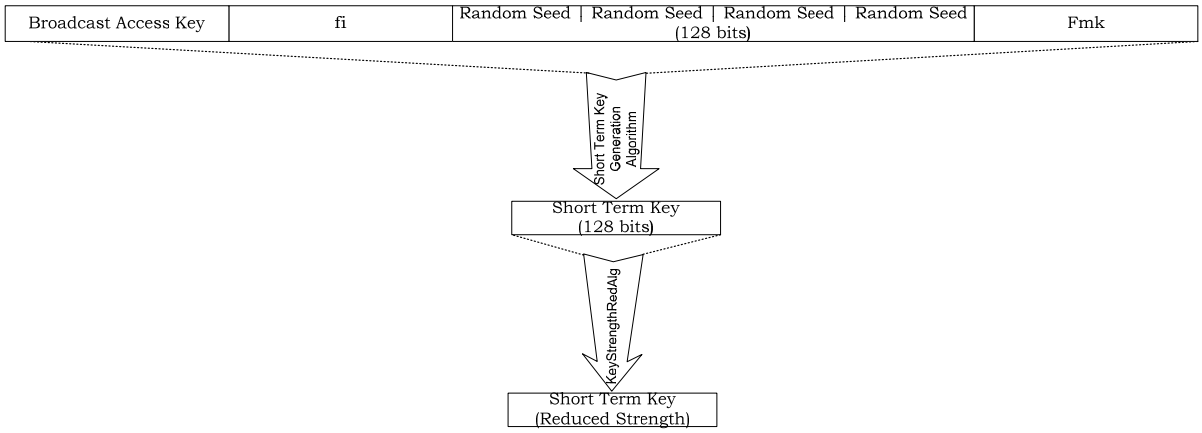

Figure 2-4. Generation of Short Term Key

The access network shall generate the Short Term Key for BlocksPerRandomSeed error control blocks associated with the logical channel under consideration using each value of RandomSeed. The access network shall change the RandomSeed used to generate the Short Term Key every BlocksPerRandomSeed error control blocks associated with the logical channel under consideration. The access network shall assume that the first error control block began transmission during the first occurrence at or after time T = 0 of an interlace-multiplex pair assigned to the logical channel under consideration, where T is the System Time in PHY frames as defined in [2]. The access network shall set the BlocksPerRandomSeed parameter to a value between 1 and 255 inclusive.

[5] BroadcastChannelSaltLength and BroadcastChannelSalt may be specified by the BroadcastParameters message or may be obtained by other means that are outside the scope of this specification.

2.4.1.1.1.3 Constructing the Cryptosync

The access network shall compute the cryptosync for the Forward Broadcast and Multicast Services Channel as shown in Table 2-10.

Table 2-10. Subfields of the Cryptosync

Subfield	Length (bits)
ChannelID	8
TimeStamp	56

ChannelID — The access network shall set this field to 0x04 to indicate that the cryptosync is used for the Forward Broadcast and Multicast Services Channel.

TimeStamp — The access network shall set this field to the 56 least significant bits of the System Time in units of PHY frames, corresponding to the beginning of transmission of the first Physical Layer packet of the error control block carrying this Broadcast Security Packet.

2.4.1.1.1.4 Encryption Procedures

The access network shall encrypt the Broadcast Packet Consolidation Protocol packet payload by exclusive-ORing the payload with the corresponding portion of the encryption mask. The size of the encryption mask is K × MACPacketSize × 8 bits. However, the sum of the lengths of all payloads in an error control block will be less than the size of the encryption mask, because there may be one or more payloads of PayloadType ‘00’, ‘10’, or ‘11’ (i.e., not to be encrypted) and the two-octet header of each Broadcast Packet Consolidation Protocol packet is not encrypted. The access network shall discard bits of the encryption mask corresponding to those bits of the Broadcast Packet Consolidation Protocol packet that is not to be encrypted. The access network shall then encrypt the Broadcast Packet Consolidation Protocol packet payload by exclusive-ORing the Broadcast Packet Consolidation Protocol packets with bits from the encryption mask in the order from the beginning of the encryption mask to the end. Figure 2-5 shows this procedure.

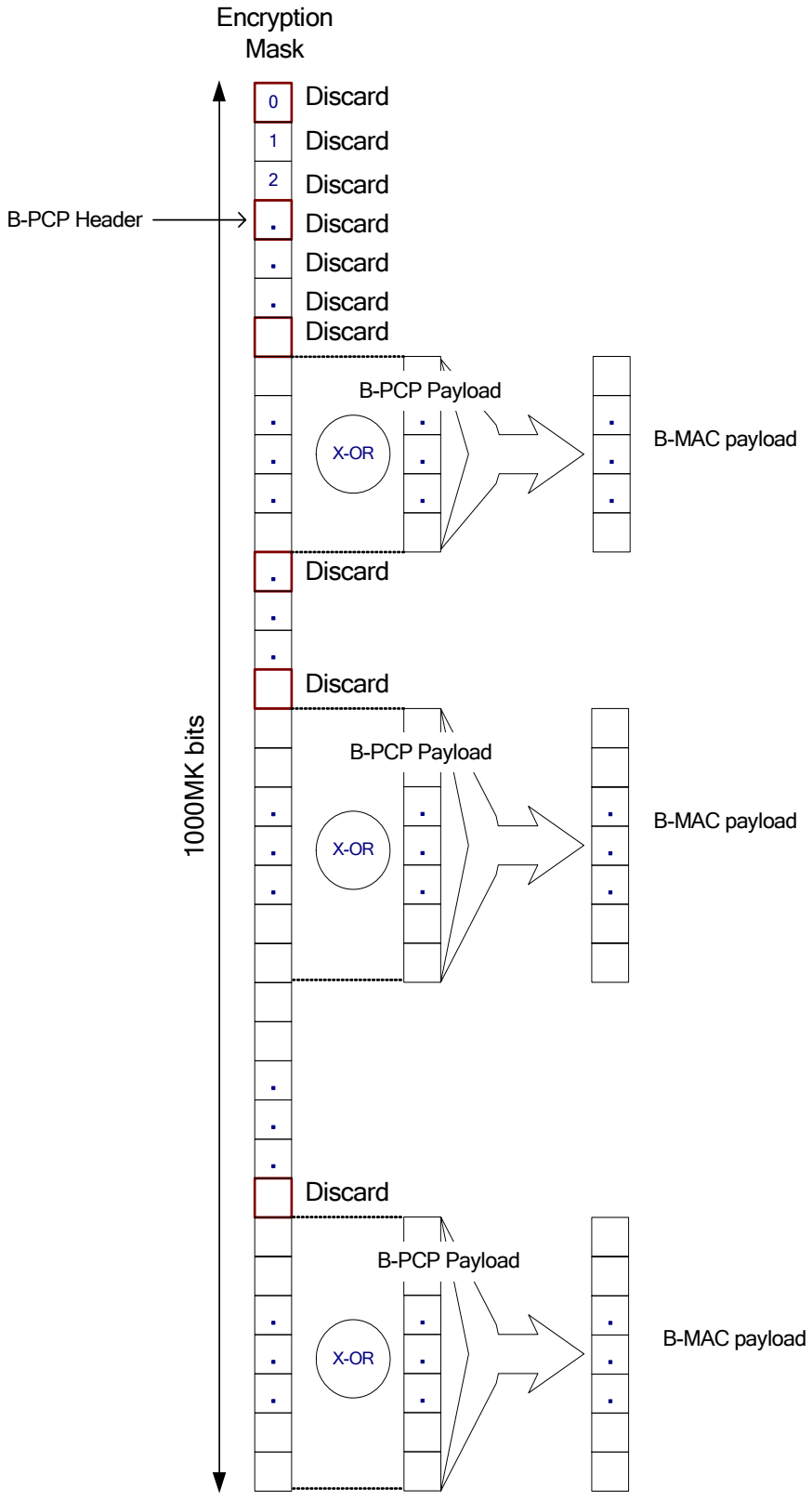

Figure 2-5. Generation of Broadcast Security Packets

2.4.1.1.1.5 Requirements for transmission of SecurityParameters Message

If the encryption mask for an error control block is generated using a different RandomSeed than the previous error control block associated with the logical channel under consideration, then the access network shall include a SecurityParameters message in the error control block. Otherwise, the access network need not include a SecurityParameters message in the error control block.

The SecurityParameters message contains one or more occurrences of the RandomSeed field, which conveys the value of a RandomSeed. If the SecurityParameters message contains multiple occurrences of the RandomSeed field, the access network shall use the first RandomSeed to generate the encryption mask for the error control block in which this SecurityParameters message is transmitted. The access network shall use successive RandomSeeds to generate encryption masks for successive error control blocks associated with the logical channel under consideration.

2.4.2 Message Formats

2.4.2.1 SecurityParameters Message

The access network sends the SecurityParameters message to provide the access terminal with information that would allow the access terminal to decrypt the content being transmitted on the Forward Broadcast and Multicast Services Channel.

Field	Length (bits)
MessageID	8
BAKSequenceNumber	4
BlocksPerRandomSeed	8
RandomSeedCount	2
RandomSeedCount+1 occurrences of the following field:	
RandomSeed	32
Reserved	2

MessageID The access network shall set this field to 0x00.

BAKSequenceNumber
The access network shall set this field to the sequence number of the Broadcast Access Key that is used to generate the Short Term Key.

BlocksPerRandomSeed
The access network shall set this field to the number of error control blocks encrypted using each Short Term Key.

RandomSeedCount The access network shall set this field to one less than the number of occurrences of the RandomSeed field following this field in this message.

RandomSeed The access network shall set this field to the RandomSeed used to generate the Short Term Key.

Reserved The access network shall set this field to '00'. The access terminal shall ignore this field.

The access network shall use the following values for the message information fields when transmitting the SecurityParameters message:

Channels	BCMCSCH (Forward Broadcast and Multicast Services Channel)
Addressing	Broadcast

2.5 Broadcast Inter-Route Tunneling Protocol

2.5.1 Overview

The Broadcast Inter-Route Tunneling Protocol performs the following functions:

- Tunneling over the Forward Broadcast and Multicast Services Channel of packets generated by the unicast Route. The Broadcast Inter-Route Tunneling Protocol Header indicates the unicast Route to which the payload belongs.

At the access network, the Broadcast Inter-Route Tunneling Protocol receives packets for transmission from the Route Protocol of a unicast Route. The Broadcast Inter-Route Tunneling Protocol adds a Broadcast Inter-Route Tunneling Protocol Header to the received packet to identify the destination unicast Route and delivers this packet to the Broadcast Packet Consolidation Protocol for transmission.

At the access terminal, the Broadcast Inter-Route Tunneling Protocol receives packets from the Broadcast Packet Consolidation Protocol. The Broadcast Inter-Route Tunneling Protocol removes the Broadcast Inter-Route Tunneling Protocol Header and delivers the packet to the Route Protocol of the corresponding unicast Route.

2.5.2 Protocol Data Unit

The protocol data unit for this protocol is a Broadcast Inter-Route Tunneling Protocol Packet. A Broadcast Inter-Route Tunneling Protocol Packet consists of a Broadcast Inter-Route Tunneling Protocol Payload and one or more Broadcast Inter-Route Tunneling Protocol Headers.

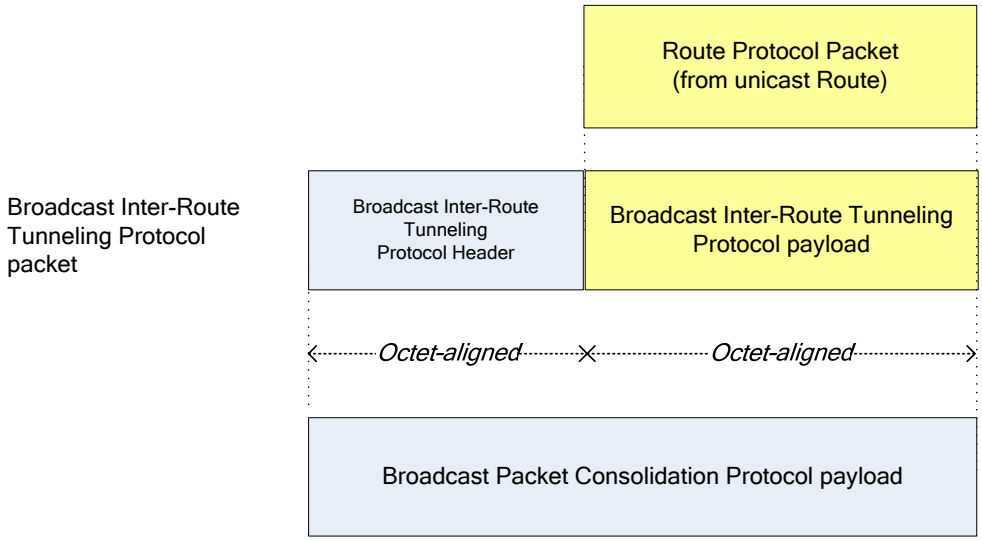

Figure 2-6. Broadcast Inter-Route Tunneling Protocol Packet

2.5.3 Broadcast Inter-Route Tunneling Protocol Header

The Broadcast Inter-Route Tunneling Protocol Header has the following format:

Field	Length (bits)
HeaderType	4
If HeaderType= '1000'	
PilotID	10
If HeaderType= '1001'	
ANID	64
Reserved	0-7 (as needed)

HeaderType — The access network shall set this field as specified in Table 2-11 to indicate the type of Broadcast Inter-Route Tunneling Protocol Header.

Table 2-11. HeaderType Values

HeaderType (binary)	Type of Inter-Route Tunneling Protocol Header
1000	PilotID Header
1001	ANID Header
Other values	Reserved

If the HeaderType field is set to '1000', the access network shall include the following field:

PilotID — The access network shall set this field to the pilot identifier of a pilot belonging to the unicast access network to which this packet belongs to.

If the HeaderType field is set to '1001', the access network shall include the following field:

ANID — The access network shall set this field to the access network identifier (see [1]) of the unicast access network to which this packet belongs.

Reserved — The access network shall include zero to seven bits to make this Broadcast Inter-Route Tunneling Protocol Header octet-aligned. The access network shall set these bits to 0. The access terminal shall ignore these bits.

2.5.4 Access Network Procedures

If the Broadcast Inter-Route Tunneling Protocol receives a Route Protocol Packet from the Route Protocol of a unicast Route, it shall perform the following:

- The Broadcast Inter-Route Tunneling Protocol shall add a Broadcast Inter-Route Tunneling Protocol Header to identify the unicast access network to which this packet belongs.
- The Broadcast Inter-Route Tunneling Protocol shall deliver the Broadcast Inter-Route Tunneling Protocol Packet to the Broadcast Packet Consolidation Protocol.

2.5.5 Access Terminal Procedures

If the Broadcast Inter-Route Tunneling Protocol receives a Broadcast Inter-Route Tunneling Protocol Packet from the Broadcast Packet Consolidation Protocol, it shall perform the following:

- The Broadcast Inter-Route Tunneling Protocol shall remove the Broadcast Inter-Route Tunneling Protocol Header to produce a Broadcast Inter-Route Tunneling Protocol Payload.
- The Broadcast Inter-Route Tunneling Protocol shall deliver the Broadcast Inter-Route Tunneling Protocol payload to the Route Protocol of the unicast Route corresponding to the access network to which this packet belongs.

2.6 Broadcast MAC Protocol

2.6.1 Overview

The Broadcast MAC Protocol contains the rules governing the operation and the timing of the Forward Broadcast and Multicast Services Channel.

The Broadcast MAC Protocol receives Broadcast Packet Consolidation Protocol packets from the Broadcast Packet Consolidation Protocol. Each packet received from the Broadcast Security Protocol is destined for one Broadcast Logical Channel. The Broadcast MAC Protocol forms an error control block by adding an outer Reed-Solomon code to the

payload destined for the logical channel. The Broadcast MAC Protocol thus reduces the radio link error rate as seen by the higher layers.

Figure 2-7 presents the structure of an Error Control Block. An error control block is formed of N rows and MACPacketSize columns. The top K rows of the error control block contain payload from the served protocols, some of which can be Stuffing Packets. The bottom R = N - K rows of the error control block contain Reed-Solomon parity octets.

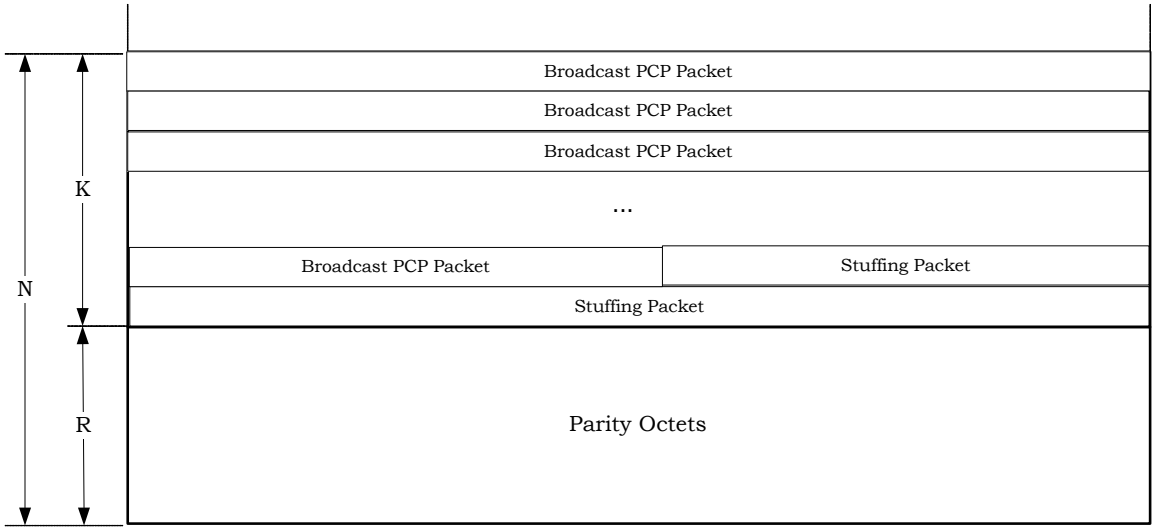

Figure 2-7. Error Control Block Structure

Data from the error control blocks is transmitted using Broadcast MAC packets. Each row of an error control block is carried using MACPacketSize-bit Broadcast MAC packets. Stuffing packet may be appended to make the number of data packets equal to K if not enough data is available to fill up the K rows as described in 2.6.3.1.6.2.

2.6.2 Protocol Data Unit

The protocol data unit for this protocol is a Broadcast MAC packet. Figure 2-8 illustrates the format of other Broadcast MAC packets except the last non-stuffing packet, which is illustrated in Figure 2-9. The details of the MAC packet containing the trailer NextUltraframeInfo is described in 2.6.3.3.

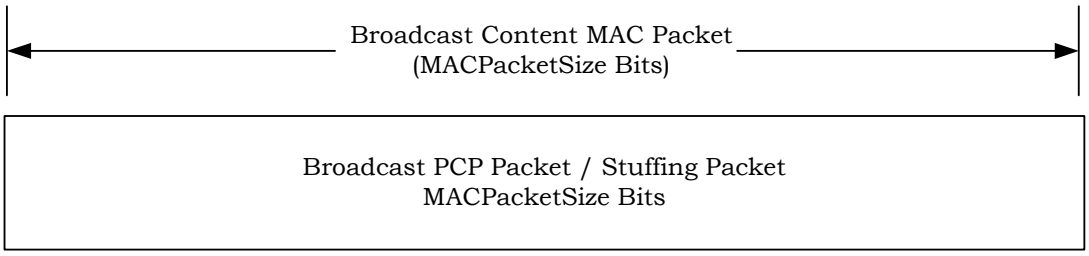

Figure 2-8. Format of the Broadcast MAC Packets

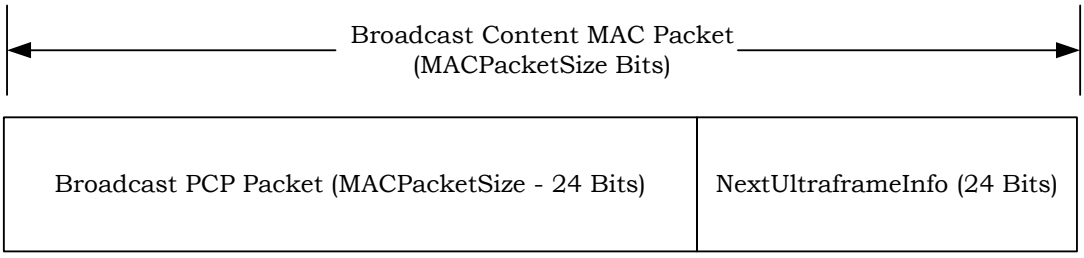

Figure 2-9. Format of the Last Broadcast MAC Packet that is not a Stuffing Packet

2.6.3 Procedures

2.6.3.1 Access Network Requirements

The ultraframe structure of the Forward Broadcast and Multicast Services Channel is described in 2.6.3.1.1. The access network shall map the Broadcast Overhead Channel into the Forward Broadcast and Multicast Services Channel as described in 2.6.3.1.1.

The access network shall map logical channels into the Forward Broadcast and Multicast Services Channel as described in 2.6.3.1.3.

The access network shall transmit the BroadcastParameters message according to the requirements in 2.6.3.1.5.

The access network shall create Broadcast MAC packets as follows:

- The access network shall create the error control block as described in 2.6.3.1.6.
- The access network shall add the 17-bit NextUltraFrameInfo defined in 2.6.3.3 to each Broadcast MAC packet.

The access network shall send the Broadcast MAC packets to the Broadcast Physical Layer Protocol for transmission of the Forward Broadcast and Multicast Services Channel as described in 2.6.3.1.6.3.

2.6.3.1.1 Broadcast Multicast Transmission Structure

BCMCS transmissions are indexed in terms of ultraframes. Each ultraframe shall consist of a number of subzones and interlaces of 48 Physical Layer super-frames as specified in the 2.2.3.4.1.

Information about the physical location of logical channels can be obtained from an associated Broadcast Overhead Channel. Up to four Broadcast Overhead Channels are allowed per ultraframe as specified by NumBOC. The set of Physical channels that each Broadcast Overhead Channel addresses is denoted by a SubbandGroup*i*, where *i* can take on values from 0 to 3. The Broadcast Overhead Channels transmitted on ultraframe k shall contain information about the logical channels transmitted on ultraframe k+1.

Each SubbandGroup*i* shall be partitioned into NumOuterFrames*i* outerframes, where NumOuterFrames*i* = 1, 2, 4, or 8. Each logical channel in an ultraframe shall be transmitted once every outerframe associated with the SubbandGroup*i*.

2.6.3.1.2 BCMCS Subband Indexing

Over each Physical Layer frame, each group of 128 hop ports that is part of the Broadcast and Multicast services is referred to as a BCMCS subband in this specification. The location of these BCMCS subbands is advertised in the BroadcastParameters message. Note that some of these hop ports may map to guard carriers, and hence not be usable for data transmission.

In each ultraframe, the BCMCS subbands are indexed by UltraframeSubbandIndex are numbered from 0 to NumSubbandsPerUltraframe - 1. The PHY frames on which BCMCS is permitted shall be numbered in increasing order with the PHY frame that occurs earlier in time being numbered lower. If more than one BCMCS subband is present in a PHY frame, then each subbands are numbered in increasing order.

As an example, consider a 5 MHz deployment with each BCMCS subband being 128 hop ports over one Phy Frame, represented as a box in Figure 2-10. The reserved subbands are represented by shaded boxes, while the BCMCS subbands are shaded boxes with an index. This index is referred to as the UltraframeSubbandIndex. In the figure, four subbands are reserved per eight interlaces, of which three are assigned to BCMCS.

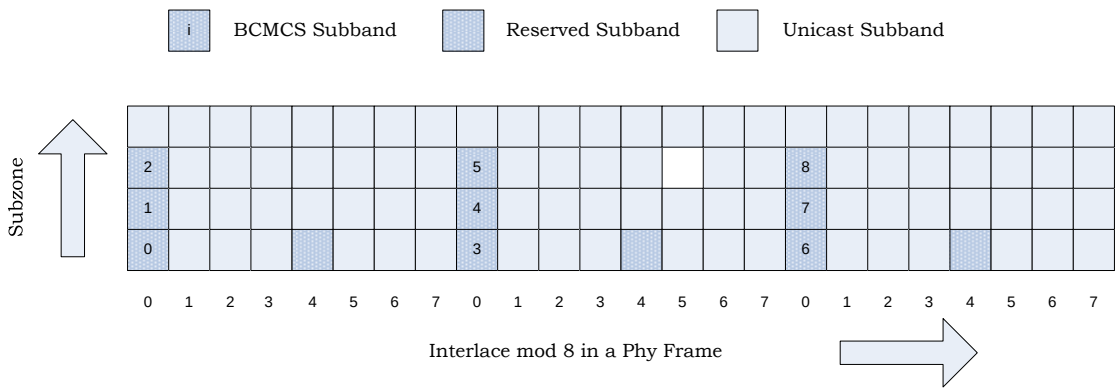

Figure 2-10. Indexing BCMCS Subbands

2.6.3.1.3 Indexing BCMCS Subbands

Each SubbandGroup*i* is consists of a collection of BCMCS subbands. The ith SubbandGroup is denoted by SubbandGroup*i*, where *i* can take on values from 0 to 3. The number of BCMCS subbands in SubbandGroup*i* is denoted by NumSubbandsPerGroup*i*, where NumSubbandsPerGroup*i* is a multiple of NumOuterFrames*i*.

Define NumOuterframeSubbandsPerGroup*i* to be the integer defined by NumSubbandsPerGroup*i* / NumOuterFrames*i*. These BCMCS subbands per Physical Layer group shall be numbered sequentially (in increasing order of the BCMCS subband number) from 0 to NumOuterframeSubbandsPerGroup*i* – 1 for each of the SubbandGroup*i* corresponding to each outerframe belonging to the SubbandGroup*i*. The pair (OuterframeIndex*i*, SubbandIndex*i*) thus has a one-to-one mapping with UltraframeSubbandIndex. Each such BCMCS subband is denoted as NumSubbandsPerGroup*i* is chosen to be a multiple of NumOuterFrames*i*.

Each SubbandGroup*i*, the BCMCS Subbands assigned to each outerframe are determined by the following pair(s): Offset*j* and Period*j*. Let k denote the index of BCMCS subband in an outerframe. Every BCMCS subband such that k ≡ Offset*j* (mod Period*j*) shall be part of SubbandGroup*i*. Note that a SubbandGroup*i* can consist of a number of such (Offset*j*, Period*j*) pairs as defined by NumOffsetsPerGroup*i* for *j* = 0, 1, …, 15. Note that this can lead to certain unused BCMCS subbands at the end of the superframe, as NumOuterframeSubbandsPerGroup*i* is a multiple of Period*j*.

Note that a given (Offset*j*, Period*j*) pair can belong to multiple Physical Channel Groups. In this case, the BroadcastMapping Message of multiple Physical layer Groups can address the same logical channel. This scenario is useful when the SFN coverage of the logical channel is different from the SFN coverage of the Broadcast Overhead Channel.

2.6.3.1.4 Logical to Physical Channel Mapping

Each Forward Broadcast and Multicast Services Channel shall consist of a number of BCMCS subbands as specified in the BroadcastParameters message and mapped to logical

channels as described in 2.6.3.1.1. For all other BCMS subbands, the logical channel occupies all the OFDM symbols.

A logical channel shall carry Broadcast PCP packets from one or more BCMCS Flows. While the same BCMCS Flow may be transmitted independently on several logical channels, the contents of a given BCMCS Flow shall not be split across multiple logical channels. If a BCMCS Flow is carried on more than one logical channel belonging to different sectors, the BCMCS Flow to physical channel mapping need not be the same on all those sectors. Logical channels carrying the same broadcast content may be transmitted synchronously across multiple sectors to facilitate soft combining. A logical channel associated with the Forward Broadcast and Multicast Services Channel may be transmitted synchronously across multiple sectors as described in 2.6.3.1.6.5.

2.6.3.1.5 Broadcast Overhead Channel

Each sector of an access network can carry up to a maximum of four Broadcast Overhead Channels as defined by the NumBOC parameter. The Broadcast Overhead Channel is sent on the last one, two, four or eight OFDM symbols of each outerframe of a SubbandGroup.

The modulation parameters of the Broadcast Overhead Channel are carried in the BroadcastParameters message. In addition to the Broadcast Overhead Channel, each logical channel also carries in band information about its location in the next ultraframe as described in 2.6.3.3.

2.6.3.1.6 Generation of Error Control Blocks

2.6.3.1.6.1 Overview

The access network shall segment the transmission on a logical channel into error control blocks (ECB). Each error control block shall begin with zero or one MAC packet received by the BCMCS MAC.

The access network shall fill data into the error control block in rows. The access network shall apply Reed-Solomon coding along columns of the error control block. The access network shall transmit the error control block on the Forward Broadcast and Multicast Services Channel in rows.

Each Error Control block shall contain N rows and MACPacketSize columns. The top K rows of the error control block shall contain payload from the served protocols or stuffing packets as described in 2.6.3.1.6.2. The bottom R = N - K rows of the error control block shall contain Reed-Solomon parity octets. The length of each Reed-Solomon code word shall be N octets. Each error control block shall consist of one Reed-Solomon code word.

The Reed-Solomon code is specified as a (N, K, R) code. N, K and R are defined as follows:

N = Number of octets in a Reed-Solomon code word. The value of N shall be as defined in [2].

K = Number of data octets in a Reed-Solomon code word. The value of K shall be as defined in [2].

R = N - K = Number of parity octets in a Reed-Solomon code word. The value of R shall be as defined in [2].

Each row of the error control block shall form the payload for one or more Broadcast MAC packets.

A logical channel shall use error control blocks with the same values of N, K, and MACPacketSize on all sectors that the access terminal is allowed to soft combine the logical channel.

2.6.3.1.6.1.1 Outer Block Encoding

The outer code is a Reed-Solomon block code that uses 8-bit symbols and operates in the Galois Field called GF(2^8). The primitive element α for this field is defined by

$$\alpha^8 + \alpha^4 + \alpha^3 + \alpha^2 + 1 = 0.$$

The j^{th} code symbol (j = 0, 1,..., N – 1), v_j, shall be defined by:

$$v_j = \begin{cases} u_j & 0 \le j \le K-1 \\ \sum_{i=0}^{K-1} u_i * p_{i,j} & K \le j \le N-1 \end{cases},$$

where

N and K are parameters of the (N, K, R) Reed-Solomon code.

u_j is the j^{th} of a block of K information symbols,

$p_{i,j}$ is the entry on the i^{th} row and the j^{th} column in the parity matrix of the code, and

$*$ and Σ indicate multiplication and summation in GF(2^8), respectively.

2.6.3.1.6.1.1.1 (1, 1, 0) Reed-Solomon Code

The (1, 1, 0) code generates 1 code symbol for each information symbol input to the encoder. The code symbol shall be the same as the information symbol.

2.6.3.1.6.1.1.2 (16, 12, 4) Reed-Solomon Code

The (16, 12, 4) code generates 16 code symbols for each block of 12 information symbols input to the encoder. The first 12 symbols are the information symbols and the remaining 4 symbols are parity symbols.

The generator polynomial for the (16, 12, 4) code is

$$g(X) = 1 + \alpha^{201}X + \alpha^{246}X^2 + \alpha^{201}X^3 + X^4.$$

The parity matrix for the (16, 12, 4) Reed-Solomon block code shall be as specified in Table 2-12.

Table 2-12. Parity Matrix for the (16, 12, 4) Outer Code

Row Index i	$\mathbf{p}_{i,12}$	$\mathbf{p}_{i,13}$	$\mathbf{p}_{i,14}$	$\mathbf{p}_{i,15}$
0	40	138	141	8
1	8	196	97	158
2	158	4	250	209
3	209	123	27	76
4	76	226	198	160
5	160	142	95	125
6	125	19	59	70
7	70	87	39	137
8	137	169	244	254
9	254	192	27	160
10	160	57	53	201
11	201	246	201	0

Note: This table lists the power h of the entry on the i^{th} row and the j^{th} column in the parity matrix, $p_{i,j} = \alpha^h$, where α is the primitive element of GF(256) and i = 0, …,11, and j = 12, 13, 14, and 15. For example, the entry of 40 in the upper left-hand corner indicates $p_{0,12} = \alpha^{40}$

2.6.3.1.6.1.1.3 (16, 13, 3) Reed-Solomon Code

The (16, 13, 3) code generates 16 code symbols for each block of 13 information symbols input to the encoder. The first 13 symbols are the information symbols and the remaining 3 symbols are parity symbols.

The generator polynomial for the (16, 13, 3) code is

$$g(X) = 1 + \alpha^{197}X + \alpha^{197}X^2 + X^3.$$

The parity matrix for the (16, 13, 3) Reed-Solomon block code shall be as specified in Table 2-13.

Table 2-13. Parity Matrix for the (16, 13, 3) Outer Code

Row Index i	$\mathbf{p}_{i,13}$	$\mathbf{p}_{i,14}$	$\mathbf{p}_{i,15}$
0	169	69	236
1	236	34	140
2	140	28	32
3	32	88	182
4	182	51	58
5	58	163	238
6	238	175	231
7	231	80	223
8	223	195	250
9	250	237	160
10	160	53	246
11	246	98	197
12	197	197	0

Note: This table lists the power h of the entry on the i^{th} row and the j^{th} column in the parity matrix, $p_{i,j} = \alpha^h$, where α is the primitive element of GF(256) and i = 0, …, 12, and j = 13, 14, and 15. For example, the entry of 169 in the upper left-hand corner indicates $p_{0,13} = \alpha^{169}$.

2.6.3.1.6.1.1.4 (16, 14, 2) Reed-Solomon Code

The (16, 14, 2) code generates 16 code symbols for each block of 14 information symbols input to the encoder. The first 14 symbols are the information symbols and the remaining 2 symbols are parity symbols.

The generator polynomial for the (16, 14, 2) code is

$$g(X) = 1 + \alpha^{152}X + X^2.$$

The parity matrix for the (16, 14, 2) Reed-Solomon block code shall be as specified in Table 2-14.

Table 2-14. Parity Matrix for the (16, 14, 2) Outer Code

Row Index i	$\mathbf{p}_{i,14}$	$\mathbf{p}_{i,15}$
0	1	65
1	65	68
2	68	224
3	224	215
4	215	119
5	119	91
6	91	44
7	44	84
8	84	36
9	36	111
10	111	201
11	201	197
12	197	152
13	152	0

Note: This table lists the power h of the entry on the i^{th} row and the j^{th} column in the parity matrix, $p_{i,j} = \alpha^h$, where α is the primitive element of GF(256) and i = 0, …, 13, and j = 14 and 15. For example, the entry of 1 in the upper left-hand corner indicates $p_{0,14} = \alpha^1$.

2.6.3.1.6.1.1.5 (32, 24, 8) Reed-Solomon Code

The (32, 24, 8) code generates 32 code symbols for each block of 24 information symbols input to the encoder. The first 24 symbols are the information symbols and the remaining 8 symbols are parity symbols.

The generator polynomial for the (32, 24, 8) code is

$$g(X) = 1 + \alpha^{44}X + \alpha^{231}X^2 + \alpha^{70}X^3 + \alpha^{235}X^4 + \alpha^{70}X^5 + \alpha^{231}X^6 + \alpha^{44}X^7 + X^8.$$

The parity matrix for the (32, 24, 8) Reed-Solomon block code shall be as specified in Table 2-15.

Table 2-15. Parity Matrix for the (32, 24, 8) Outer Code

Row Index i	$\mathbf{p}_{i,24}$	$\mathbf{p}_{i,25}$	$\mathbf{p}_{i,26}$	$\mathbf{p}_{i,27}$	$\mathbf{p}_{i,28}$	$\mathbf{p}_{i,29}$	$\mathbf{p}_{i,30}$	$\mathbf{p}_{i,31}$
0	120	75	145	26	65	36	140	205
1	205	104	114	214	181	51	52	211
2	211	207	161	201	132	185	85	141
3	141	128	179	163	34	51	134	89
4	89	78	120	201	16	228	20	158
5	158	165	209	26	193	94	81	183
6	183	33	95	169	72	70	1	43
7	43	83	243	80	240	229	2	243
8	243	22	117	52	230	221	240	68
9	68	168	2	127	148	157	178	252
10	252	145	45	164	120	227	11	87
11	87	174	122	52	2	44	181	20
12	20	5	147	125	141	177	249	186
13	186	6	46	218	27	129	195	67
14	67	55	185	0	3	153	30	151
15	151	207	250	155	56	145	70	2
16	2	39	150	223	214	201	65	45
17	45	169	6	147	51	128	145	64
18	64	100	24	146	118	108	215	32
19	32	191	27	236	189	247	12	174
20	174	93	52	173	213	252	85	160
21	160	240	214	203	155	26	95	238
22	238	22	157	161	236	19	175	44
23	44	231	70	235	70	231	44	0

Note: This table lists the power *h* of the entry on the i^{th} row and the j^{th} column in the parity matrix, $p_{i,j} = \alpha^h$, where α is the primitive element of GF(256) and i = 0, …, 23, and j = 24, …, 31. For example, the entry of 120 in the upper left-hand corner indicates $p_{0,24} = \alpha^{120}$.

2.6.3.1.6.1.1.6 (32, 26, 6) Reed-Solomon Code

The (32, 26, 6) code generates 32 code symbols for each block of 26 information symbols input to the encoder. The first 26 symbols are the information symbols and the remaining 6 symbols are parity symbols.

The generator polynomial for the (32, 26, 6) code is

$$g(X) = 1 + \alpha^{36}X + \alpha^{250}X^2 + \alpha^{254}X^3 + \alpha^{250}X^4 + \alpha^{36}X^5 + X^6.$$

The parity matrix for the (32, 26, 6) Reed-Solomon block code shall be as specified in Table 2-16.

Table 2-16. Parity Matrix for the (32, 26, 6) Outer Code

Row Index i	$\mathbf{p}_{i,26}$	$\mathbf{p}_{i,27}$	$\mathbf{p}_{i,28}$	$\mathbf{p}_{i,29}$	$\mathbf{p}_{i,30}$	$\mathbf{p}_{i,31}$
0	243	66	154	39	233	16
1	16	58	74	113	204	81
2	81	63	43	10	0	29
3	29	210	130	61	234	162
4	162	185	49	175	57	168
5	168	182	143	213	35	110
6	110	126	78	245	11	26
7	26	60	14	172	35	249
8	249	126	98	3	112	168
9	168	235	50	228	84	131
10	131	192	197	218	92	141
11	141	13	12	223	195	7
12	7	182	247	197	104	14
13	14	128	241	2	158	3
14	3	15	67	131	98	192
15	192	39	244	247	7	167
16	167	182	222	123	77	30
17	30	113	66	57	164	56
18	56	120	141	45	242	32
19	32	183	185	157	12	147
20	147	210	44	252	175	223
21	223	154	155	195	99	215
22	215	161	30	237	228	70
23	70	177	61	136	39	223
24	223	34	79	169	195	36
25	36	250	254	250	36	0

Note: This table lists the power h of the entry on the i^{th} row and the j^{th} column in the parity matrix, $p_{i,j} = \alpha^h$, where α is the primitive element of GF(256) and i = 0, …, 25, and j = 26, …, 31. For example, the entry of 243 in the upper left-hand corner indicates $p_{0,26} = \alpha^{243}$.

2.6.3.1.6.1.1.7 (32, 28, 4) Reed-Solomon Code

The (32, 28, 4) code generates 32 code symbols for each block of 28 information symbols input to the encoder. The first 28 symbols are the information symbols and the remaining 4 symbols are parity symbols.

The generator polynomial for the (32, 28, 4) code is

$$g(X) = 1 + \alpha^{201}X + \alpha^{246}X^2 + \alpha^{201}X^3 + X^4.$$

The parity matrix for the (32, 28, 4) Reed-Solomon block code shall be as specified in Table 2-17.

1 **Table 2-17. Parity Matrix for the (32, 28, 4) Outer Code**

Row Index i	$\mathbf{p}_{i,28}$	$\mathbf{p}_{i,29}$	$\mathbf{p}_{i,30}$	$\mathbf{p}_{i,31}$
0	207	34	22	229
1	229	210	95	141
2	141	50	89	32
3	32	160	127	224
4	224	37	223	248
5	248	5	131	120
6	120	229	44	228
7	228	73	240	113
8	113	215	118	88
9	88	208	113	74
10	74	37	215	178
11	178	76	97	78
12	78	225	181	5
13	5	218	168	182
14	182	188	204	212
15	212	157	221	40
16	40	138	141	8
17	8	196	97	158
18	158	4	250	209
19	209	123	27	76
20	76	226	198	160
21	160	142	95	125
22	125	19	59	70
23	70	87	39	137
24	137	169	244	254
25	254	192	27	160
26	160	57	53	201
27	201	246	201	0

Note: This table lists the power h of the entry on the i^{th} row and the j^{th} column in the parity matrix, $p_{i,j} = \alpha^h$, where α is the primitive element of GF(256) and i = 0, …, 27, and j = 28, …, 31. For example, the entry of 207 in the upper left-hand corner indicates $p_{0,28} = \alpha^{207}$.

2.6.3.1.6.2 Stuffing Packets

The access network shall add stuffing packets to Broadcast PCP packets if necessary to make the payload equal to K rows as described in 2.6.3.1.6.1. These packets shall contain an all zero payload and shall not be passed to the Physical layer, and hence not transmitted over the air.

2.6.3.1.6.3 Multiplexer

Each row of the error control block shall form the payload for Broadcast MAC packets for a given logical channel, which shall be transmitted in Broadcast Physical Layer packets assigned to the logical channel in time order of the start of transmission of the Broadcast Physical Layer packets.

2.6.3.1.6.4 Transmission Formats

For each Broadcast Physical Layer packet, the Broadcast MAC Protocol shall provide a *transmission format* to the Broadcast Physical Layer Protocol. A transmission format defines a set of parameters of a Broadcast Physical Layer packet as described in this section. The access network shall assign a transmission format to each logical channel. For all Broadcast Physical Layer packets associated with a given logical channel, the access network shall use the transmission format that is associated with that logical channel.

The transmission format of a Broadcast Physical Layer packet shall be of one of the following two types:

- The Broadcast Overhead Channel Transmission
- The Broadcast Transmission Formats

The BroadcastMapping Message transmitted on the Forward Broadcast and Multicast Services Channel is associated with the transmission format of the BroadcastMapping Message (see 2.6.3.2.1). A logical channel transmitted on the Forward Broadcast and Multicast Services Channel is associated with the broadcast transmission format (see [2]).

A basic broadcast transmission format is identified by its packet format index. Each packet format index corresponds to a packet size, rate set, and radio configuration, and modulation order.

The transmission formats for the Broadcast Overhead Channel are shown in Table 2-18. The spectral efficiencies correspond to the number of outerframes per ultraframe. The modulation order is 2 in all cases. Note that the number of OFDM symbols (NumOFDMSymbolsPerBOC) required for the transmission of the Broadcast Overhead Channel can be found by NumOFDMSymbolsPerBOC = Packet Size / 99.

Table 2-18. Broadcast Overhead Channel Transmission Formats

Packet Format Index	Packet Size	Rate Set	Radio Configuration	Spectral Efficiency (per outerframes in an ultraframe)			
				1	2	4	8
0	99	1/2/3/4	1	1.021	0.510	0.255	0.128
1	99	1/2/3/4	2	0.421	0.211	0.105	0.053
2	198	1/2/3/4	1	1.021	0.510	0.255	0.128
3	198	1/2/3/4	2	0.421	0.211	0.105	0.053
4	495	1/2/3/4	1	1.021	0.510	0.255	0.128
5	495	1/2/3/4	2	0.421	0.211	0.105	0.053
6	792	1/2/3/4	1	1.021	0.510	0.255	0.128
7	792	1/2/3/4	2	0.421	0.211	0.105	0.053

For BCMCS data, the number of bits (including PAD and FCS bits) carried by a Broadcast Physical Layer packet is called its *Packet Size* and denoted by N_{data}. The *Span* of a packet is defined to be the number of transmissions that are allowed for the packet.

A *Rate Set* within a given Transmission Mode is defined by two parameters: The BCMCS subband configuration of the first BCMCS subband of a packet and the packet size. A broadcast transmission format, also called the *BCMCS Transmission Format*, is defined by a Packet Format Index and the number of transmissions. Within each transmission mode, there are four rate sets referred to as Rate Sets 1, 2, 3, 4. Each rate set contains two Radio Configurations in addition to the unicast numerology, which can be used for the third transmission. In this case, the first and second transmissions are sent using broadcast numerology, while the third transmission occurs with unicast numerology.

The Transmission Formats are shown in Table 2-19. Two BCMCS Transmission Formats are *rate-compatible* if and only if they have the same packet format index, but have possibly different Spans.

The packet format consists of four bits. These four bits index the spectral efficiency and the modulation format to be used for each HARQ transmission of a data packet. Note that the default maximum number of transmissions is three (in this case, the Span is three), however a sector can choose to transmit once or twice as well for each packet format index. In this case, its Span is set to one or two respectively.

The packet size for each assignment is a computed based on the spectral efficiency listed in the table below and the assignment size. The packet size is given in Table 2-19.

Table 2-19. Broadcast Transmission Formats

Packet Format Index	Packet Size	Rate Set	Radio Configuration	Modulation Order	Spectral Efficiency for each Transmission		
					1	2	3
0	1536	1	1	4	2.26	1.13	0.72
1	768	1	1	2	1.13	0.57	0.36
2	2048	2	1	4	3.02	1.51	0.96
3	1024	2	1	2	1.51	0.75	0.75
4	2560	3	1	4	1.89	1.26	0.91
5	1280	3	1	2	0.94	0.63	0.46
6	3568	4	1	4	2.64	1.76	1.27
7	1784	4	1	2	1.32	0.88	0.64
8	1536~~768~~	1	2	4	2.18	1.09	0.70
9	768~~384~~	1	2	2	1.09	0.54	0.35
10	2048~~1024~~	2	2	4	2.90	1.45	0.94
11	1024~~512~~	2	2	2	1.45	0.73	0.47
12	2560~~1280~~	3	2	4	1.82	1.21	0.89
13	1280~~640~~	3	2	2	0.91	0.61	0.44
14	3568~~1792~~	4	2	4	2.54	1.69	1.24
15	1784~~896~~	4	2	2	1.27	0.85	0.62

2.6.3.1.6.5 Forward Broadcast and Multicast Services Channel Transmission from Multiple Sectors

This section provides an overview of single frequency network (SFN) and variable-rate transmission on the Forward Broadcast and Multicast Services Channel.

2.6.3.1.6.5.1 Single-frequency Network (SFN) Transmission

The Forward Broadcast and Multicast Services Channel is particularly suitable for SFN transmissions in which all sectors in a given broadcast coverage area synchronize their broadcast transmissions and transmit the same waveform (with the exception of sector-dependent delay and complex gain) over the air during the time intervals allocated to the Broadcast Physical Layer packets. At the access terminal's antenna, all transmissions that arrive from the participating sectors combine to appear as a single transmission that goes through a multipath channel with possibly large delay spread between the first and the last arriving paths.

2.6.3.1.6.5.2 Rate Compatible Transmissions

The access network may be configured so that adjacent sectors broadcasting the same content on the same BCMCS subbands may use transmission formats with different spans

as long as the transmission formats are rate-compatible with one another. As in the SFN transmission, the transmission time of the first BCMCS subband of each packet are synchronized across all sectors transmitting the same content. The BroadcastParameters message transmitted by a sector specifies the transmission format of the corresponding logical channel. Figure 2-11 shows a rate compatible transmission scheme, in which Cell A uses a transmission format with a span of 2 BCMCS subbands, while cells B and C use a rate-compatible transmission format with a span of 3 BCMCS subbands. Cell A may choose to transmit a supercast packet in the free slot as illustrated.

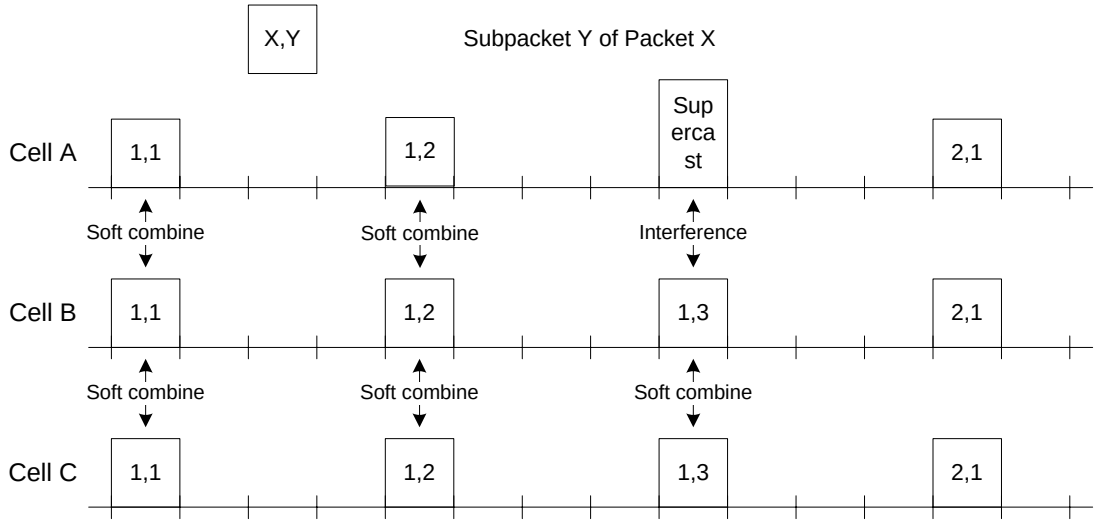

Figure 2-11. An Example of Variable Rate Transmission Scheme

2.6.3.1.6.6 Forward Broadcast and Multicast Services Channel Parameters

The access network shall determine the values of the following parameters for each logical channel transmitted on the Forward Broadcast and Multicast Services Channel:

- *Period*: The Period parameter assigned to a logical channel shall be greater than or equal to the Span of the transmission format of that logical channel. If the Period is greater than the Span of a Packet Format Index, the access network shall wait until the next period to transmit the next BCMCS packet. The access network may use this available slot(s) for supercast transmissions as illustrated in Figure 2-11. The method by which the access network sets the Period parameter is beyond the scope of this specification.
- *FDSSeed*: Frequency-domain spreading seed. A 10-bit binary number used in frequency-domain spreading as described in [2]. The method by which the access network sets the FDSSeed parameter is beyond the scope of this specification.
- *PilotStagger*: A parameter used in pilot tone insertion described in [2]. PilotStagger is a content dependent parameter: For different contents broadcast at the same time, the access network should assign different values for the PilotStagger parameter. The method by which the access network sets the PilotStagger parameter is beyond the scope of this specification.

- *Pilot-to-Data Power Ratios*: Specified in 2.6.3.1.6.6.1.
- *Modulation Layer*: This parameter specifies whether the logical channel is transmitted on the base layer or the enhancement layer if hierarchical modulation is supported.

For every Broadcast Physical Layer packet, the Broadcast MAC Protocol shall provide the values of the following parameters to the Broadcast Physical Layer Protocol:

- FDSSeed of the logical channel served by the Broadcast Physical Layer packet.
- PilotStagger of the logical channel served by the Broadcast Physical Layer packet.
- DCPDROffset and the in-use pilot-to-data-ratio (PDR) parameters of the logical channel served by the Broadcast Physical Layer packet as defined in 2.6.3.1.6.6.1.
- ModulationLayer of the logical channel served by the Broadcast Physical Layer packet.

2.6.3.1.6.6.1 Pilot-to-Data Power Ratio (PDR) Parameters

The term *in-use pilot-to-data-ratio (PDR) parameters* of a logical channel associated with the Forward Broadcast and Multicast Services Channel shall be represented by 4-bits and interpreted as follows:

Let Z be the value of the 4-bit representation of a parameter when interpreted as an unsigned integer. Then, the value of the parameter in dB is obtained as 0.5 × (Z - 4). For example, a value of -2 dB is represented as '0000' and a value of 5.5 dB is represented as '1111'.

The default Pilot to data Ratios for the Broadcast Overhead Channel associated with the appropriate transmission formats shall be as specified in Table 2-21.

Table 2-20. Default Pilot to Data Ratio of the Broadcast Overhead Channel

BOC-Transmission-Format	PDRBOCDefault (dB)
0	2
1	2

For each logical channel associated with the Forward Broadcast and Multicast Services Channel, the access network shall determine the values of the default PDR parameters as follows:

The access network shall determine the values of the default Pilot to Data Ratios of each logical channel based on the BCMCS Transmission Format of that logical channel according to Table 2-21. The pilot to data ratio for the first two transmissions is denoted by BCMCSPilotToDataRatio, and may be different from the third transmission, which is denoted by PilotToDataRatio.

The BroadcastParameters message (described in 2.6.3.2.1) carries information to indicate the in-use PDR parameters of logical channels.

Table 2-21. Default Pilot to Data Ratio of the Broadcast Messages

BCMCS-Transmission-Format	PDRBOCDefault (dB)
0	2
1	2
2	2
3	2
4	2
5	2
6	2
7	2
8	2
9	2
10	2
11	2
12	2
13	2
14	2
15	2
16	2

For each logical channel associated with the Broadcast and Multicast Services Channel, the access network shall set the value of a 1-bit parameter called BCMCSPDRProvidedForThisLogicalCh as follows:

- If the BCMCS Transmission Format of the logical channel consists of a span of two or less, the access network shall set the BCMCSPDRProvidedForThisLogicalCh parameter as follows:
  - The access network shall set the BCMCSPDRProvidedForThisLogicalCh parameter to '0' if the value of BCMCSPilotToDataRatio is the same as the value of PDRBOCDefault.
  - Otherwise, the access network shall set the BCMCSPDRProvidedForThisLogicalCh parameter to '1'.
- If the BCMCS Transmission Format of the logical channel consists of a span of 3, the access network shall set the BCMCSPDRProvidedForThisLogicalCh parameter as follows:

- If all of the following conditions are true, the access network shall set the BCMCSPDRProvidedForThisLogicalCh parameter to '0':
  - The value of BCMCSPilotToDataRatio is the same as the value of PDRBOCDefault for the first two transmissions.
  - The value of PilotToDataRatio is the same as the value of PDRBOCDefault for the third transmissions.
- Otherwise, the access network shall set the BCMCSPDRProvidedForThisLogicalCh parameter to '1'.

The BroadcastMapping message (described in 2.6.3.2.1) carries information to indicate the in-use PDR parameters of logical channels.

2.6.3.1.6.7 MAC Index

For every Broadcast Physical Layer packet, the Broadcast MAC Protocol shall provide a MAC Index to the Broadcast Physical Layer Protocol. The Broadcast MAC Protocol shall set the MAC Index to $N_{BroadcastGenericMACIndex}$.

2.6.3.2 Message Formats

2.6.3.2.1 BroadcastMapping Message

The access network sends the BroadcastMapping message to provide the access terminal with the mapping between logical channels and starting BCMCS subband on the Broadcast and Multicast Services Channel.

Field	Length (bits)
MessageID	8
BroadcastParametersSignature	16
NumLogicalChannels	8
NumLogicalChannels occurrences of the following two fields:	
StartLocation*j*	8
Duration*j*	4
Reserved	0 – 7 (as needed)

MessageID The access network shall set this field to 0x00.

BroadcastParametersSignature
The access network shall set this field to the Signature of the corresponding BroadcastParameters message.

NumLogicalChannels
: The access network shall set this field to the number of logical channels indexed by the BroadcastMapping Message.

StartLocationj
: The access network shall set this field to the starting location of logical channel j in number of Subbandsi as specified in 2.6.3.1.3.

Durationj
: The access network shall set this field to the number of number of consecutive BCMCS subbands that the logical channel j occupies as specified in Table 2-22.

Reserved
: The access network shall add reserved bits in order to make the length of the entire message equal to an integer number of octets. The access network shall set these bits to zero. The access terminal shall ignore these bits.

Table 2-22. Description of the Duration*j* Field, where *j* is the Index of the Logical Channel

Duration*j*	**Burst Length (BCMCS subbands)**
'0000'	1
'0001'	2
'0010'	3
'0011'	4
'0100'	6
'0101'	8
'0110'	9
'0111'	12
'1000'	16
'1001'	20
'1010'	24
'1011'	32
'1100'	36
'1101'	48
'1110'	60
'1111'	64

2.6.3.3 Broadcast MAC NextUltraframeInfo Format

The access network shall place the following fields at the end of every Broadcast MAC packet.

Field	Length (bits)
StartBCMCSSubbandNumber	8
EndBCMCSSubbandNumber	8
Read BroadcastParameters	1
Reserved	7

StartBCMCSSubbandNumber

The access network shall set this field to the location of the first BCMCS subband of the logical channel in the next ultraframe. If the logical channel is not present in the next ultraframe, the access network shall set this field to NULL.

EndBCMCSSubbandNumber

The access network shall set this field to the location of the last BCMCS subband of the logical channel in the next ultraframe. If the logical channel is not present in the next ultraframe, the access network shall set this field to NULL.

Read BroadcastParameters

The access network shall set this field to '0' if the parameters broadcast on the BroadcastParameters has not changed. The access network shall set this field to '1' if the parameters broadcast on the BroadcastParameters shall change on the next instance of the BroadcastParameters.

Reserved The access network shall set these bits to '0'.

2.7 Interface to Other Protocols

2.7.1 Commands Sent

This protocol does not issue any commands.

2.7.2 Indications

This protocol does not register to receive any indications.

2.8 Configuration Attributes

2.8.1 Simple Attributes

This protocol does not define any simple attributes.

2.8.2 Complex Attributes

This protocol does not define any complex attributes.

2.8.3 Non-Attribute Data

This protocol does not define any static or dynamic non-attribute data.

2.8.4 Protocol Numeric Constants

Constant	Meaning	Value
$N_{BroadcastType}$	Type field for this protocol suite	[1]
$N_{BroadcastBasicSubtype}$	Subtype field for this protocol suite	0x0000
$N_{BCIPeriod}$	The period of repetition of the BroadcastParameters message (in units if superframe)	240

2.9 Session State Information

The Session State Information record (see [1]) consists of parameter records. This protocol suite defines the following parameter records:

2.9.1.1 RegisteredBCMCSFlows

Table 2-23. The Format of the Parameter Record for the RegisteredBCMCSFlows Parameter

Field	Length (bits)
ParameterType	8
Length	8
BCMCSFlowIDLength	2
BCMCSFlowCount	6
BCMCSFlowCount occurrences of the following two fields:	
BCMCSFlowID	(BCMCSFlowIDLength + 1) × 8
ExpiryTime	32

ParameterType This field shall be set to 0x01 for this parameter record.

Length This field shall be set to the length of this parameter record in units of octets excluding the Length field.

BCMCSFlowIDLength
This field shall be set to one less than the length of the BCMCS Flow Identifier in units of octets. This field shall not be set to '00'.

BCMCSFlowCount	This field shall be set to the number of BCMCS Flow Identifiers included in this parameter record.
BCMCSFlowID	This field shall be set to the BCMCS Flow Identifier that the access terminal may be monitoring.
ExpiryTime	This field shall be set to the System Time in units of 1.28 sec when the registration for the BCMCSFlowID is expected to expire. If the expiry time is unknown, then this field shall be set to zero.

No text.