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DRAFT Amendment to IEEE Standard for ~~Local and metropolitan area networks~~

WirelessMAN-Advanced Air Interface for Broadband Wireless Access Systems

Enhancements to Support Machine-to-Machine Applications

Sponsor

LAN/MAN Standards Committee
of the
IEEE Computer Society

and the

IEEE Microwave Theory and Techniques Society

Introduction

This introduction is not part of IEEE Std 802.16p, IEEE Standard for ~~Local and metropolitan area networks—Part 16:~~ Air Interface for Broadband Wireless Access Systems - Amendment: ~~Air Interface for Broadband Wireless Access Systems~~ Enhancements to Support Machine-to-Machine Applications.

This amendment specifies support for Machine-to-Machine Applications. ~~As of the publication date, the current applicable version of IEEE Std 802.16 is IEEE Std 802.16-2009, as amended by IEEE 802.16j-2009, IEEE 802.16h-2010, and IEEE 802.16m-2011.~~

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This document was developend by the IEEE 802.16 Working Group on Broadband Wireless Access, which develops the WirelessMAN® Standard for Wireless Metropolitan Area Networks.

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NOTE-The editing instructions contained in this amendment define how to merge the material contained herein into the existing base standard IEEE Std 802.16-2009 as amended by IEEE Std 802.16j, IEEE Std 802.16h, and IEEE 802.16m. The editing instructions are shown in ***bold italic***. Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using strike through (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

1. Overview

1.1 Scope

1.2 Purpose

1.4 Reference models

3. Definitions

Add the following definitions:

3.147 Machine-to-Machine (M2M) communication: Information exchange between user devices through a Base Station, or between a device and a server in the core network through a Base Station that may be carried out without any human interaction.

3.148 M2M ASN: An Access Service Network that supports M2M service

3.149 M2M device: An MS that is capable of providing M2M communication

3.150 M2M server: An entity that communicates with M2M devices. The M2M server runs M2M applications and provides M2M specific services for one or more M2M devices.

3.151 M2M feature: A unique characteristic of an M2M application. One or more features may be needed to support an application.

3.152 M2M device group: A group of M2M devices that share one or more features in common

6. WirelessMAN-Advanced Air Interface

6.1 Introduction

6.2 Medium access control

6.2.1 Addressing

6.2.1.2 Logical identifiers

6.2.1.2.1 Station identifier (STID)

Insert the following text at the end of the first paragraph of 6.2.1.2.1

The STID is also used to identify the M2M devices in the domain of the ABS. The ABS may assign the same STID to multiple M2M devices.

If the assigned STID to an M2M device is shared with other M2M device(s), the ABS shall assign the frame (s) in which the STID is valid for an M2M device. The assigned STID to an M2M device is valid only in the frame (i.e. $Frame_{num}$) that satisfies the following condition.

$$Frame_{num} \bmod STID\_Valid\_Periodicity = STID\_Valid\_Offset,$$

where $Frame_{num}$ denotes the frame sequence number. The parameters *STID_Valid_Periodicity* and *STID_Valid_Offset* are transmitted by ABS in AAI-REG-RSP message. For the M2M devices sharing the same STID, their *STID_Valid_Periodicity* values shall be identical, and their *STID_Valid_Offset* values shall be unique.

Insert new subclause 6.2.1.3 as indicated

6.2.1.3 Address for machine to machine application

6.2.1.3.1 M2M Group Identifier (MGID)

A 15-bit value that uniquely identifies an M2M device group in the domain of the network entity that assigns MGID that one or more M2M devices belong to. The domain of the network entity is identified by M2M GROUP ZONE ID. M2M GROUP ZONE ID may be broadcasted in the AAI-SCD message.

An MGID is assigned to a service flow of an M2M device by a network entity after initial network entry through DSA procedure and released during an explicit network exit (e.g., power down location update) or when the M2M device enters DCR mode. The assigned MGID shall be retained by an M2M device even in idle state unless the M2M device exits from the network or the network explicitly deletes the service flow associated with the MGID. The MGID can be re-assigned during connected state and idle state. During connected state, the MGID may be changed, and deleted by DSC, and DSD procedure respectively.

During the idle state, the MGID may be changed by location update (i.e., M2M device-initiated location update or ABS-initiated location update) or network reentry. When the ABS updates the MGID through the ABS-initiated location update, the ABS can trigger the group location update as well as individual location update. When the ABS changes the MGID of all M2M devices within the multicast group, the ABS can trigger the group location update via paging message. When the M2M device performs the timer based update, if the ABS needs to update the MGID of M2M device, the AAI-RNG-RSP message with new MGID is sent by the ABS in response to the AAI-RNG-REQ message.

An ABS may use AAI-PAG-ADV to indicate the update of MGID and its new value to all the M2M devices in a group. When an idle mode M2M device that belongs to the M2M device group (indentified by its MGID) receives a paging message directed to its MGID and the Action Code is set to 0b11, this M2M device shall update its MGID based on the new MGID value indicated.

After receiving the updated MGID value, the M2M device shall send an acknowledgement (ACK) message to the ABS. This ACK message may be carried in the AAI-MSG-ACK message. If the ABS does not receive the acknowledgement message from any of the M2M devices belonging to that M2M device group which MGID was updated, it assumes that those M2M devices missed the MGID update information. In the next paging cycle the ABS may ask those M2M devices to perform location update and may send them a unicast message with the new MGID value (AAI-RNG-RSP).

The ABS may use the M2M device group MAC Control (MGMC) message with the MGID to send the same information to multiple M2M devices. The AMS may respond to acknowledge this message with AAI-MSG-ACK defined in 6.2.3.36.

6.2.1.3.2 Fixed M2M Deregistration ID (FMDID)

A 16-bit value that uniquely identifies a fixed M2M device in domain of the ABS. A FMDID is assigned to a fixed M2M device by an ABS during idle mode entry and released during the network reentry. The ABS may assign a new FMDID to a fixed M2M device during location update procedure.

6.2.2 MAC PDU formats

6.2.2.1.3 MAC signaling header

Change the contents of Table 662 as indicated

Table 662—Type field encodings for MAC signaling header type

Type field (5-bits)	MAC signaling header type
00000	BR with STID
00001	BR without STID
00010	Service specific scheduling control header
00011	Sleep control
00100	AMS battery level report
00101	Uplink power status report
00110	Correlation matrix feedback
00111	MIMO feedback
01000	M2M Bandwidth request (BR) with STID header
~~01000~~01001-11111	*Reserved*

Add new subclause 6.2.2.1.3.9

6.2.2.1.3.9 M2M Bandwidth request (BR) with STID header

When an M2M device requests bandwidth through an UL resource allocated by the CDMA Allocation A-MAP IE, it shall transmit M2M BR with STID signaling header on the allocated UL resource if the STID_Valid_offset is assigned to it. Otherwise it shall transmit BR with STID signaling header. M2M BR with STID header format is defined in Table 670a.

Table 670a—M2M BR with STID header format

Syntax	Size (bit)	Notes
M2M BR with STID () {		
FID	4	Flow Identifier. Set to 0010.
Type	5	MAC signaling header type = 0b01000.
Length	3	Indicates the length of the signaling header in bytes.
BR Size	17	Aggregated bandwidth request size in bytes
BR FID	4	The FID for which UL bandwidth is requested.
STID	12	STID of the M2M device that requests UL bandwidth.
STID_Valid_Offset	3	STID_Valid_Offset of the M2M device that requests UL bandwidth
}		

6.2.3 MAC Control messages

Modify Table 683 as indicated

Table 683—MAC Control messages

No.	Functional areas	Message names	Message description	Security	Connection
70	RELAY	AAI-ARS-CONFIG-CMD	ARS configuration Command	N/A	Unicast
70	M2M	AAI-MGMC	M2M device group MAC Control	N/A	Broadcast
71-255			Reserved		

6.2.3.1 AAI-RNG-REQ

Modify Table 684 as indicated

Table 684—AAI-RNG-REQ message field description

Field	Size (bits)	Value	Condition
Ranging Purpose Indication	4	0b0000 = Initial network entry 0b0001 = HO reentry 0b0010 = Network reentry from idle mode ... 0b1101 = NS/EP call setup 0b1110 = Abnormal power down indication ~~0b1110~~ –0b1111 = *Reserved*	
...	...		...
} else if (Ranging Purpose Indication == 0b0010) {		// Network reentry from idle mode	
if (S-SFH Network Configuration bit == 0b1 or AMSID privacy is disabled){			
AMS MAC address	48	AMS's real MAC address	
} else{			
Deregistration Identifier (DID)	18	The ID that the AMS is assigned for idle mode and currently maintains.	If the Localized_Idle_Mode flag is set to 1 in AAI-DREG-REQ/RSP message, DID shall not be included in this message.
Fixed M2M Deregistration ID (FMDID)	16	Used to indicate Fixed M2M Deregistration ID used to identify the fixed M2M device in idle mode 0..2^{16}-1	Only present if the Localized_Idle_Mode flag is set to 1 in AAI-DREG-REQ/RSP message.
}			
MFM bitmap	2	Bitmap to indicate the MFM (MIMO Feedback Mode)s for which the AMS is sending feedback as described in talbe 878. Maximum of 2 distinct concurrent MFM are allowed with MFM_bitmap. LSB #0: MFM 0 LSB #1: MFM 4	Present if MFM 0 or MFM 4 are supported by a fixed M2M device
If (LSB#0 in MFM_bitmap == 1){			
Wideband CQI	4		
Wideband STC rate	3	.'STC rate - 1.' mapped to 3-bit unsigned integer (i.e., STC rate=1 as 0b000 ~ STC rate=8 as 0b111)	
}			

Table 684—AAI-RNG-REQ message field description

Field	Size (bits)	Value	Condition
If (LSB#1 in MFM_bitmap == 1){			
Wideband CQI	4		
Wideband STC	3	'STC rate - 1.' mapped to 3-bit unsigned integer (i.e., STC rate=1 as 0b000 ~ STC rate=8 as 0b111)	
Wideband PMI	6	Wideband preferred matrix index (PMI), size of which is number of PMI bits ('NB.') used, mapped to NB LSB bits of this field, while the remaining MSB bit(s) set to zero(0)	
}			
Paging Controller ID	48	The Paging Controller ID that the AMS currently maintains in idle mode.	If the Localized_Idle_Mode flag is set to 1 in AAI-DREG-REQ/RSP message, Paging Controller ID shall not be included in this message.
...			
Bandwidth Request Indicator	1	1: indicates BW grant is required for transmission of BR header after completion of network reentry	Optional
} else if (Ranging Purpose Indication == 0b0011 |0b0110|0b0111| 0b1011) {		// Idle mode location update (and with other additional purposes)	
...	...	...	...
}~~//end of Ranging Purpose Indication~~ else if (Ranging Purpose Indication == 0b1110) {		//Abnormal or involuntary power down	
}			
...	...	...	...
Retrials	2	The number of failed trials in this ranging process Bits 0-1: Indicates the number of retrials in the channel ranging access as follows: 00 - Success in the first attempt 01 - Success in the second attempt 10 - Success in the third attempt 11 - Success in the 4th or later attempt	May be included by M2M devices after initial ranging during network entry or re-entry, periodic ranging, or HO ranging.

6.2.3.2 AAI-RNG-RSP

Modify Table 685 as indicated

Table 685—AAI-RNG-RSP message field description

Field	Size (bits)	Value/Description	Condition
...		...	...
Unsolicited bandwidth grant indicator	1	1: indicates that an unsolicited UL allocation will be provided without request from AMS during network entry or network re-entry.	Shall be included when AMS is attempting network entry Shall be included if AAI-RNG-RSP message is transmitted in response to AAI-RNG-REQ message that includes bandwidth request indicator during network reentry from idle mode.
For(*i*=0;*i*<Num_MGID; *i*++){		Number of MGID and FID (Num_MGID) to update in the T-ABS[1..TBD]. Mapping of current MGID and FID and new MGID and FID to be updated.	Presented if the mapping between MGID and FID needs to be updated
Current MGID	15		
Current FID	4		
New MGID	15		
New FID	4		
~~}~~			
...		...	...
If (Location Update Response== 0x0){			
...	...	...	...
New Fixed M2M Deregistration ID	16	New FMDID that the fixed M2M device shall maintain in idle mode.	Only present if the Localized_Idle_Mode flag is set to 1 in AAI-DREG-REQ/RSP message.
...	...	...	...
}			
...	...	...	...

6.2.3.9 AAI-REG-RSP

Change the contents of Table 692 as indicated

Table 692—AAI-REG-RSP message field description

Field	Size (bits)	Value/Description	Condition
...	...	...	...
STID_Valid_Periodicity	3	The STID_Valid_Periodicity together with STID_Valid_Offset indicates at which frames the assigned STID is valid for the M2M device	Shall be included when an M2M device is performing initial network entry or an M2M device has no STID pre-assigned when it is performing network reentry procedure (see 6.2.15)
STID_Valid_Offset	3	The STID_Valid_Offset together with STID_Valid_Periodicity indicates at which frames the assigned STID is valid for the M2M device	Shall be included when an M2M device is performing initial network entry or an M2M device has no STID pre-assigned when it is performing network reentry procedure (see 6.2.15)

6.2.3.21 AAI-DREG-REQ message

Modify Table 704 as indicated

Table 704—AAI-DREG-REQ message field description

Field	Size (bits)	Value/Description	Condition
Deregistration_Request_Code	3	Used to indicate the purpose of this message 0x00: AMS deregistration request from ABS and network 0x01: request for AMS deregistration from S-ABS and initiation of AMS idle mode. 0x02: response for the unsolicited AAI-DREG-RSP message with action code 0x05 by the ABS. 0x03: reject for the unsolicited AAI-DREG-RSP message with action code 0x05 by the ABS. This code is applicable only when an AMS has a pending UL data to transmit. 0x04: request for AMS deregistration from S-ABS to enter DCR mode 0x05: response for the unsolicited AAI-DREG-RSP message with action code 0x00, 0x01, 0x02 or 0x03 0x06-0x07: *Reserved*	
If (Deregistration_Request_Code == 0x01) {			

Table 704—AAI-DREG-REQ message field description

Field	Size (bits)	Value/Description	Condition
Localized_Idle_Mode flag	1	0: The M2M device enters the normal idle mode. 1: The M2M device enters the localized idle mode.	This parameter shall be presented when the fixed M2M device enters the idle mode and localized idle mode is supported by the M2M device.
...			
}			
If (Deregistration_Request_Code == 0x02) {			
Localized_Idle_Mode flag	1	0: The M2M device enters the normal idle mode. 1: The M2M device enters the localized idle mode.	This parameter shall be presented when the fixed M2M device enters the idle mode and localized idle mode is supported by the M2M device.
}			
...	...	...	...

6.2.3.22 AAI-DREG-RSP message

Modify Table 705 as indicated

Table 705—AAI-DREG-RSP message format

Field	Size (bits)	Value/Description	Condition
Action Code	4	Used to indicate the purpose of this message 0x00: AMS shall immediately terminate service with the ABS and should attempt network entry at another ABS 0x01: AMS shall listen to the current ABS but shall not transmit until a RES-CMD message or AAI-DREG-RSP message with action code 0x02 or 0x03 is received. 0x02: AMS shall listen to the current ABS but only transmit on the control connection. 0x03: AMS shall return to normal operation and may transmit on any of its active connections. 0x04: This option is valid in response to a AAI-DREG-REQ message with De-registration_Request_Code=0x00. The AMS shall terminate current Connected State with the ABS. 0x05: AMS shall begin idle mode initiation: a) to signal AMS to begin idle mode in unsolicited manner or b) to allow AMS to transmit AMS-initiated idle mode request at the REQ-Duration expiration 0x06: This option is valid only in response to a AAI-DREG-REQ message with De-registration_Request_Code 0x01: a) to reject AMS-initiated idle mode request or b) to allow AMS to transmit AMS-initiated idle mode request at the REQ-Duration expiration 0x07: This option is valid in response to a AAI-DREG-REQ message with De-registration_Request_Code= 0x01 to allow AMS-initiated idle mode request. 0x08: This option is valid only in response to an AAI-DREG-REQ message with De-registration_Request_Code 0x04 to allow retention of the AMS's connection information 0x09: This option is valid only in response to an AAI-DREG-REQ message with De-registration_Request_Code 0x04 to reject retention of the AMS's connection information. 0x10-0x15: *Reserved*	
If (Action Code == 0x05) {			

Table 705—AAI-DREG-RSP message format

Field	Size (bits)	Value/Description	Condition
Localized_Idle_Mode flag	1	0: The M2M device enters the normal idle mode. 1: The M2M device enters the localized idle mode.	This parameter shall be presented when the fixed M2M device enters the idle mode and when localized idle mode is supported by the ABS.
Paging cycle	4	Used to indicate Paging cycle for the AMS 0x00: 4 superframes 0x01: 8 superframes 0x02: 16 superframes 0x03: 32 superframes 0x04: 64 superframes 0x05: 128 superframes 0x06: 256 superframes 0x07: 512 superframes 0x08: 32768 superframes 0x09: 262144 superframes 0x10: 4194304 superframes 0x11~~08~~-0x15: *Reserved*	Values 0x08-0x10 may be applied to M2M devices only.
Paging offset	12	Used to indicate Paging offset for the AMS. Determines the superframe within the paging cycle from which the paging listening interval starts. Shall be smaller than Paging cycle value.	
M2M paging offset	10	Used to indicate the superframe within the paging cycle at which the M2M device's paging listening interval starts. The superframe is determined by concatenating the M2M paging offset field and the Paging offset field. M2M paging offset shall be interpreted as the MSB. Shall be smaller than Paging cycle value.	May be present when the Paging cycle value is set to 0x08, 0x09, or 0x10
Paging controller ID	48	Used to indicate Paging controller that manages and retains the AMS's idle mode information $0..2^{48}-1$	For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b0
Paging group ID	16	Used to indicate Paging group that the AMS is located in $0..2^{16}-1$	For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b0
Deregistration ID	18	Used to indicate Deregistration ID used to identify the AMS in idle mode $0..2^{18}-1$	Present when the S-SFH Network Configuration bit == 0b0. For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b0.

Table 705—AAI-DREG-RSP message format

Field	Size (bits)	Value/Description	Condition
Fixed M2M Deregistration ID (FMDID)	16	Fixed M2M Deregistration ID	For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b1.
Idle Mode Retain Information element	5	Provided as part of this message indicative only. Network reentry from idle mode process requirements may change at time of actual reentry. For each bit location, a value of 0 indicates the information for the associated reentry control messages shall not be retained and managed; a value of 1 indicates the information for the associated reentry control message shall be retained and managed. Bit 0: Retain AMS service and operational information associated with AAI-SBC-REQ/RSP messages. Bit 1: Retain AMS service and operational information associated with AAI-PKM-REQ/RSP messages. Bit 2: Retain AMS service and operational information associated with AAI-REG-REQ/RSP messages. Bit 3: Retain AMS service and operational information associated with network address. Bit 4: Retain AMS state information. The information retained by setting bit 4 includes configuration of all Service Flows in the AMS as set by successful AAI-DSA and AAI-DSC transactions. In particular it includes FIDs and related description (QoS descriptors and CS classifier information)	
REQ-Duration	8	Used to indicate waiting value for the AAI-DREG-REQ message with De-registration_Request_Code=0x01 0..2^8-1: measured in frames	present if needed
M2M device-specific Idle Mode Timer	24	Length in seconds of the maximum interval between two consecutive location updates while the M2M device is in idle mode	May present when the M2M device enters idle mode
}			
If (Action Code == 0x06) {			
REQ-Duration	8	Used to indicate waiting value for the AAI-DREG-REQ message with De-registration_Request_Code=0x01 0..2^8-1: measured in frames	present if needed
}			

Table 705—AAI-DREG-RSP message format

Field	Size (bits)	Value/Description	Condition
If (Action Code == 0x07) {			
Localized_Idle_Mode flag	1	0: The M2M device enters the normal idle mode. 1: The M2M device enters the localized idle mode.	This parameter shall be presented when the fixed M2M device enters the idle mode and when localized idle mode is supported by the ABS.
Paging cycle	4	Used to indicate Paging cycle for the AMS 0x00: 4 superframes 0x01: 8 superframes 0x02: 16 superframes 0x03: 32 superframes 0x04: 64 superframes 0x05: 128 superframes 0x06: 256 superframes 0x07: 512 superframes 0x08: 32768 superframes 0x09: 262144 superframes 0x10: 4194304 superframes 0x11~~08~~-0x15: *Reserved*	Values 0x08-0x10 may be applied to M2M devices only.
Paging offset	12	Used to indicate Paging offset for the AMS. Determines the superframe within the paging cycle from which the paging listening interval starts. Shall be smaller than Paging cycle value.	
Second paging offset	12	Used to indicate additional paging offset for the M2M device.	Optional
M2M paging offset	10	Used to indicate the superframe within the paging cycle at which the M2M device's paging listening interval starts. The superframe is determined by concatenating the M2M paging offset field and the Paging offset field. M2M paging offset shall be interpreted as the MSB. Shall be smaller than Paging cycle value.	May be present when the Paging cycle value is set to 0x08, 0x09, or 0x10
Paging controller ID	48	Used to indicate Paging controller that manages and retains the AMS's idle mode information $0..2^{48}-1$	For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b0
Paging group ID	16	Used to indicate Paging group that the AMS is located in $0..2^{16}-1$	For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b0

Table 705—AAI-DREG-RSP message format

Field	Size (bits)	Value/Description	Condition
Deregistration ID	18	Used to indicate Deregistration ID used to identify the AMS in idle mode $0..2^{18}-1$	Present when the S-SFH Network Configuration bit == 0b0. For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b0.
Fixed M2M Deregistration ID (FMDID)	16	Fixed M2M Deregistration ID	For fixed M2M devices, this parameter is presented only when the Localized_Idle_Mode flag == 0b1.
Idle Mode Retain Information element	5	Provided as part of this message indicative only. Network reentry from idle mode process requirements may change at time of actual reentry. For each bit location, a value of 0 indicates the information for the associated reentry control messages shall not be retained and managed; a value of 1 indicates the information for the associated reentry control message shall be retained and managed. Bit 0: Retain AMS service and operational information associated with AAI-SBC-REQ/RSP messages. Bit 1: Retain AMS service and operational information associated with AAI-PKM-REQ/RSP messages. Bit 2: Retain AMS service and operational information associated with AAI-REG-REQ/RSP messages. Bit 3: Retain AMS service and operational information associated with network address. Bit 4: Retain AMS state information. The information retained by setting bit 4 includes configuration of all Service Flows in the AMS as set by successful AAI-DSA and AAI-DSC transactions. In particular it includes FIDs and related description (QoS descriptors and CS classifier information)	
M2M device-specific Idle Mode Timer	24	Length in seconds of the maximum interval between two consecutive location updates while the M2M device is in idle mode	May present when the M2M device enters idle mode
Transmission Type	1	0 : *Reserved* 1 : Allowed to send data only after receiving paging message with M2M report code 0b1	Present if needed

Table 705—AAI-DREG-RSP message format

Field	Size (bits)	Value/Description	Condition
Max number of paging cycle	16	This is for M2M device to wait for AAI-PAG-ADV with M2M report code 0b1. See 6.2.18.7.1. The unit is the duration of the paging cycle.	Present if Transmission Type is set to 1
}			

6.2.3.23 AAI-PAG-ADV (paging advertisement) message

Modify Table 706 as indicated

Table 706—AAI-PAG-ADV message field description

Field	Size (bits)	Value/Description	Condition
...	...	...	...
For (*i*=0; *i*<M; *i*++) {			M equals the number of bits in Paging_Group_IDs bitmap whose bit is set to 1.
For (*j*=0; *j*<Num_AMSs; *j*++) {		Num_AMSs indicates the number of paged AMSs in a corresponding paging group 1..32	
Deregistration Identifier	18	Used to indicate Deregistration ID for the AMS or M2M device to be paged (Deregistration Identifier and Paging Cycle are used to identify each paged AMS) 0..2^{18}- 1	Present if the S-SFH Network Configuration bit == 0b0
MAC Address Hash	24	Used to identify the AMS to be paged	Present if the S-SFH Network Configuration bit == 0b1
Paging Cycle	4	Used to indicate Paging cycle for the AMS to be paged 0x00: 4 superframes 0x01: 8 superframes 0x02: 16 superframes 0x03: 32 superframes 0x04: 64 superframes 0x05: 128 superframes 0x06: 256 superframes 0x07: 512 superframes 0x08: 32768 superframes 0x09: 262144 superframes 0x10: 4194304 superframes 0x11~~08~~-0x15: *Reserved*	Present if the S-SFH Network Configuration bit == 0b0 Values 0x08-0x10 shall be applied to M2M devices only.

Table 706—AAI-PAG-ADV message field description

Field	Size (bits)	Value/Description	Condition
Action Code	1	Used to indicate the purpose of the AAI-PAG-ADV message 0b0: perform network reentry 0b1: perform ranging for location update	
If (Action Code == 0b0) {			
Initial ranging backoff start	4	Indicate the initial backoff window size for M2M devices	
}			
M2M network access type	2	Indicate the network reentry type for M2M device; 0b00: Resource allocation (i.e., Assignment A-MAP offset) for AAI-RNG-REQ 0b01: dedicated ranging channel allocation in AAI-PAG-ADV 0b10: dedicated ranging channel allocation in broadcast assignment A-MAP IE 0b11: No dedicated ranging channel	
If (M2M network access type == 0b00) {			
Assignment A-MAP offset for AAI-RNG-REQ		Indicate offset that Assignment A-MAP IE for AAI-RNG-REQ message is transmitted.	
}			
M2M Report code	1	Indication for the M2M device to send the uplink report 0b0 : *reserved* 0b1 : Send uplink report	Present if M2M is supported
} // End of for (j=0;j<Num_AMSs;j++)			
} // End of for (i=0; i<M; i++) {			
Ranging backoff window indicator	1	0b0: increasing the ranging backoff window size by a factor of 2 per every ranging retry 0b1: decreasing the ranging backoff window size by a factor of 2 per every ranging retry as described in 6.2.18.7.2	If Initial ranging backoff start field is present

Table 706—AAI-PAG-ADV message field description

Field	Size (bits)	Value/Description	Condition
For (*i*=0; *i*<Num_MGID; *i*++) {		Num_MGID indicates the number of MGIDs included in this paging message [0..63]	Shall be included if the ABS sends DL multicast data for M2M after transmission of the AAI-PAG-ADV message.
MGID	15	M2M Group ID	
Action Code	2	0b00: Performing network reentry 0b01: Performing location update 0b10: Receiving multicast traffic without requiring network reentry 0b11: MGID re-assignment	
If (Action Code == 0b00) {			
Initial ranging backoff start	4	Indicate the initial backoff window size for M2M devices included in this group	
M2M network access type	2	Indicate the network access scheme for M2M device 0b00: Resource allocation (i.e., Assignment A-MAP offset) for AAI-RNG-REQ, This type is only applicable to fixed M2M device (i.e., Localized_Idle_Mode flag was set to 1 at the idle mode initiation). Except fixed M2M device, mobile M2M device shall perform the contention-based ranging. 0b01: dedicated ranging channel allocation, S-RCH 0b10: dedicated ranging channel allocation, NS-RCH 0b11: No dedicated ranging channel	
If (M2M network access type == 0b01 | 0b10) {			
M2M ranging opportunity sub-frame index	3	Indicates the subframe index of the allocated ranging opportunity dedicated for M2M devices.	

Table 706—AAI-PAG-ADV message field description

Field	Size (bits)	Value/Description	Condition
Periodicity of the M2M ranging	3	Indicates the periodicity of the ranging dedicated for M2M devices. 0b000: transmission in every frame 0b001: transmission in the first frame in every super-frame 0b010: transmission in the first frame in every even numbered superframe, i.e., mod(superframe number, 2) = 0 0b011: transmission in the first frame in every 4th superframe, i.e., mod(super-frame number, 4) = 0 [0b100~0b111: Reserved]	
}			
If (M2M network access type == 0b00) {			
Assignment A-MAP start offset for AAI-RNG-REQ		This parameter indicates the offset that M2M device start to monitor the resource (i.e., Assignment A-MAP IE) for the AAI-RNG-REQ mes-sage.	
Resource monitor timer		Time duration that M2M device monitors the resource (i.e., Assignment A-MAP IE) for AAI-RNG-REQ message.	
}			
} // End of if (Action code ==0b00) {			
If (Action Code == 0b10) {			
Multicast transmission start time (MTST)	8	Least significant 8 bits of the frame number in which the ABS starts sending DL multicast data.	Shall be present when the MTST needs to be included in this message.
}			
If (Action Code == 0b11) {			
New MGID	15		
Current FID	4		
New FID	4		
}			

Table 706—AAI-PAG-ADV message field description

Field	Size (bits)	Value/Description	Condition
}			
Ranging backoff window indicator	1	0b0: increasing the ranging backoff window size by a factor of 2 per every ranging retry 0b1: decreasing the ranging backoff window size by a factor of 2 per every ranging retry as described in 6.2.18.7.2	If Initial ranging backoff start field is present
For (*j*=0; *j*<Num_FMDID; *j*++) {		Num_FMDID indicates the number of FMDIDs included in this paging message [1..32]	Shall be included when the ABS pages the fixed M2M devices in localized idle mode.
Fixed M2M Deregistration ID (FMDID)	16	Fixed M2M Deregistration ID	
Action Code	1	0: Performing network re entry 1: Performing location update	
M2M report code	1	Indication for the M2M device to send the uplink report 0b1: send uplink report	Present if needed
M2M network access type	2	Indicate the network re-entry type for M2M device; 0b00: Resource allocation (i.e., Assignment A-MAP offset) for AAI-RNG-REQ 0b01: dedicated ranging channel allocation in AAI-PAG-ADV 0b10: dedicated ranging channel allocation in broadcast assignment A-MAP IE 0b11: No dedicated ranging channel	
If (M2M network access type == 0b00) {			
Assignment A-MAP offset for AAI-RNG-REQ		Indicate offset that A-MAP IE for AAI-RNG-REQ message is transmitted.	
}			
} // End of for (k=0; k<Num_FMDID; k++)			

Table 706—AAI-PAG-ADV message field description

Field	Size (bits)	Value/Description	Condition
M2M ranging opportunity sub-frame index	3	Indicates the subframe index of the allocated ranging opportunity dedicated for M2M devices.	Optional, This parameter shall be present if the M2M network access type of individually paged M2M devices is set to 0b01.
Periodicity of the M2M ranging	3	Indicates the periodicity of the ranging dedicated for M2M devices. 0b000: transmission in every frame 0b001: transmission in the first frame in every superframe 0b010: transmission in the first frame in every even numbered superframe, i.e., mod(superframe number, 2) = 0 0b011: transmission in the first frame in every 4th superframe, i.e., mod(superframe number, 4) = 0 [0b100~0b111: Reserved]	Optional, This parameter shall be present if the M2M network access type of individually paged M2M devices is set to 0b01.
}			
Extension Flag	1	Used to indicate the remaining part of the AAI-PAG-ADV message exists 0b0: This is the last fragment of the AAIPAG-ADV message 0b1: This is not the last fragment of the AAI-PAG-ADV message; the remaining fragments of the message will be transmitted in the subsequent subframes or frames.	
Emergency Alert Indication	1	Used to indicate the presence of emergency information 0b0: *Reserved* 0b1: There is emergency information	Optional Present if there is emergency information

6.2.3.31 AAI-System Configuration Descriptor (SCD) message

Change the contents of Table 714 as indicated

Table 714—AAI-SCD message field description

Field	Size (bits)	Value/Description	Condition
Configuration Change Count	4	The value is increased whenever the contents of this message except the dedicated ranging information for M2M devices are changed. The value rolls over from 0 to 15	
~~...~~			
MSB of the extended super-frame number for M2M	10	The 10 MSB of the extended super-frame number, which is a 22-bit number obtained by concatenating this value with the superframe number as signaled by the P-SFH and S-SFH SP1.	
If (M2M ranging indica-tor=0b00) {			
restriction of Access class (i)	1	INTEGER (0..1)	Optional
restriction of Access class (i+1)	1	INTEGER (0..1)	Optional
restriction of Access class (i+2)	1	INTEGER (0..1)	Optional
restriction of Access class (i+3)	1	INTEGER (0..1)	Optional
}			
M2M Configuration Change Count	4	The value is increased whenever the contents of the dedicated raging information for M2M devices are changed. The value rolls over from 0 to 15. The operation of this field is same with Configuration Change Count as defined in 6.2.3.31.	
M2M ranging indicator	2	Indicate the ranging configuration for M2M devices. 0b00: normal ranging as defined in Table 839 in 6.3.5.5.1.2 0b01: dedicated ranging for M2M devices 0b10: M2M devices are not allowed to perform network reentry (M2M cell bar) 0b11: *Reserved*	
If ((M2M ranging indicator == 0b01) {			
M2M ranging opportunity subframe index	3	Indicates the subframe index of the allocated ranging opportunity dedi-cated for M2M devices.	Present if an ABS assigns ranging resources dedicated for M2M devices

Table 714—AAI-SCD message field description

Field	Size (bits)	Value/Description	Condition
Periodicity of the M2M ranging	[3]	Indicates the periodicity of the ranging dedicated for M2M devices. 0b000: transmission in every frame 0b001: transmission in the first frame in every superframe 0b010: transmission in the first frame in every even numbered superframe, i.e., mod(superframe number, 2) = 0 0b011: transmission in the first frame in every 4th superframe, i.e., mod(superframe number, 4) = 0 [0b100~0b111: *Reserved*]	Present if an ABS assigns ranging resources dedicated for M2M devices
}			
Indication of GD scheme	1	0b00: Not support GD scheme 0b01: Support GD scheme	
If (Indication of GD scheme=0b01){			
Probability threshold of M2M device group delegate selection	10	Probability threshold Value of quantized in 0.001 steps as from 0 to 1.	
}			

6.2.3.43 Privacy key MAC Control messages (AAI-PKM-REQ/AAI-PKM-RSP)

Change Table 726 as indicated

Table 726—AAI-PKM-REQ message field description

Field	Size (bits)	Value/Description	Condition
PKM v3 message type code	4	- PKMv3 Reauth-Request; PKM v3 message code = 1 - PKMv3 EAP-Transfer; PKM v3 message code = 2 -PKMv3 Key_Agreement-MSG#2; PKM v3 message code = 4 - PKMv3 TEK-Request; PKM v3 message code = 6 - PKMv3 TEK-Invalid; PKM v3 message code =8 - PKMv3 MGTEK-Request; PKM v3 message code = 10 ~~9~~12-16: *Reserved*	
...	...	...	...
If (PKM v3 message code == 10) {			

Table 726—AAI-PKM-REQ message field description

Field	Size (bits)	Value/Description	Condition
MGID	15	Multicast group identifier that the AMS subscribes.	May be present when an M2M device is registered for M2M multicast service of the M2M device group
}			

Change Table 727 as indicated

Table 727—AAI-PKM-RSP message field description

Field	Size (bits)	Value/Description	Condition
PKM v3 message type code	4	- PKMv3 EAP-Transfer; PKM v3 message code =2 - PKMv3 Key_Agreement-MSG#1; PKM v3 message code =3 - PKMv3 Key_Agreement-MSG#3; PKM v3 message code =5 - PKMv3 TEK-Reply; PKM v3 message code =7 - PKMv3 TEK-Invalid; PKM v3 message code =8 - PKMv3 MGTEK-Update; PKM v3 message code = 9 - PKMv3 MGTEK-Reply; PKM v3 message code = 11 ~~9~~12-16: *Reserved*	
...			
If (PKM v3 message code == 9) {			
New_MGSS	64	A newly provided MGSS (M2M service Group Security Seed) for an M2M device group	May be present when an M2M device is registered for M2M multicast service of the M2M device group
}			
If (PKM v3 message code == 11) {			
MGID	15	Multicast group identifier	May be present when an M2M device is registered for M2M multicast service of the M2M device group

Table 727—AAI-PKM-RSP message field description

Field	Size (bits)	Value/Description	Condition
MGSS	64	MGSS of the currently used MGTEK	May be present when an M2M device is registered for M2M multicast service of the M2M device group
M2MGTEK_COUNT		The index of the currently used MGTEK	May be present when an M2M device is registered for M2M multicast service of the M2M device group
}			

Change Table 728 as indicated

Table 728—PKM v3 message types

Code	PKM message type	MAC control message name
1	PKMv3 Reauth-Request	AAI-PKM-REQ
2	PKMv3 EAP-Transfer	AAI-PKM-REQ/AAI-PKM-RSP
3	PKMv3 Key_Agreement-MSG#1	AAI-PKM-RSP
4	PKMv3 Key_Agreement-MSG#2	AAI-PKM-REQ
5	PKMv3 Key_Agreement-MSG#3	AAI-PKM-RSP
6	PKMv3 TEK-Request	AAI-PKM-REQ
7	PKMv3 TEK-Reply	AAI-PKM-RSP
8	PKMv3 TEK-Invalid	AAI-PKM-REQ/AAI-PKM-RSP
9	PKMv3 MGTEK-Update	AAI-PKM-RSP
10	PKMv3 MGTEK-Request	AAI-PKM-REQ
11	PKMv3 MGTEK-Reply	AAI-PKM-RSP
~~9~~12-16	*Reserved*	-

6.2.3.47 DSx MAC Control message

6.2.3.47.1 AAI-DSA-REQ

Change the paragraph as indicated

The following parameters may be included in the AAI-DSA-REQ message:

— Predefined BR index parameters: Predefined BR index parameters define the mapping from predefined BR index(es) to BR action and BR size, which is used in 3-step Bandwidth Request procedure, and are only included in ABS-initiated DSA-REQ. They are determined based on the QoS parameters of the service flow in the AAI-DSx messages. If BR Action is 0b00 or 0b01, the same BR Index shall not be assigned to different service flows. If BR action is 0b10 (BR), ABS shall assign different BR index to service flows whose UL Grant Scheduling Type is different and shall assign different BR index to different service flows whose UL Scheduling Type is same but BR size is different. If the STID assigned to an M2M device is shared with other M2M device(s), then ABS shall assign different BR indexes to the M2M devices sharing STID. The ABS shall use the STID and assigned BR index received in the quick access message to identify the M2M device if the received STID is assigned to multiple M2M devices. If BR action is 0b11, the Purpose Indication bits shall be followed to indicate the activity of the M2M device.

Change Table 740 as indicated

Table 740—AAI-DSA-REQ message field description

Field	Size (bits)	Value/Description	Condition
...			
For(i = 1; $i \leq$ N-Predefined-BR-indices ; i++) {		The mapping of predefined BR index used in quick access message to BR size and BR actions N-Predefined-BR-indices is the number of predefined BR indices [1..15]	
Predefined BR index	4	Predefined BR index	Present if N-Predefined-BR-indices is not zero
BR action	2	0b00: ertPS service flow requests to resume to maximum sustained rate 0b01: aGP service flow requests to switch to Primary QoS parameters 0b10: BR 0b11: ~~*Reserved*~~Abnormal Power Down Indication	Present if N-Predefined-BR-indices is not zero
...			
}			
...			
MGID	15	MGID to be added	Shall be present if this service flow is related with M2M multicast service and when an 802.16p ABS initiates AAI-DSA-REQ.

Table 740—AAI-DSA-REQ message field description

Field	Size (bits)	Value/Description	Condition
MGSS	64	MGSS (M2M service Group Security Seed) for an M2M device group	May be present when an ABS initiates AAI-DSA-REQ for this service flow that is related with M2M multicast service

6.2.3.47.2 AAI-DSA-RSP

Change Table 741 as indicated

Table 741—AAI-DSA-RSP message field description

Field	Size (bits)	Value/Description	Condition
...	...	...	...
Confirmation Code	1	Zero indicates the request was successful. Nonzero indicates failure	Shall always be present
If (Confirmation Code == 0 && AMS-initiated AAI-DSA-REQ)			
{			
FID	4	An identifier of a service flow	
MGID	15	MGID to be added	Shall be present if this service flow is related with M2M multicast service and when an M2M device initiates AAI-DSA-REQ.
}			
...	...	...	...

6.2.3.47.4 AAI-DSC-REQ

Add new parameter at the end of Table 743 as indicated

Table 743—AAI-DSC-REQ message field description

Field	Size (bits)	Value/Description	Condition
...	...	...	...
MGID	15	MGID to be changed to	Shall be present if MGID needs to be changed

Add new subclause 6.2.3.64

6.2.3.64 AAI-MTE-IND (Multicast transmission end indication) message

The ABS shall multicast (using MGID) AAI-MTE-IND message to M2M devices to indicate the end of multicast transmission. If an M2M device in idle mode receives the AAI-MTE-IND message, the M2M device may enter the paging unavailable interval as specified in 6.2.18.2.

Table 763a—AAI-MTE-IND message field description

Field	Size (bits)	Value/Description	Condition
FID	4	Flow ID related to the multicast traffic	

Add new subclause 6.2.3.65

6.2.3.65 AAI-MGMC (M2M device group MAC control) message

The AAI-MGMC message may be sent to a group of M2M devices that belong to the same M2M device group (defined by a MGID) to indicate parameters and/or instructions. The ABS may send the AAI-MGMC message to M2M devices in connect state.

Table 763b—AAI-MGMC message field description

Field	Size (bits)	Value/Description	Condition
Action Code	2	Use to indentify the purpose if this message 0b00: re-assignment of MGID value 0b01-0b11: *Reserved*	
If (Action Code == 0x00) {			
Current MGID	15	Current MGID value to be assigned	
New MGID	15	New MGID value to be assigned	
Current FID	4	Current FID value to be assigned	
New FID	4	New FID value to be assigned	
}			

6.2.4 Construction and transmission of MAC PDUs

6.2.5 AAI Security

Add new subclause 6.2.5.5 as indicated

6.2.5.5 Security Support for Multicast Traffic

Security for multicast traffic provides encryption and integrity protection of such data information for secure group informing and management. A common M2M service group traffic encryption key (MGTEK) is used by M2M devices within a group.

6.2.5.5.1 Key Derivation

The key hierarchy defines what keys are present in the system for multicast traffic and how keys are generated. The ABS derives the M2M service Group Security Seed (MGSS) from the network entity that manages M2M device group.

6.2.5.5.1.1 MGTEK Derivation

The MGTEK is the transport encryption key used to encrypt M2M service multicast data. The MGTEK is derived based on the MGSS, M2MGTEK_COUNT and the MAK (M2M service Authorization Key). The generation and transport of the MAK is outside the scope of the IEEE 802.16 standard.

The MGSS is provided through the AAI-DSA transaction during the network entry, which also provides MGID.

The MGTEK derivation is done:

$$MGTEK = Dot16KDF (MAK, MGSS \mid M2MGTEK\_COUNT \mid MGID \mid \text{“MGTEK”}, 128), \quad (1)$$

Where:

- MAK is M2M service Authorization Key that is provided to all authorized M2M devices.
- MGSS is M2M service Group Security Seed that is common for a M2M device group.
- M2MGTEK_COUNT is the index of the currently used MGTEK.
- MGID is the identifier of the group, which the AMS and MAK and MGSS is associated with.

6.2.5.5.2 Key Hierarchy

Figure 456a outlines the process to calculate the MGTEK based on a MAK, a M2MGTEK_COUNT and a MGSS provided by the ABS.

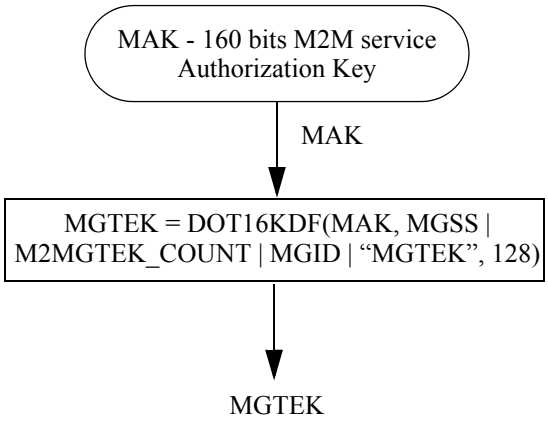

Figure 456a—MGTEK derivation from MAK

6.2.5.5.3 MGTEK Key Usage

The MGTEK is used for encrypting DL multicast data by the ABS, which is also used for decrypting such DL multicast data by the AMS.

6.2.5.5.3.1 MGTEK Update

The MGTEK update is triggered whenever a new MAK is derived, or the 3 MSB of ROC concatenated with the frame number reaches 0x7FFFFF or a member of the M2M device group has been unsubscribed.

When the 3 MSB of ROC concatenated with the frame number reaches 0x7FFFFF, the M2MGTEK_COUNT is incremented by one, and a new MGTEK is derived.

When the MGTEK update is triggered due to an unsubscribing member, a new MGSS is provided to AMSs in the M2M device group through AAI-PKM-RSP message. The M2MGTEK_COUNT is initialized. A new MGTEK is generated with the new MGSS and the M2MGTEK_COUNT.

The AMS may request current M2MGTEK parameters by transmitting an AAI-PKM-REQ message to the ABS. Here, the AMS shall include its MGID. After authenticating the AAI-PKM-REQ, the ABS shall respond with current MGSS and M2MGTEK_COUNT via the AAI-PKM-RSP message.

6.2.5.5.3.2 Key Update during Location Update

When a new MGSS is derived, an AMS in idle mode shall be indicated through an AAI-PAG-ADV message to perform network reentry to update the MGTEK. When an ABS detects that the AMS is to update the MGTEK, the ABS sends the new MGSS in the AAI-PKM-RSP message.

6.2.5.5.4 Encrypted M2M multicast MPDU format

Unique initial counter and MGTEK pair is required across all messages. This subclause describes the initialization of the 128-bit initial counter, constructed from the frame number and a new 8-bit Rollover counter (ROC).

ROC shall be reset to zero upon obtaining a new MGTEK. The first 3 most significant bits of the ROC is the rollover counter for the frame number, i.e., when the frame number reaches 0x0000 (from 0x3FFF) it is incremented by 1 mod 8. The 5 least significant bits of ROC shall be allocated to M2M multicast MAC PDUs in such manner that no two M2M multicast MAC PDUs in the same frame using the same MGTEK have the same ROC value.

Using this method, up to 32 PDUs per frame using the same MGTEK can be supported. A new encryption key (MGTEK) is required every $2^3 \times 2^{14} = 2^{17}$ frames.

The PDU payload for AES-CTR encryption shall be prepended with the 8-bit ROC, i.e., the ROC is the 8 MSBs of the 32-bit nonce. The ROC shall not be encrypted.

Any tuple value of {AES Counter, KEY} shall not be used more than once for the purposes of encrypting a block. The AMS and ABS shall ensure that a M2MGTEK_COUNT is incremented by one, and a new MGTEK is derived and ready for use before the 3 MSB of ROC concatenated with the frame number reaches 0x7FFFFF.

A 32-bit nonce is constructed as Table 774a.

Table 774a—Construction of 32-bit nonce

Byte number	0	1 2	3
Field	ROC	Superframe number	Frame index
Contents	ROC	0b0000 | MSB 4-bit of superframe number| LSB 8-bit of superframe number	0b000000 | Frame index (2 bits)

A 32-bit nonce NONCE = n0 | n1 | n2 | n3 is made of ROC and 12 bits superframe number and 2 bits frame index (see Table 774a). NONCE shall be repeated four times to construct the 128-bit counter block required by the AES-128 cipher. (initial counter = NONCE|NONCE|NONCE|NONCE). When incremented, this 16-byte counter shall be treated as a big endian number.

This mechanism can reduce per-PDU overhead of transmitting the full counter. At the most 2^{32} PDUs can be encrypted with a single MGTEK.

The plaintext PDU shall be encrypted using the active MGTEK derived from MAK, MGSS and M2MGTEK_COUNT, according to CTR mode specification. A different 128-bit counter value is used to encrypt each 128-bit block within a PDU.

The processing yields a payload that is 8 bits longer than the plaintext payload. See Figure 456b—.

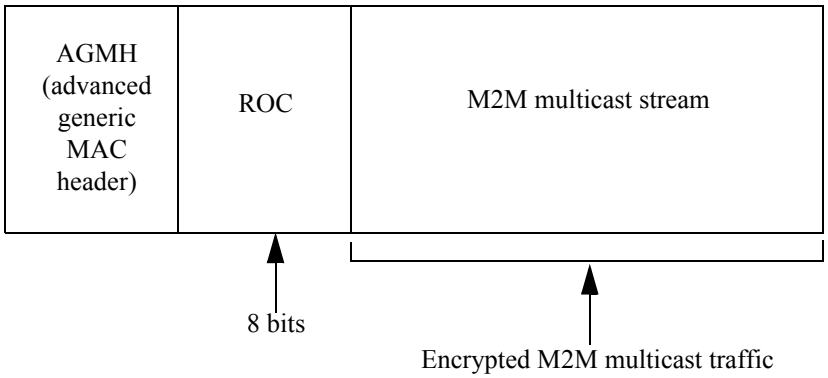

Figure 456b—M2M multicast MAC PDU ciphertext payload format

6.2.6 MAC HO procedures

6.2.7 Persistent scheduling in the Advanced Air Interface

Add the following text at the end of 6.2.7

Long-cycle persistent allocation is used for high priority M2M connections with periodic traffic pattern and relatively fixed payload size. To allocate resources persistently to a fixed M2M device, the ABS may transmit the UL M2M Persistent Allocation MAP IE for UL allocations with longer allocation period.

6.2.8 Multicarrier operation

6.2.9 Group Resource Allocation

6.2.10 Connection management

6.2.11 Bandwidth request and allocation mechanism

6.2.12 Quality of service (QoS)

6.2.13 ARQ mechanism

6.2.14 HARQ functions

6.2.14.2.1.2 Uplink

Add the following text at the end of 6.2.14.2.1.2

When an ABS allocates new UL resource to an M2M device sharing a STID, if there is UL burst retransmitted by another device sharing the same STID at the same UL subframe, the ABS shall allocate the new UL resource by using different ACID from the ACID of retransmitted UL burst.

6.2.15 Network entry and initialization

Add new subclause 6.2.15.7 as indicated

6.2.15.7 Access class of M2M devices

The ABS may restrict the usage of non-dedicated ranging channel by M2M devices, by setting the access class to 1 in the AAI-SCD message. Access class set to 1 restricts M2M devices from performing ranging for network reentry. The M2M devices may perform network entry/reentry after the ABS sets the M2M access class to 0.

Access class restriction in AAI-SCD message may be used for configuring 4 access classes and every access classes can span 4 continuous superframes based on NS-RCH configuration. Access class relative ID of superframe R is expressed as follows:

$$R = mod(\text{superframe number}, N)$$

$N = M \times W$ is the total number of superframes which all of access class include and is set for 16, M is the total number of access class and is set to 4, W is the number of superframes in one access class and is set to 4.

Allocation of access class can refer to Table 795a. The ABS can decide which access class that the M2M devices can use for ranging during network re-entry.

Table 795a—Allocation of access class

Field	Condition
Access class (i)	$0 \le R \le 3$
Access class (i+1)	$4 \le R \le 7$
Access class (i+2)	$8 \le R \le 11$
Access class (i+3)	$12 \le R \le 15$

Table 795b—Mapping for access class

Access class restriction	Notes
0	M2M devices may access the network
1	M2M devices shall not access the network

6.2.16 Periodic ranging

Add the following text at the end of 6.2.16 as indicated

For fixed M2M devices, periodic ranging may be omitted.

6.2.17 Sleep mode

6.2.18 Idle mode

Add new subclause 6.2.18.7 as indicated

6.2.18.7 Idle mode for M2M application

The procedures described in this subsection shall apply to M2M devices. In case there is a contradiction between this subsection and other subsections of 6.2.18, the procedures described in this subclause shall take precedence.

M2M device-specific Idle Mode Timer for the M2M device may be assigned during idle mode initiation. In this case, the AAI-DREG-RSP message includes M2M device-specific Idle Mode Timer. When the M2M device receives the AAI-DREG-RSP message with M2M device-specific Idle Mode Timer, the M2M device shall perform location update prior to the expiration of the M2M device-specific Idle Mode Timer. At every location update including the paging group location update, the M2M device-specific Idle Mode Timer is restarted.

6.2.18.7.1 Paging operation

Group paging may be used for M2M devices. For this, M2M Group Identifier (MGID) defined in 6.2.1.3.1 may be included in a paging message instead of an individual identifier to identify the group of M2M devices.

AAI-PAG-ADV with M2M report code set to 0b1 may be used to poll M2M devices for periodic uplink non-realtime data transmission for fixed M2M devices. The interval of periodic uplink data transmission should be longer than or equal to the paging cycle. If an M2M device receives the AAI-DREG-RSP message with the Transmission Type set to 1 and Max number of paging cycle attribute during idle mode entry, the M2M device shall wait for the AAI-PAG-ADV with M2M report code = 1 as long as Max number of paging cycle × length of paging cycle . If the M2M device does not receive the AAI-PAG-ADV with M2M report code = 1, it may send the uplink data.

Two paging offsets may be assigned to the M2M device with a long paging cycle (e.g., above several minutes or hours) at the idle mode initiation. If the M2M device does not receive the AAI-PAG-ADV message at its first paging offset, the M2M device shall monitor the transmission of the AAI-PAG-ADV message at its second paging offsets. After transmitting the AAI-PAG-ADV message with action code 0b0 (Performing network reentry) during M2M device's first paging offset, if the ABS does not receive a response from the paged M2M device, the ABS may re-page this M2M device at its second paging offset that is indicated in AAI-DREG-RSP message.

6.2.18.7.2 Network re-entry from idle mode for M2M devices

ABS may assign ranging resources, including ranging code and ranging opportunity, dedicated for M2M devices. In this case, M2M devices perform ranging for network (re-)entry using dedicated ranging resources. When ABS assigns the CDMA Allocation A-MAP IEs for AAI-RNG-REQ to those M2M devices, the opportunity index in RA-ID masked for the CDMA Allocation A-MAP IEs can be set to one of opportunity index '0b01' and '0b10'. In this case, the opportunity index for assignment of the dynamic NS-RCH shall be set to the other value. The information of dedicated ranging resources is transmitted in the AAI-SCD message. If ABS does not assign dedicated ranging resources, M2M devices perform ranging for network (re-)entry using the ranging resources defined in Table 833 in 6.3.5.5.1.2. The configuration of ranging assignment for M2M devices is indicated through M2M ranging indicator in the AAI-SCD message.

If the M2M network access type is set to 0b00, the M2M device doesn't need to send CDMA code for ranging but sends AAI-RNG-REQ message using the resource allocation information indicated in AAI-PAG-ADV message.

When the M2M device receives the group paging message (i.e., AAI-PAG-ADV with MGID) and M2M network access type is set to 0b00 (i.e., Resource allocation for AAI-RNG-REQ), it starts to monitor the Assignment A-MAP IE to obtain the resource for AAI-RNG-REQ message at 'Assignment A-MAP start off-

set for AAI-RNG-REQ' during the 'Resource monitor timer'. If the M2M device does not decode the Assignment A-MAP IE until the expiration of the 'Resource monitor timer', it performs contention-based ranging.

If the M2M device receives the group paging message (i.e., AAI-PAG-ADV with MGID) and the M2M network access type is set to 0b01, the ABS shall allocate the dedicated ranging channel (i.e., M2M ranging opportunity subframe index, Periodicity of the M2M ranging) for M2M devices in AAI-PAG-ADV message, the dedicated S-RCH allocation is used for ranging.

If the M2M device receives the group paging message (i.e., AAI-PAG-ADV with MGID) and the M2M network access type is set to 0b10, the ABS shall allocate the dedicated ranging channel (i.e., M2M ranging opportunity subframe index, Periodicity of the M2M ranging) for M2M devices in AAI-PAG-ADV message, the dedicated NS-RCH allocation is used for ranging.

If the M2M device receives the group paging message (i.e., AAI-PAG-ADV with MGID) and the M2M network access type is set to 0b11, M2M device performs the normal ranging using the ranging resources defined in Table 839 in 6.3.5.5.1.2.

When the M2M device receives the individual paging message (i.e., AAI-PAG-ADV with FMDID) and M2M network access type is 0b00 (i.e., Resource allocation for AAI-RNG-REQ), it decodes the Assignment A-MAP IE to obtain the resource of AAI-RNG-REQ message at 'Assignment A-MAP offset for AAI-RNG-REQ'.

When the M2M device receives the individual paging message (i.e., AAI-PAG-ADV with DID or FMDID) and M2M network access type is set to 0b01 (i.e., dedicated ranging channel allocation in AAI-PAG-ADV), the ABS shall allocate the dedicated ranging channel (i.e., M2M ranging opportunity subframe index, Periodicity of the M2M ranging) for M2M devices in AAI-PAG-ADV message and information of the dedicated ranging channel is included in the AAI-PAG-ADV message.

When the M2M device receives the individual paging message (i.e., AAI-PAG-ADV with DID or FMDID) and M2M network access type is set to 0b10 (i.e., dedicated ranging channel allocation in broadcast assignment A-MAP IE), the ABS shall allocate the dedicated ranging channel (i.e., M2M ranging opportunity subframe index, Periodicity of the M2M ranging) for M2M devices in AAI-PAG-ADV message and information of the dedicated ranging channel is included in the Broadcast Assignment A-MAP IE.

If the M2M device receives the individual paging message (i.e., AAI-PAG-ADV with DID or FMDID) and the M2M network access type is set to 0b11, M2M device performs the normal ranging using the ranging resources defined in Table 839 in 6.3.5.5.1.2.

During paging, an ABS may assign a ranging backoff start to M2M devices by AAI-PAG-ADV message. The ranging start included in the AAI-PAG-ADV message may be different from one assigned by SFH SP3. If M2M devices receive AAI-PAG-ADV message which includes ranging backoff start, they shall use the ranging backoff start included in the AAI-PAG-ADV message to determine initial backoff window for initial ranging during network reentry or location update. This ranging backoff start shall be only applied to the ranging process that is in response to the AAI-PAG-ADV message. The ranging backoff mechanism supported to each M2M device shall be negotiated through TBD message.

When the M2M devices restart the ranging procedure and the ranging backoff window indicator in AAI-PAG-ADV message is set to 0b1, they shall determine the ranging opportunities within following backoff window size: Backoff window size(K_x) = The initial backoff window size(K)/2^X, X is the number of ranging retransmissions and the minimum K_x is set to more than 2.

The M2M devices shall determine the start point of the backoff window as following equation:

The start point of the x^{th} backoff window per each M2M device $= \max\left(\sum_{i=0}^{i=x-1} K_i(x-1)^{th} + delay_{T31}\right)$, K_0 is same to the initial backoff window size (K) and $Delay_{T31}$ is the processing delay term as T31. The unit is depending on the ranging configuration as described in 6.3.5.5.1.2.

During network reentry, the M2M device may request UL BW grant without a contention-based bandwidth request by including Bandwidth Request Indicator in an AAI-RNG-REQ message. If an ABS receives the AAI-RNG-REQ message with Bandwidth Request Indicator set to 1, the ABS may allocate an UL bandwidth, without a contention-based bandwidth request from the M2M device by setting the Unsolicited bandwidth grant indicator in an AAI-RNG-RSP message to the M2M device. If the Unsolicited bandwidth indicator is enabled, the ABS should allocate UL bandwidth within the BR grant time duration after sending the AAI-RNG-RSP message.

The M2M device should monitor the A-MAP IE during the BR grant time duration for possible bandwidth allocation without performing any bandwidth request. If the M2M device fails to identify allocated bandwidth within the BR grant time duration, the M2M device may perform contention based bandwidth request.

The BR grant timer in ABS is started when the ABS transmits the AAI-RNG-RSP message with the unsolicited bandwidth grant indicator set to 1 to the M2M device.

The BR grant timer in M2M device is started when the M2M device receives the AAI-RNG-RSP message with the unsolicited bandwidth grant indicator set to 1 sent to it.

6.2.18.7.3 Idle mode optimizations for fixed M2M devices

A fixed M2M device in idle mode does not need to perform the paging operation and location update operation based on the paging group. To eliminate the need for allocating the unnecessary paging information (i.e., Paging Group ID, Paging Controller ID), a fixed M2M device may enter localized idle mode. The localized idle mode entry procedure is the same as the idle mode entry procedure as defined in 6.2.18.1.

Localized idle mode for the fixed M2M device is initiated either by the M2M devices or by its ABS.

In case of M2M device-initiated localized idle mode entry, a fixed M2M device may include Localized_Idle_Mode flag set to 1 in the AAI-DREG-REQ message. The fixed M2M device may request the ABS to retain specific M2M device service and operational information for idle mode management proposes through inclusion of the Idle Mode Retain information element in the AAI-DREG-REQ message.

When an ABS receives an AAI-DREG-REQ with Localized_Idle_Mode flag set to 1 and accepts M2M device's request, it does not inform the Paging Controller that the M2M device enters idle mode.

Then the ABS sends AAI-DREG-RSP with Localized_Idle_Mode flag set to 1 or 0. Localized_Idle_Mode flag set to 1 indicates that ABS accepted M2M device's request. Then the M2M device transitions to localized idle mode and does not perform the paging operation and location update operation based on the paging group.

Localized_Idle_Mode flag set to 0, the M2M device enters the normal idle mode.

Using ABS-initiated localized idle mode entry, an ABS may signal for a fixed M2M device to begin localized idle mode by sending an AAI-DREG-RSP message in unsolicited manner. This unsolicited AAI-DREG-RSP may include Localized_Idle_Mode flag set to 1. When a fixed M2M device receives an unsolicited AAI-DREG-RSP with Localized_Idle_Mode flag set to 1, the fixed M2M device shall immediately start

the idle mode initiation procedures by sending AAI-DREG-REQ message with Localized_Idle_Mode flag set to 1 or 0 in response to the unsolicited AAI-DREG-RSP message.

6.2.18.7.3.1 Idle mode operations for fixed M2M devices

When the fixed M2M device enters the localized idle mode, a Fixed M2M Deregistration ID (FMDID) is assigned to the fixed M2M device and Paging Controller ID, Paging Group ID and Deregistration ID is not required to be assigned to the fixed M2M device.

The ABS can page the fixed M2M devices via group paging or individual paging. When the ABS pages the fixed M2M devices via group paging, it transmits the AAI-PAG-ADV message with MGIDs to the fixed M2M devices. When the ABS individually pages the fixed M2M devices, it transmits the AAI-PAG-ADV message with FMDID to the fixed M2M devices.

PGID information of the PGID-Info message is not applicable to the fixed M2M device because the Paging Group ID is not assigned to the fixed M2M device.

Fixed M2M device does not perform the paging group based update because the Paging Group ID is not assigned to the fixed M2M device. Fixed M2M device performs the timer based update based on the M2M device-specific Idle Mode Timer.

6.2.18.7.4 Network reentry from idle mode for M2M device group

In order to reduce network congestion produced by a large number of M2M devices, network reentry may be initiated for a group of M2M devices. M2M device in a M2M device group is called as group member (GM). An M2M device in a group is authorized to act as representative for this M2M device group and is expected to initiate the first ranging access for this M2M device group. Such M2M device that initiates ranging for an M2M device group is called as a group delegate (GD). ABS assigns a dedicated ranging code to a GD. When an M2M device group is expected to report their data, group delegates of the group send a ranging code based on M2M Group ID (MGID) from a ranging code set to ABS. On receiving this ranging code, the ABS sends AAI-RNG-ACK in response, which includes three ranging status (success, abort and continue) for group. All group members listen to confirmation for the dedicated ranging code transmitted by the group GD in AAI-RNG-ACK message. After all group members get "success" information, they will use common or dedicated ranging resource for network access.

Upon a detection of an event specific for a group (i.e., MGID), the GMs of this group shall start the T32 timer defined in 6.11. Within the T32 timer the GMs of this group await the AAI-RNG-ACK message, which is expected to be a response to the ranging code sent by this group's GD. If GMs receive the AAI-RNG-ACK, which is the response of the ranging code transmitted by the GD, every GM initiates further action for network re-entry. If GMs do not receive such AAI-RNG-ACK message within the duration of T32, the GMs perform voluntary network re-entry upon expiry of T32. ABS shall indicate whether network support GD scheme or not and detail indication is included in AAI-SCD message.

- If ranging status is "success", all GMs in this group start its network reentry procedure by transmitting a ranging code. The ranging code chosen may be in legacy code sets for ranging or may be a new one, and the legacy initial ranging opportunity or a new one may be used for transmitting the ranging code. Before transmitting the ranging code, the GM shall randomly select a back-off value within the initial backoff window for network access.
- If ranging status is "abort", all GM in this group shall start the ranging abort timer and abort the ranging process until the ranging abort timer expires. After abort timer expires, this group shall restart the ranging procedure based on GD.
- If ranging status is "continue", the GD in this group shall adjust its parameters accordingly and continue the ranging process.

6.2.18.7.4.1 Selection of M2M device group delegate

Selection of M2M device group delegate should support fix and mobility of group. Random selection rule by M2M devices can be used for supporting selection of M2M device group delegate.

When member of M2M device group needs report UL data, it will receive random selection probability θ by broadcast message AAI-SCD and produce random number by itself and then compare produced random number m with random selection probability θ,

if $m \le \theta$, it can become group delegate,

if $m > \theta$, it cannot become group delegate,

Group delegate will choose certain superframe based on MGID and then send dedicated ranging code to ABS in this superframe. If group delegate listens "continue or abort" information for dedicated ranging code for this group in AAI-RNG-ACK, group delegate won't change its identification of delegate. If group delegate listens to "success" information for dedicated ranging code for this group in AAI-RNG-ACK, group delegate will go back to group member.

If group member cannot listen any information on dedicated ranging code for this group and ABS cannot detect dedicated ranging code for this group, ABS will increase random selection probability θ and then group member will produce random number and compare it with random selection probability θ again.

ABS will broadcast random selection probability by broadcast message (AAI-SCD). And ABS controls variety of random selection probability θ and during the interval between two AAI-SCD messages, random selection probability θ is fixed. MS calculates the random data and probability based on the following equation (184a).

$$\text{Yrand} = (\text{Xrand\_seed} \times m + n) \bmod j \qquad (184a)$$

m, n is integer and one of these two parameters has to be prime numbe; j is the max of Yrand and prime number $2^{16} - 15 = 65521$;

$$P_{selection} = (Yrand)/j$$

6.2.18.7.4.2 Ranging channel and ranging code for M2M device group

When an M2M device group is expected to report their data or is paged, group delegates of the group send a ranging code based on multicast group ID (MGID) from the above ranging code set to ABS.

Calculation equation on dedicated ranging code is as follows:

$$r_{\text{dedicated ranging code}} = mod(floor(MGID/M), N_{\text{ranging opportunity}}) \qquad (184b)$$

The M2M individual additional RP codes shall be used for initial network entry and association of M2M individual device. The Zadoff-Chu sequences with cyclic shifts are used for the RP codes. The p^{th} RP code $x_p(k)$ is defined and generated in Equation (291) (see 6.3.8.2.4.1). N_{cont} is the total number of initial (0~N_{IN}-1) and handover RP codes (N_{IN}~N_{IN}+N_{HO}-1) per sector for normal contention-based approach. N_{dedi} is the total number of dedicated handover RP code. When dedicated handover RP code set is not allocated, the available additional RP codes set can be used for M2M device group. $N_{\text{M2M group}}$ is the total num-

ber of the available additional RP codes set for M2M device group ($N_{cont} + N_{dedi}$~ $N_{cont}+N_{dedi}$ $+N_{M2M\ group}$ -1) where maximum possible $N_{M2M\ group}$ per sector is 32.

For certain M2M device group, 4 cases for this:

$$\mathrm{mod}(MGID,M) - \mathrm{mod}(C,M) = 0 \quad (184c)$$

$$M = \lfloor MGID_{total} \times \alpha_{multiplexing\ factor\ of\ dedicated\ ranging\ code} / (N_{M2M\ group} \times N_{ranging\ opportunity}) \rfloor \quad (184d)$$

$\alpha_{multiplexing\ factor\ of\ dedicated\ ranging\ code}$ can be carriered in S-SFH SP1. $N_{ranging\ opportunity}$ is related on configuration of ranging opportunity. C is related on superframe number with ranging opportunity. $MGID_{total}$ is the total number of MGID.

1) If Configuration of ranging opportunity==0, $C = 4 \times \text{superframe number} + i$; i is expressed as frame number (0,1,2,3); $N_{ranging\ opportunity} = 4$
2) If Configuration of ranging opportunity==1, $C = \text{superframe number}$; $N_{ranging\ opportunity} = 1$
3) If Configuration of ranging opportunity==2, $C = \text{superframe number}/2$; mod(superframe number, 2)==0; $N_{ranging\ opportunity}$ =1/2;
4) If Configuration of ranging opportunity==3, $C = \text{superframe number}/4$; mod(superframe number, 4)==0; $N_{ranging\ opportunity}$ =1/4.

6.2.18.7.5 S-SFH update in idle mode

When the paging cycle of an M2M device is greater than or equal to $\text{S-SFH change cycle} \times 2^{\text{bit size of S-SFH change count}}$, the M2M device shall decode all the SFH SP IEs before its paging listening interval.

6.2.19 Deregistration with context retention (DCR) mode

6.2.20 Co-located coexistence (CLC)

6.2.21 Interference mitigation mechanism

6.2.22 MAC control reliability

6.2.23 Power management for the active mode

6.2.24 Update of S-SFH IEs

6.2.25 Short message service

6.2.26 Coverage loss detection and recovery from coverage loss

6.2.27 AMS deregistration

6.2.28 Support for multicast service

Add new subclause 6.2.28.4 as indicated

6.2.28.4 Multicast operation for machine to machine (M2M) applications

Multicast Service for M2M applications provides concurrent transport of DL data common to M2M devices belonging to an M2M device group using an MGID in an ABS. Multicast service is associated with an ABS and is offered in the downlink only. Each multicast connection is associated with a service flow provisioned with the QoS and traffic parameters for that service flow. Service flows to carry multicast data are instantiated on individual M2M devices participating in the service while in Connected State. During such instantiation, the M2M device learns the parameters that identify the service and associated service flows.

The ABS shall use a combination of MGID and FID to provide the multicast service. The same MGID and FID is assigned to a group of M2M devices that participate in the same multicast service and is assigned by a network during DSA procedure.

To access the multicast service, the M2M device that is assigned an MGID shall apply the 16-bit CRC mask with masking prefix = 0b0, message type indicator = 0b010, and decimal value = 4094 to decode the assignment A-MAP IE. If the MGID is included in the Broadcast Assignment A-MAP IE, the M2M device shall obtain the multicast burst according to the instruction in the Broadcast Assignment A-MAP IE.

6.2.28.4.1 Multicast operation

An ABS may establish a DL multicast service by creating a multicast connection with each M2M device to be associated with the service. Any available FID may be used for the multicast service (i.e., there are no dedicated FIDs for multicast transport connections). The multicast connection shall be established using a combination of MGID and FID assigned through AAI-DSA MAC control. Since a multicast connection is associated with a service flow, it is associated with the QoS and traffic parameters of that service flow. For multicast connections, ARQ is not applicable, but a common security key is used to provide encryption and integrity protection for multicast traffic as described in 6.2.5.5.

6.2.28.4.2 Multicast connection establishment

When an M2M device registers to receive multicast services, the S-ABS or the M2M device may initiate the DSA procedure for multicast connections. The M2M device's discovery and registration of multicast services with the ABS through upper layer signaling are outside the scope of this standard.

The AAI-DSC procedures are used to change multicast service flows. The AAI-DSD procedure can be used to delete the multicast service flow for an M2M device. In addition, the multicast service flows of an M2M device are deleted when the M2M device exits from a network or enters DCR mode. The M2M device shall retain service flow information associated multicast service during idle mode. The ABS shall send the AAI-DSA-REQ/RSP to the M2M device with the relevant multicast parameters including MGID.

6.2.28.4.3 M2M Multicast operation in idle mode

An M2M ABS may provide the multicast service for M2M devices in idle mode with or without requiring network reentry of the M2M devices. Before an M2M ABS sends DL multicast data, the M2M ABS may transmit the paging message including the multicast traffic indication to M2M devices during the paging listening intervals of the M2M devices. If an M2M device receives the paging message indicating multicast traffic reception without network reentry during its paging listening interval, the M2M device shall start receiving the DL multicast data without the idle mode termination.

The multicast transmission start time may be included in the paging message in order to indicate when the DL multicast data is sent by the ABS. The value of multicast transmission start time shall be less than the start time of next paging listening interval of the M2M devices receiving the AAI-PAG-ADV message. The M2M device may power down until the frame indicated by multicast transmission start time in the AAI-PAG-ADV message.

When the multicast data transmission ends, the ABS shall signal the end of multicast data transmission to the M2M devices by sending the AAI-MTE-IND message. Upon receiving the AAI-MTE-IND message, the M2M devices may enter the paging unavailable interval as specified in 6.2.18.2.

6.2.28.4.4 Reliable multicast transmission for M2M applications

An M2M ABS shall provide the reliable transmission of the multicast traffic for M2M applications.

Add new subclause 6.2.29 as indicated

6.2.29 Abnormal power down reporting

When a MS detects an abnormal power down event, it tries to send an AAI-RNG-REQ message with the Ranging Purpose Indication indicating that an abnormal or involuntary power down has occurred (value 0b1110).

6.2.29.1 Abnormal power down reporting in connected state

If the MS is in connected state with uplink bandwidth already allocated and available, then it may use the available bandwidth to send this AAI-RNG-REQ message containing the Ranging Purpose Indication with value 0b1110.

If the MS is in connected state but does not have available UL bandwidth, then it may use the procedure defined in 6.3.6 to request bandwidth. Upon receiving bandwidth allocation it may send the AAI-RNG-REQ message containing the Ranging Purpose Indication with value 0b1110.

If the MS is in connected state but does not have available UL bandwidth, then it may use the quick access procedure defined in 6.2.11 to report the abnormal power down event. The Predefined BR index may be used to indicate that an abnormal or involuntary power down has occurred.

6.2.29.2 Abnormal power down reporting in idle state

When an abnormal power down occurs, an M2M device in idle mode that has been configured to report abnormal power down events and that has a valid security association with the preferred ABS shall select a ranging opportunity within a backoff window starting at the next frame. The M2M device shall set the back-off window size as large as possible, yet such that it is guaranteed to complete the abnormal power down reporting procedure before its power is depleted. The M2M shall select the ranging opportunity, t, where $t = 1, ..., b$, within the backoff window according to the cumulative distribution function

$$F(t) = \frac{N^{t/b} - 1}{N - 1}$$

, where b is the backoff window size and N is the value of the configurable system parameter Abnormal Power Down Ranging Opportunity Selection Parameter (see Table 982). At the selected ranging opportunity the M2M device shall transmit the Abnormal Power Down Ranging Preamble Code, which is also a configurable system parameter (see Table 982).

The ABS, upon receiving the ranging code, may include a CDMA Allocation A-MAP IE in the next frame identifying the M2M device and provide an allocation sufficiently large to allow the M2M device to transmit an AAI-RNG-REQ message including a Ranging Purpose Indication and the CMAC Tuple. Upon receiving this allocation, the M2M device shall transmit a AAI-RNG-REQ message including a Ranging Purpose Indication with value 0b1110 (power outage) and a valid CMAC Tuple. The M2M device shall not repeat sending of a ranging code if it does not receive an allocation from the ABS.

If the target ABS evaluates the CMAC Tuple as valid and can supply a corresponding authenticating CMAC Tuple, then the Target ABS may reply with an encrypted AAI-RNG-RSP message including the Location Update Response indicating success completing the abnormal power down reporting process.

6.3 Physical layer

6.3.5 Downlink control structure

6.3.5.5 DL control information elements

6.3.5.5.1.2 S-SFH IE

Change the contents of Table 841 as indicated

Table 841—S-SFH SP3 IE format

Syntax	Size (bit)	Notes
...	...	...
M2M SCD count	4	The value is increased whenever the contents of the dedicated ranging information for M2M devices are changed. The value rolls over from 0 to 15. The operation of this field is same with SCD count as defined in 6.3.5.5.1.2.
multiplexing factor of dedicated ranging code	3	Indicate multiplexing ratio of dedicated ranging code 0b000:1 0b001:1/2 0b010:1/4 0b011:1/8 0b100:1/16 0b101:1/32 0b110:1/64 0b111:1/128
...	...	...

6.3.5.5.2.4 Assignment A-MAP IE

Modify Table 849 as indicated

Table 849—Description of CRC mask

Masking Prefix (1bit MSB)	Remaining 15 bit LSBs	
0b0	Type Indicator	Masking code
	0b000	12 bit STID or TSTID
	0b001	Refer to Table 850
	0b010	Refer to Table 851
	0b011	LSB 12 bits of FMDID or LSB 12 bits of DID

Table 849—Description of CRC mask

Masking Prefix (1bit MSB)	Remaining 15 bit LSBs
0b1	15-bit RA-ID: The RA-ID is derived from the AMS's random access attributes [i.e., superframe number (LSB 5bits), frame_index (2 bits), preamble code index for ranging or BR (6 bits) and opportunity index for ranging or BR (2 bits)] as defined below: RA-ID = (LSB 5 bits of superframe number | frame_index | preamble_code_index | opportunity_index)

Modify Table 851 as indicated

Table 851—Description of the masking code for type indicator 010

Decimal Value	Description
4094	Used to mask Broadcast Assignment A-MAP IE for multicast assignment for M2M application (i.e., Function Index = 0b11)
4095	Used to mask Broadcast Assignment A-MAP IE for multicast assignment (i.e., Function Index = 0b10)
Others	*Reserved*

6.3.5.5.2.4.7 CDMA Allocation A-MAP IE

Modify Table 859 as indicated

Table 859—CDMA Allocation A-MAP IE*

Syntax	Size (bits)	Notes
CDMA_Allocation_A-MAP IE {		
A-MAP IE type	4	CDMA Allocation A-MAP IE
CDMA allocation indication	1	0b0: Bandwidth allocation in response to a received contention-based bandwidth request. 0b1: Bandwidth allocation in response to a received contention-based ranging request
If (CDMA allocation indication ==0b0){		
...	...	...
}		
Else if (CDMA allocation indication ==0b1) {		

Table 859—CDMA Allocation A-MAP IE*

Syntax	Size (bits)	Notes
Uplink/Downlink Indicator	1	Indicates whether the following fields are for resource assignment in the uplink or in the down-link. 0b0: Uplink 0b1: Downlink
Resource Index	11	
ISizeOffset	5	
HFA	3	
If (Uplink/Downlink Indica-tor==0b0) {		
...	...	...
} Else {		
ACID	4	
AI_SN	1	
SPID	2	
~~Reserved~~	~~8~~	
MEF	1	MIMO encoder format 0b0: SFBC 0b1: Vertical encoding
if (MEF == 0b1){		
Mt	3	
Reserved	4	
} else {		
Reserved	7	
}		
}		
}		

Insert the following texts at the end of section 6.3.5.5.2.4.7

For M2M devices the DL HARQ burst signaled by the CDMA Allocation A-MAP IE is transmitted using MIMO encoder format and the modulation scheme indicated the CDMA Allocation A-MAP IE.

6.3.5.5.2.4.13 Broadcast Assignment A-MAP IE

Modify Table 866 as indicated

Table 866—Broadcast Assignment A-MAP IE*

Syntax	Size (bit)	Notes
Broadcast_Assignment_A-MAP_IE() {		
A-MAP IE Type	4	Broadcast Assignment A-MAP IE
Function Index	2	0b00: This IE carries broadcast assignment information 0b01: This IE carries handover ranging channel allocation information 0b10: This IE carries multicast assignment information 0b11: ~~*Reserved*~~ This IE carries multicast assignment information for M2M application or ranging channel allocation information for M2M devices
...	...	...
} else if (Function Index ==0b10) {		
...	...	...
}		
else {//Function Index == 0b11		
SubFunction Index	1	0b0: Multicast assignment information for M2M application 0b1: Ranging channel allocation information for M2M devices
If (SubFunction Index == 0b0) {		
MGID	15	
Burst Size	6	
Resource Index	11	
Long_TTI_Indicator	1	
}		
else {//SubFunction Index==0b1		
Number of Ranging Opportunities (N)	1	0: one NS-RCH 1: two NS-RCHs
for(i=0; i<N; i++) {		
Subframe Index	3	
Ranging opportunity index	1	Indicates 2-bit Opportunity index of the ranging channel specified in 16.2.15.3. 0b0: 0b01 0b1: 0b10

Table 866—Broadcast Assignment A-MAP IE*

Syntax	Size (bit)	Notes
Dedicated ranging indicator	1	0: this ranging channel is used for purpose of normal ranging 1: this ranging channel is used for the purpose of dedicated ranging indicated in in the AAI-PAG-ADV message
}		
Reserved	27/22	
}		
}		
}		

*A 16 bit CRC is generated based on the randomized contents of the Broadcast Assignment A-MAP IE. The CRC is masked by the 16-bit CRC mask generated according to Table 849. If Function index == 0b00 or 0b01, the CRC is masked by the 16-bit CRC mask with masking prefix = 0b0 and message type indicator = 0b001. If Function index == 0b10 or 0b11, the CRC is masked by the 16-bit CRC mask with masking prefix = 0b0 and message type indicator = 0b010.

6.3.5.5.2.4.14 Extended Assignment A-MAP IE

Add new subclause 6.3.5.5.2.4.14.1 as indicated

6.3.5.5.2.4.14.1 Fixed M2M Ranging Assignment A-MAP IE

The Fixed M2M Ranging Assignment A-MAP IE is used to allocate ranging channel of idle mode fixed M2M device.

The fixed M2M device with FMDID shall apply the 16-bit CRC mask with masking prefix = 0b0, message type indicator = 0b011, and masking code = LSB 12 bits of FMDID to decode the assignment A-MAP IE. The MSB 4 bits of FMDID is included in Fixed M2M Ranging Assignment A-MAP IE.

The fixed M2M device with DID shall apply the 16-bit CRC mask with masking prefix = 0b0, message type indicator = 0b011, and masking code = LSB 12 bits of DID to decode the assignment A-MAP IE. The MSB 6 bits of DID and paging cycle are included in Fixed M2M Ranging Assignment A-MAP IE.

Table 867a—Fixed M2M Ranging Assignment A-MAP IE

Syntax	Size (bits)	Description/Notes
M2M_Fixed_Ranging_Assignment_A-MAP_IE() {		
A-MAP IE Type	4	

Table 867a—Fixed M2M Ranging Assignment A-MAP IE

Syntax	Size (bits)	Description/Notes
Extended Assignment A-MAP IE type	4	Fixed M2M Ranging Assignment A-MAP IE
M2M Device Identifier type	1	0: DID 1: FMDID
If (M2M Device Identifier type == 0) {		
MSB 6 bits of Deregistration Identifier (DID)	6	MSB 6 bits of Deregistration Identifier (DID)
Paging Cycle	4	Paging cycle
}		
If (M2M Device Identifier type == 1) {		
MSB 4 bits of Fixed M2M device Identifier (FMDID)	4	MSB 4 bits of Fixed M2M device Identifier (FMDID)
}		
Uplink/Downlink Indicator	1	Indicates whether the following fields are for resource assignment in the uplink or in the downlink. 0b0: Uplink 0b1: Downlink
Resource Index	11	512 FFT size: 0 in first 2 MSB bits + 9 bits for resource index 1024 FFT size: 11 bits for resource index 2048 FFT size: 11 bits for resource index Resource index includes location and allocation size.
Burst Size	5	
Reserved	11	
}		

Add new subclause 6.3.5.5.2.4.16 as indicated

6.3.5.5.2.4.16 UL M2M persistent allocation A-MAP IE

The UL M2M persistent allocation A-MAP IE is specified in Table 867b.

Table 867b—UL M2M persistent allocation A-MAP IE

Syntax	Size (bits)	Description/Notes
UL M2M Persistent Allocation A-MAP_IE() {		
A-MAP IE Type	4	UL M2M Persistent Allocation A-MAP_IE
Allocation Period	4	Period of persistent allocation for M2M: Bit 0~2: 0b000: deallocation 0b001: 2 frames 0b010: 4 frames 0b011: 6 frames 0b100: 5 superframes 0b101: 10 superframes 0b110: 25 superframes 0b111: 50 superframes Bit 3: *Reserved*
if (Allocation Period==0b00){	-	-
Resource Index	11	Confirmation of the resource index for a previously assigned persistent resource that has been deallocated 512 FFT size: 0 in first 2 MSB bits + 9 bits for resource index 1024 FFT size: 11 bits for resource index 2048 FFT size: 11 bits for resource index Resource index includes location and allocation size
TTI and Relevance	2	Indicates the TTI type and the location of UL subframe relevant to this A-MAP. 0b00: long TTI 0b01: default TTI, the first UL subframe relevant to this A-MAP 0b10: default TTI, the second UL subframe relevant to this A-MAP 0b11: default TTI, the third UL subframe relevant to this A-MAP
HFA	6	Explicit Index for HARQ Feedback Allocation to acknowledge receipt of deallocation A-MAP IE
Reserved	13	Reserved bits
} else if (Allocation Period != 0b00){	-	-
IsizeOffset	5	Offset used to compute burst size index
Resource Index	11	Confirmation of the resource index for a previously assigned persistent resource that has been deallocated 512 FFT size: 0 in first 2 MSB bits + 9 bits for resource index 1024 FFT size: 11 bits for resource index 2048 FFT size: 11 bits for resource index Resource index includes location and allocation size

Table 867b—UL M2M persistent allocation A-MAP IE

Syntax	Size (bits)	Description/Notes
TTI and Relevance	2	Indicates the TTI type and the location of UL sub-frame relevant to this A-MAP. 0b00: long TTI 0b01: default TTI, the first UL subframe relevant to this A-MAP 0b10: default TTI, the second UL subframe relevant to this A-MAP 0b11: default TTI, the third UL subframe relevant to this A-MAP
HFA	3	HARQ Feedback Allocation
N_ACID	2	Number of ACIDs for implicit cycling of HARQ channel identifier. 0b00: 1 0b01: 2 0b10: 3 0b11: 4
Initial_ACID	4	Initial value of HARQ channel identifier for implicit cycling of HARQ channel identifiers.
Reserved	5	Reserved bits
}		
}		

6.11 Global values

Change the contents of Table 982 as indicated

Table 982—Parameters and constants

System	Name	Time reference	Minimum value	Default value	Maximum value
AMS	T59	Time interval between periodic ranging for fixed M2M devices	-	-	TBD
M2M device	T32	This is an event report timer. Timer starts on detection of an event identified for a Group (i.e. MGID)	Minimum value of T31 x 2		TBD
M2M device	Abnormal Power Down Ranging Opportunity Selection Parameter	Constant used in defining the CDF used for selecting a ranging opportunity to report an abnormal power down event in Idle State. Refer to 6.2.29.2	-	-	-
M2M device, ABS	Abnormal Power Down Ranging Preamble Code	Ranging preamble code used to indicate an abnormal power down event. Refer to 6.2.29	-	-	-