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IEEE Standard for Air Interface for Broadband Wireless Access Systems—

Amendment 1: Enhancements to Support Machine-to-Machine Applications

IEEE Computer Society
and the
IEEE Microwave Theory and Techniques Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
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IEEE Std 802.16p™-2012
(Amendment to
IEEE Std 802.16™-2012)

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Approved 30 August 2012
IEEE-SA Standards Board

Abstract: Enhancements to the WirelessMAN-OFDMA Air Interface, an air interface designated as “IMT-2000” by the International Telecommunication Union—Radiocommunication Sector (ITU-R), are specified by this amendment. The enhancements provide improved support for machine-to-machine applications.
Keywords: amendment, broadband wireless access (BWA), IEEE 802.16, IEEE 802.16p, IMT-2000 radio interface, machine to machine (M2M), mobile broadband, orthogonal frequency-division multiple access (OFDMA), WirelessMAN-OFDMA Air Interface, wireless metropolitan area networks

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IEEE Std 802.16f™-2005 (amendment)	22 September 2005	**Roger B. Marks,** *Working Group Chair* **Kenneth Stanwood,** *Vice Chair* **Dean Chang,** *Working Group Secretary* **Phillip Barber,** *Task Group Chair* **Changhoi Koo,** *Task Group Vice Chair* **Itzik Kitroser,** *Task Group Vice Chair* **Joey Chou,** *IEEE 802.16f Chief Technical Editor*
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Introduction

This introduction is not part of IEEE Std 802.16p-2012, IEEE Standard for Air Interface for Broadband Wireless Access Systems—Amendment 1: Enhancements to Support Machine-to-Machine Applications.

This amendment specifies enhancements to the WirelessMAN-OFDMA Air Interface, an air interface designated as "IMT-2000" by the International Telecommunication Union—Radiocommunication Sector (ITU-R). The enhancements provide improved support for machine-to-machine applications. As of the approval date, the applicable version of IEEE Std 802.16 is IEEE Std 802.16-2012, as amended by IEEE Std 802.16p-2012.

Conformance test methodology

The multipart conformance test documents for IEEE Std 802.16 are designated by "IEEE Standard 802.16/ ConformanceXX."

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IEEE Standard for

Air Interface for Broadband Wireless Access Systems—

Amendment 1: Enhancements to Support Machine-to-Machine Applications

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. 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]

[1]Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Overview

Insert new subclause 1.7 as follows:

1.7 Support for machine-to-machine (M2M) communications

The M2M communication is referred to as the information exchange between 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.

M2M communications is a very distinct capability that enables the implementation of the "Internet of things."

Some of the typical use cases that the M2M communication enables are secured access and surveillance, tracking and tracing, public safety, payment, healthcare, remote maintenance and control, metering, consumer devices, and retailing.

In order to enable a range of machine-to-machine applications in which the device communications require wide area wireless coverage in licensed bands, and are automated rather than human-initiated or human-controlled for purposes such as observation and control, some MAC protocols and PHY specifications have been changed for enhancement. MAC enhancements and minimal PHY modifications include support of lower power consumption at the device, support by the base station of significantly larger numbers of devices, efficient support of small burst transmission, and improved device authentication.

3. Definitions

Insert the following definitions in alphabetical order:

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.

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

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

M2M feature: A unique characteristic of an M2M application.

M2M device group: A group of M2M devices that share one or more downlink multicast service flows.

4. Abbreviations and acronyms

Insert the following abbreviations and acronyms in alphabetical order:

M2M	machine-to-machine
M2MCID	M2M multicast connection identifier

6. MAC common part sublayer

6.3 Data/Control plane

6.3.1 Addressing and connections

Insert the following text at the end of subclause 6.3.1:

One or more BS in an area of the network may be grouped into an M2M zone and identified by an M2M GROUP ZONE ID. A BS may belong to at most one M2M group zone. The BS may broadcast the M2M GROUP ZONE ID of the zone to which it belongs in the DCD message.

The M2M multicast connection ID (M2MCID) uniquely identifies a downlink multicast service flow shared by a group of M2M devices within an M2M zone. Implicitly, it is also used to identify the group of M2M devices that share the downlink multicast service flow. An M2M device may share more than one downlink multicast service flow each identified by an M2MCID. All M2MCIDs that are assigned to an M2M device belong to the same M2M group zone.

The M2MCID is assigned to a service flow of an M2M device during the DSA procedure and released during the DSD procedure or an explicit network exit (e.g., power down location update). The assigned M2MCID shall be retained by an M2M device even in idle mode unless the M2M device exits from the network or the network explicitly deletes the service flow associated with the M2MCID. The M2MCID may be reassigned during normal operation mode and idle mode. During normal operation, the M2MCID may be changed and deleted by DSC and DSD procedures respectively.

During idle mode, the M2MCID may be changed by a location update procedure or during network reentry through the RNG-RSP message. The BS may trigger the group location update via paging message. In normal operation, the BS may update the M2MCID for a M2M device group using the MAC Group Management Control (MGMC) message.

When the M2M device performs the timer-based location update, if the BS needs to update the M2MCID of M2M device, the BS may send a RNG-RSP message with an M2MCID Update TLV, which contains a new M2MCID value in response to the RNG-REQ message.

A BS may use the MOB_PAG-ADV message to indicate the update of the M2MCID 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 (identified by its M2MCID) receives a paging message containing an M2MCID TLV identifying one of its service flows and an Action Code TLV with value set to 0b11, this M2M device shall update the M2MCID based on the value indicated by M2MCID reassignment TLV (see 11.17.5).

After receiving the updated M2MCID value, the M2M device shall send an acknowledgement (ACK) to the BS.

If the BS does not receive an acknowledgement from some of the M2M devices, it may trigger location update in the next paging cycle of those M2M devices by sending MOB_PAG-ADV message containing MS MAC Address hash and it may send a RNG-RSP message with an M2MCID Update TLV containing the new M2MCID to each of them during the location update procedure.

The BS may use the M2M Group MAC Control (MGMC) message with the M2MCIDs to send the information to multiple M2M devices. The M2M device shall respond to acknowledge this message with M2M ACK MAC Control (MAMC) message.

The information of the neighboring M2M Group Zones may be advertised by BSs of a given M2M Group Zone in MOB_NBR-ADV message. Neighboring M2M Group Zones implies the M2M Group Zones to which the neighboring BSs belong are different from the M2M Group Zone to which the serving BS belongs.

The MOB_NBR-ADV message contains M2M_GROUP_ZONE_ID of the neighboring M2M Group Zones along with the mappings of M2MCID from the M2M Group Zone of the serving BS to one or more neighboring M2M Group Zones. When an M2M device changes its preferred or serving BS to a BS that belongs to a different M2M Group Zone than the current serving BS, it may have the M2MCID mapping information for the M2M Group Zone of that BS, if it has already received the MOB_NBR-ADV.

The MOB_NBR-ADV message including M2M Group Zone information should be transmitted by the BSs that are situated at the M2M Group Zone boundaries.

6.3.2.1 MAC header formats

Change the contents of Table 6-2 as indicated:

Table 6-2—MAC header HT and EC fields encoding

HT	EC[a]	MAC PDU type	Reference figure	Reference table
...				
1	0	DL: ~~This encoding is not defined~~ DL M2M MAC signaling header type I. MAC PDU without data payload, with a 3-bit type field, see Table 6-27c for type encoding definitions. UL: MAC signaling header type I. MAC PDU without data payload, with a 3-bit type field, see Table 6-6 for type encoding definitions.	Figure 6-5, Figure 6-6, Figure 6-7–Figure 6-12	Table 6-6, Table 6-7, Table 6-8–Table 6-13 Table 6-27c, Table 6-27d
...				

6.3.2.1.2.2 MAC signaling header type II

Change the contents of Table 6-14 as indicated:

Table 6-14—Type field encodings for MAC signaling header II

Type field	MAC header type (with HT/EC = 0b11)	Reference figure	Reference table
0	Feedback header, with another 4-bit type field; see Table 6-16 for its type encodings.	Figure 6-14, Figure 6-15	Table 6-15
1	Extended relay MAC Signaling Header Type II Extended M2M device MAC Signaling Header Type II (M2M)	Figure 6-18	Table 6-20 Table 6-27a

Insert new subclause 6.3.2.1.2.2.3 as follows:

6.3.2.1.2.2.3 Extended M2M device MAC signaling header type II

This type of MAC header is UL-specific. There is no payload following the MAC header. The Extended M2M device MAC signaling header type II is illustrated in Figure 6-18. Table 6-27a describes the encoding of the 3-bit extended type field following the type field.

Table 6-27a—Extended Type field encodings for extended M2M device MAC signaling header type II

Extended Type field	MAC header type	Reference table
0	M2M abnormal power down report header	Table 6-27b
1 ~ 7	*Reserved*	

Insert new subclause 6.3.2.1.2.2.3.1 as follows:

6.3.2.1.2.2.3.1 M2M abnormal power down report header

When an M2M device in normal operation mode detects an abnormal power down event, it sends an M2M abnormal power down report signaling header indicating that an abnormal or involuntary power down has occurred. The M2M abnormal power down report signaling header is defined in Table 6-27b.

Table 6-27b—Description of fields in M2M abnormal power down report header

Name	Length (bit)	Description
CID	16	M2M device's basic connection identifier.
Emergency Type	1	0b0: power outage 0b1: *Reserved*
Reserved	17	Set to 0.
HCS	8	Header Check Sequence (same usage as HCS entry in Table 6-3).

Insert new subclause 6.3.2.1.3 as follows:

6.3.2.1.3 DL MAC header without payload

This MAC header format is applicable to DL only. The MAC header is not followed by any MAC PDU payload and CRC.

Insert new subclause 6.3.2.1.3.1 as follows:

6.3.2.1.3.1 DL M2M MAC signaling header type I

For this MAC header format, there is no payload following the MAC header. The DL M2M MAC signaling header type I is illustrated in Figure 6-5. Table 6-27c describes the encoding of the 3-bit Type field following the EC field.

Table 6-27c—Type field encodings for DL M2M MAC signaling header type I

Type field (3 bits)	MAC header type (with HT/EC = 0b10)	Reference table
0	M2M abnormal power down confirmation header	Table 6-27d
1 ~ 7	*Reserved*	

Insert new subclause 6.3.2.1.3.1.1 as follows:

6.3.2.1.3.1.1 M2M abnormal power down confirmation header

An M2M abnormal power down confirmation signaling header shall be transmitted by the BS in response to a received abnormal power down report. The M2M abnormal power down confirmation signaling header is defined in Table 6-27d.

Table 6-27d—Description of fields in M2M abnormal power down confirmation header

Name	Length (bit)	Description
Type	3	The type of M2M abnormal power down confirmation header is defined in Table 6-27c.
Reserved	35	Set to 0.
HCS	8	Header Check Sequence (same usage as HCS entry in Table 6-3).

6.3.2.3 MAC management messages

Change the contents of Table 6-51 as indicated:

Table 6-51—MAC management messages

Type	Message name	Message description	Connection
...			
110	MOB_MTE-IND	Multicast transmission end indicator	Broadcast/Multicast
111	MGMC	M2M Group MAC Control message	Broadcast/Multicast
112	MAMC	M2M ACK MAC Control message	Basic
113~~110~~–255		*Reserved*	

6.3.2.3.3 UCD (UL channel descriptor) message

Insert the following text at the end of the 6.3.2.3.3 as indicated:

When network reentry of M2M group based on group delegate is used, the following parameters should be included:

Dedicated codes set for M2M group

Number of dedicated codes for M2M group. Possible values are 0–255. Default value is 0.

Probability threshold of M2M group delegate selection

10 bits are used for probability threshold Value of quantized in 0.001 steps as from 0 to 1.

Multiplexing factor of dedicated ranging code

3 bits are used for indicating multiplexing ratio of dedicated ranging code including (1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128).

6.3.2.3.5 RNG-REQ (ranging request) message

Change the paragraph as indicated:

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform reentry, HO, ~~or~~ location update, or abnormal power down reporting:

Ranging Purpose Indication

The presence of this item in the message indicates the following MS action:

If Bit 0 is set to 1, in combination with a serving BSID, it indicates that the MS is currently attempting to HO or reentry; or, in combination with a Paging Controller ID, indicates that the MS is attempting network reentry from idle mode to the BS.

If Bit 1 is set to 1, it indicates that the MS is initiating the idle mode location update process.

Bit 2: Seamless HO indication. When this bit is set to 1 in combination with other included information elements, it indicates the MS is initiating ranging as part of seamless HO procedure.

Bit 3: Ranging Request for Emergency Call Setup. When this bit is set to 1, it indicates MS action of Emergency Call Process.

Bit 4: MBS update. When this bit is set to 1, the MS is currently attempting to perform location update due to a need to update service flow management encodings for MBS flows.

Bit 5: Network Reentry from idle mode of MS which has entered idle mode in AAI-only ABS

Bit~~s~~ 6~~–7~~: *Reserved*

Bit 7: Power down reporting indication. When these bits are set to 001 by an M2M device, it indicates that an abnormal or involuntary power down has occurred.

Change the paragraph as indicated:

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform reentry or location update:

Paging Controller ID (see 11.1.8.2)

The Paging Controller ID is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity

for the MS while in idle mode. This parameter shall not be included when a RNG-REQ is transmitted by an M2M device in Localized Idle Mode.

Insert the following text at the end of the 6.3.2.3.5 as indicated:

The MIMO Feedback information TLV parameter may be included in a RNG-REQ message when the Matrix A or Matrix B is supported by a fixed M2M device:

MIMO Feedback information

This TLV includes the 1-bit Matrix indicator indicating the preferred STC/MIMO matrix and 4-bit DL Effective CINR as defined in Table 8-332.

The following parameter may be included in a RNG-REQ message when an M2M device performs ranging:

Ranging Retries

The number of ranging retries in the current ranging attempt.

The following TLV parameter may be included in a RNG-REQ message when an M2M device transmits the RNG-REQ message in response to an MOB_PAG-ADV message that contains M2MCID Reassignment for M2M TLV.

M2MCID Update Acknowledgement Indicator

This TLV is used to acknowledge the receipt of an M2MCID update.

The following TLV parameter shall be included in a RNG-REQ message when an M2M device does not have the information of new M2M Group Zone.

M2MCID update request

This TLV is used to request M2MCIDs update.

6.3.2.3.6 RNG-RSP (ranging response) message

Insert the following text at the end of the subclause 6.3.2.3.6 as indicated:

The following TLV parameter may be included in a RNG-RSP message to update M2MCID in an M2M device.

M2MCID Update

6.3.2.3.9 Privacy key management (PKM) messages (PKM-REQ/PKM-RSP)

Change the contents of Table 6-63 as follows:

Table 6-63—PKM message codes

Code	PKM message type	MAC management message name
...	...	...
33	MIH Comeback Response	PKM-RSP
34	PKMv2 AK Transfer	PKM-RSP
35	PKMv2 AK Transfer Ack	PKM-REQ
36	M2M Key Request	PKM-REQ

Table 6-63—PKM message codes *(continued)*

Code	PKM message type	MAC management message name
37	M2M Key Reply	PKM-RSP
~~36~~38–255	*Reserved*	

Insert new subclause 6.3.2.3.9.31 as indicated:

6.3.2.3.9.31 M2M Key Request message

The M2M device sends this message to the BS to request the currently used multicast security parameters.

Code: 36

Attributes are shown in Table 6-93a.

Table 6-93a—M2M Key Request attributes

Attribute	Contents
M2MCID	The identifier of the M2M device group of which the M2M device is a member.
HMAC/CMAC Digest	Message digest calculated using AK.

The HMAC/CMAC Digest attribute shall be the final attribute in the message's attribute list. Inclusion of the HMAC/CMAC Digest attribute allows the M2M device and BS to authenticate the PKMv2 Key-Request message. The HMAC/CMAC Digest attribute's authentication key is derived from the AK.

Insert new subclause 6.3.2.3.9.32 as indicated:

6.3.2.3.9.32 M2M Key Reply message

The BS sends this message to the M2M device to provide security information that the M2M device uses to derive the currently used multicast security key, M2MGTEK.

Code: 37

Attributes are shown in Table 6-93b.

Table 6-93b—M2M Key Reply attributes

Attribute	Contents
M2MCID	The identifier of the M2M device group of which the M2M device is a member.
MGSS	Randomly generated seed value for generating M2MGTEK.
M2MGTEK_COUNT	The current M2MGTEK_COUNT value that the M2M device uses to derive the M2MGTEK.
HMAC/CMAC Digest	Message digest calculated using AK.

The HMAC/CMAC Digest attribute shall be the final attribute in the message's attribute list. Inclusion of the HMAC/CMAC Digest attribute allows the M2M device and BS to authenticate the PKMv2 Key-Request message. The HMAC/CMAC Digest attribute's authentication key is derived from the AK.

6.3.2.3.10 DSA-REQ message

Insert the following text at the end of 6.3.2.3.10:

When the DSA-REQ message is sent to an M2M device, the following TLV may be included:

M2MCID (see 11.13.46)

M2MCID associated with the SF.

Minimal Access Window Size (see 11.13.47)

The minimal size of a window within which the M2M device shall select the start time for the network entry procedure.

When the DSA-REQ message is sent to an M2M device to establish a DL multicast service flow, the following TLV may be included:

M2M Multicast Traffic Reception timer (see 11.13.48)

The maximum time interval that M2M devices in idle mode shall wait to receive the M2M multicast data, in unit of frames (0~255), as defined in 6.3.34.1.

6.3.2.3.11 DSA-RSP message

Insert the following text at the end of 6.3.2.3.11:

When the DSA-RSP message is sent to an M2M device, the following TLV may be included:

Minimal Access Window Size (see 11.13.47)

The minimal size of a window within which the M2M device shall select the start time for the network entry procedure.

When the DSA-RSP message is sent to an M2M device to establish a DL multicast service flow, the following TLV may be included:

M2M Multicast Traffic Reception timer (see 11.13.48)

The maximum time interval that M2M devices in idle mode shall wait to receive the M2M multicast data, in unit of frames (0~255), as defined in 6.3.34.1.

6.3.2.3.13 DSC-REQ (DSC request) message

Insert the following text at the end of 6.3.2.3.13:

When the DSC-REQ message is sent to an M2M device, the following TLV may be included:

M2MCID (see 11.13.46)

New M2MCID, replacing a previously associated M2MCID.

Minimal Access Window Size (see 11.13.47)

The minimal size of a window within which the M2M device shall select the start time for the network entry procedure.

When the DSC-REQ message is sent to an M2M device to change a DL multicast service flow, the following TLV may be included:

M2M Multicast Traffic Reception timer (see 11.13.48)

The maximum time interval that M2M devices in idle mode shall wait to receive the M2M multicast data, in unit of frames (0~255), as defined in 6.3.34.1.

6.3.2.3.14 DSC-RSP (DSC response) message

Insert the following text at the end of 6.3.2.3.14:

When the DSC-RSP message is sent to an M2M device, the following TLV may be included:

Minimal Access Window Size (see 11.13.47)

The minimal size of a window within which the M2M device shall select the start time for the network entry procedure.

When the DSC-RSP message is sent to an M2M device to change a DL multicast service flow, the following TLV may be included:

M2M Multicast Traffic Reception timer (see 11.13.48)

The maximum time interval that M2M devices in idle mode shall wait to receive the M2M multicast data, in unit of frames (0~255), as defined in 6.3.34.1.

6.3.2.3.26 DREG-CMD (de/reregister command) message

Insert the following text at the end of 6.3.2.3.26:

When the DREG-CMD message is sent to an M2M device, the following TLVs may be included:

M2M device-specific Idle mode timer

Length of the maximum interval between two consecutive location updates while the M2M device is in idle mode.

Localized_Idle_Mode flag

Bit 0: Indicator of the Localized Idle Mode for fixed M2M device

0b0: The M2M device enters the idle mode excluding the procedures in 6.3.22.11.2.

0b1: The M2M device enters the localized idle mode.

Bits 1–7: *Reserved*

When Localized_Idle_Mode flag is not present in the DREG-CMD message, the M2M device enters the idle mode excluding the procedures in 6.3.22.11.2.

Max number of paging cycle

The maximum number of paging cycles for an M2M device to wait for MOB_PAG-ADV with M2M report code. The unit is the duration of the paging cycle.

6.3.2.3.37 DREG-REQ (SS deregistration request) message

Insert the following text at the end of 6.3.2.3.37:

When the DREG-REQ message is sent to a BS, the following TLV may be included:

Localized_Idle_Mode flag

Bit 0: Indicator of the Localized Idle Mode for fixed M2M device.

0b0: The M2M device enters the idle mode excluding the procedures in 6.3.22.11.2.

0b1: The M2M device enters the localized idle mode.

Bits 1–7: *Reserved*

6.3.2.3.42 MOB_NBR-ADV (neighbor advertisement) message

Insert the following text at the end of 6.3.2.3.42:

The following parameters may be included only once as last TLVs in MOB_NBR-ADV (M2M only):

M2M_Group_Zone_Change_TLV (11.18.3)

This TLV may be added in the MOB_NBR-ADV message when the mapping of M2MCIDs between the current M2M Group Zone and the neighbor M2M Group Zone needs to be indicated.

Neighbor M2M_Group_Zone_Indication_TLV (11.18.4)

This TLV may be added in the MOB_NBR-ADV message to indicate the M2M Group Zones supported by the neighboring BSs.

6.3.2.3.51 MOB_PAG-ADV (BS broadcast paging) message

Insert the following text at the end of 6.3.2.3.51:

When MOB_PAG-ADV message is sent to M2M devices, the following TLV may be included:

M2M device group paging parameter TLV (see 11.17.5)

M2M device group paging parameter is a compound TLV that provides a group paging method of paging all M2M devices belonging to an M2M device group. Each M2M device group paging parameter TLV contains M2MCID TLV identifying an M2M device group paged and Action code TLV that identifies the operation of M2M devices after receiving the MOB_PAG-ADV. According to the value of Action code TLV, other TLVs (e.g., Multicast transmission start time TLV in Action code 0b10) may be included in this M2M device group paging parameter TLV.

When the MOB_PAG-ADV message is used to poll fixed M2M devices for periodic non-real time uplink data transmission, the following TLV may be included:

M2M report code (see 11.17.6)

Action instruction to M2M device:

One bit in TLV corresponds to one M2M device paged. Each bit set to 1 indicates for the M2M device to send the uplink report. The order of the assignments is the same as the order of appearance of MS MAC address in this message.

The following TLV may be included when paging an M2M device:

M2M Paging parameter (see 11.17.7)

The following TLV may be included when paging an M2M device:

Ranging backoff start (see 11.17.8)

Insert new subclause 6.3.2.3.99 as indicated:

6.3.2.3.99 MOB_MTE-IND (multicast transmission end indication) message

The BS shall send a MOB_MTE-IND message to a group of M2M devices to indicate the end of multicast transmission by using either broadcast manner or multicast manner. In case of broadcast manner, M2M management CID is used for sending the MOB_MTE-IND message and the MOB_MTE-IND message is not encrypted. If a MOB_MTE-IND message is multicast and the multicast SA is established for the group of these M2M devices, then the MOB_MTE-IND shall be encrypted using the established multicast SA (see 7.2.2.2.14 for details on encryption method). The PHY burst with the MAC PDU carrying the MOB_MTE-

IND message is indicated by the M2MCID in DL MAP. The CID field in the MAC PDU header is set to any M2MCID other than the M2MCIDs assigned to the M2M device and EC equal to zero or one indicates whether the MOB_MTE-IND message is encrypted or not. In case MOB_MTE-IND message is encrypted the multicast SA corresponding to the M2M device group identified by the M2MCID in DL MAP is used to decrypt the MOB_MTE-IND message. When an M2M device in idle mode receives the MOB_MTE-IND message, the M2M device may enter the paging unavailable interval as specified in 6.3.22.4.

Table 6-227a—MOB_MTE-IND message format

Syntax	Size (bits)	Notes
MOB_MTE-IND_Message_Format() {		
Management message type = 110	8	
Num_M2MCID	4	Number of M2MCID
for (*i*=0; *i*<Num_M2MCID; *i*++) {		
M2MCID	16	M2MCID related to the multicast traffic. The same M2MCID shall be used for the multicast service flow of all the M2M devices in the M2M device group.
}		
}		

Insert new subclause 6.3.2.3.100 as indicated:

6.3.2.3.100 MGMC (M2M group MAC control) message

The MGMC message may be sent to a group of M2M devices that belong to the same M2M device group (defined by an M2MCID) to indicate parameters and/or instructions. The BS may send the MGMC message to M2M devices in normal operation mode by using either broadcast manner or multicast manner. In case of broadcast manner, M2M management CID will be used for sending the MGMC message. If MGMC carries control information for one M2M device group and Multicast SA is established for that M2M Device Group, then the MGMC shall be encrypted using the established Multicast SA (see 7.2.2.2.14 for details on encryption method). The multicast PHY burst with the MAC PDU carrying the MGMC message intended for one M2M device group is indicated by the M2MCID in DL MAP. The CID field in the MAC PDU header is set to any M2MCID other than the M2MCIDs assigned to the M2M device and EC equals to zero or one indicates whether the MGMC message is encrypted or not. In case MGMC message is encrypted, the multicast

SA corresponding to the M2M device group identified by the M2MCID in DL MAP is used to decrypt the MGMC message.

Table 6-227b—MGMC message format

Syntax	Size (bit)	Notes
MGMC_Message_Format() {		
Management Message Type = 111	8	
Num_M2MCID	4	Number of M2MCID
for (*i*=1; *i* <= Num_M2MCID; *i*++) {		
M2MCID	16	
Action Code	2	Use to identify the purpose if this message 0b00: reassignment of M2MCID value 0b01–0b11: *Reserved*
If (Action Code == 0x00) {		
New M2MCID	16	New M2MCID value to be assigned
}		
}		
}		

Insert new subclause 6.3.2.3.101 as indicated:

6.3.2.3.101 MAMC (M2M ACK MAC control) message

The MAMC message may be sent by M2M devices to acknowledge the M2M Group MAC Control (MGMC) message reception. The MAMC message contains the M2MCID and Action Code values corresponding to the MGMC message that has been received.

Table 6-227c—MAMC message format

Syntax	Size (bit)	Notes
MAMC_Message_Format() {		
Management Message Type = 112	8	
M2MCID	16	
Action Code	2	Action Code of the MGMC message that has been received
}		

6.3.9 Network entry and initialization

6.3.9.5 Initial ranging and automatic adjustments

6.3.9.5.1 Contention-based initial ranging and automatic adjustments

Change the following paragraphs as indicated:

First, an SS shall synchronize to the DL and learn the UL channel characteristics through the UCD MAC management message. At this point, the SS shall scan the UL-MAP message to find an initial ranging interval. The BS shall allocate an initial ranging interval consisting of one or more transmission opportunities. For SC and OFDM PHY, the size of each transmission opportunity shall be as specified by the UCD TLV, Ranging Request Opportunity Size.

For SC and OFDM PHY, the SS shall put together a RNG-REQ message to be sent in an initial ranging interval. The duration of the burst carrying the RNG-REQ message shall be as specified in the Ranging Request Burst Size TLV (see 11.3.1). The CID field shall be set to the non-initialized SS value (zero). For the OFDM PHY, the initial ranging process may include a subchannelized mechanism specified in 8.3.7.2. For the OFDMA PHY, the initial ranging process shall begin by sending initial ranging CDMA codes on the UL allocation dedicated for that purpose (for more details see 6.3.10.3), instead of RNG-REQ messages sent on contention slots. When an M2M device attempts to enter or reenter the network and the network entry or reentry is not in response to paging (e.g., it may be triggered by an event), it shall apply a uniform random process to select the start time of network entry procedure from a window whose size is greater than or equal to the Minimum Access Window Size. The Minimum Access Window Size does not apply to the abnormal power down procedure, see 6.3.35.

An M2M device may perform ranging using the ranging backoff window start assigned in the MOB_PAG-ADV message. The assigned ranging backoff start shall be different from the one assigned by the UCD message. This ranging backoff start shall only be applied to the ranging performed in response to the MOB_PAG-ADV message.

6.3.14 Quality of service (QoS)

6.3.14.2 Service flows

Insert the following text at the end of 6.3.14.2:

M2M devices should set bit 6 to 1 in Idle Mode Retain Information in the DREG-REQ message.

6.3.22 MS idle mode (optional)

6.3.22.6 BS Broadcast Paging message

Insert the following text at the end of 6.3.22.6:

A MOB_PAG-ADV message with an M2M report code may be used to poll fixed M2M devices for periodic non-realtime uplink data transmission. If an M2M device receives the DREG-CMD message with the Transmission Type set to 1 and Max number of paging cycle TLV during idle mode entry, the M2M device shall wait for a MOB_PAG-ADV with an M2M report code as long as Max number of paging cycle $\times$ length of paging cycle before sending uplink data. If the M2M device does not receive at least one MOB_PAG-ADV with an M2M report code within Max number of paging cycle $\times$ length of paging cycle, it may send the uplink data without receiving MOB_PAG-ADV with an M2M report code.

Group paging may be used for M2M devices. For this, M2MCID defined in 6.3.1 may be included in a paging message instead of an individual identifier to identify the group of M2M devices. The M2M device follows the paging cycle as defined in 6.3.22.5 for monitoring both individual and group paging.

Insert new subclause 6.3.22.11 as follows:

6.3.22.11 MS idle mode for M2M application

A M2M device-specific Idle mode timer may be assigned to an M2M device during idle mode initiation. In this case, the DREG-CMD message shall include a M2M device-specific Idle mode timer as defined in 11.14.1. The network entity administering idle mode activity for the M2M device shall maintain an idle mode system timer corresponding to the M2M device-specific Idle mode timer to retain the M2M device's service and operational information. When the M2M device receives the DREG-CMD message with an M2M device-specific Idle mode timer, the M2M device shall periodically 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 shall be restarted.

Insert new subclause 6.3.22.11.1 as follows:

6.3.22.11.1 Network reentry from idle mode for M2M devices

The BS may assign M2M specific ranging resources, including ranging code and ranging opportunity, dedicated for M2M devices. See 8.4.5.4.33 and 11.3.1, Table 11-12. In this case, M2M devices shall perform ranging for network (re)entry using the dedicated ranging resources. If the BS does not assign dedicated ranging resources, M2M devices shall perform ranging for network (re)entry using the ranging resources defined as specified in 6.3.10.3. The BS may restrict ranging access from M2M devices by transmitting a M2M Ranging Allocation UL-MAP Extended IE with the access restriction indicator set to 1. If M2M devices receive a M2M Ranging Allocation UL-MAP Extended IE with the access restriction indicator set to 1, they shall not perform initial ranging for network reentry to this BS in the frame to which the UL-MAP is relevant. The M2M devices may perform reselection of preferred BS or may resume initial ranging in the frames without the M2M Ranging Allocation UL-MAP Extended IE with the access restriction indicator set to 1. When the BS transmits a M2M Ranging Allocation UL-MAP Extended IE with the access restriction indicator set to 0, the BS shall also transmit a UL-MAP IE with UIUC=12 identifying the same region as the M2M Ranging Allocation UL-MAP Extended IE with the dedicated ranging indicator set to 1. When the BS transmits a M2M ranging region TLV in UCD, the BS shall also assign a ranging region TLV in UCD identifying the same region as the M2M ranging region TLV in UCD and with the dedicated ranging indicator set to 1.

During paging, a BS may assign a new ranging backoff start to M2M devices by a MOB_PAG-ADV message. If M2M devices receive MOB_PAG-ADV message, which includes ranging backoff start TLV, they shall use the ranging backoff start TLV included in the MOB_PAG-ADV message to determine initial backoff window for initial ranging during network reentry or location update. The assigned new M2M device specific ranging backoff start shall be different from one assigned by the UCD message and shall only be applied to the ranging process that is in response to the MOB_PAG-ADV message.

For individual paging, the dedicated ranging opportunities can be assigned by the BS to the M2M devices by using the TLV for CDMA code and transmission opportunity assignment in the MOB_PAG-ADV message, as specified in 6.3.2.3.51 and 11.17.1.

The BS may indicate an M2M network access type TLV for M2M device in MOB_PAG-ADV message.

If the M2M network access type TLV is set to '0b00', the M2M device does not need to send initial ranging code. When the M2M device receives group paging message (i.e., the MOB_PAG-ADV with M2MCID TLV) and M2M network access type TLV (i.e., 0: Resource allocation for RNG-REQ), it starts to monitor

the UL-MAP IE containing a Fast Ranging IE to obtain the resource of RNG-REQ message at "UL MAP start offset for RNG-REQ" during the "Resource monitor timer". "Resource monitor timer" starts in the frame where the M2M device expects to receive the Fast Ranging IE. If the M2M device does not decode the Fast Ranging IE until the expiration of the "Resource monitor timer", it performs ranging for network reentry using the ranging resources defined as specified in 6.3.10.3.

When the M2M device receives individual paging message (i.e., the MOB_PAG-ADV with MAC address hash) and M2M network access type TLV (i.e., 0b00: Resource allocation for RNG-REQ), it decodes the UL-MAP IE containing a Fast Ranging IE to obtain the resource of RNG-REQ message at "'UL-MAP offset for RNG-REQ" and shall proceed to send a unicast RNG-REQ on the allocated bandwidth. Timer T55 starts in the frame where the M2M device expects to receive the Fast Ranging IE. Upon expiration of this timer, the M2M device shall not expect the BS to grant an UL allocation via the Fast Ranging IE and shall perform ranging for network reentry using the ranging resources defined as specified in 6.3.10.3.

If the M2M device receives individual paging message (i.e., the MOB_PAG-ADV with MAC address hash) and the M2M network access type TLV is set to "0b01", the BS shall allocate the dedicated M2M ranging channel for M2M devices paged in the MOB_PAG-ADV message. The M2M device can find the dedicated CDMA code assignment and transmission opportunity offset in the "CDMA code and transmission opportunity assignment" TLV of the MOB_PAG-ADV message for ranging.

If the M2M device receives individual paging message (i.e., the MOB_PAG-ADV with MAC address hash) and the M2M network access type TLV is set to "0b10", the BS shall allocate the dedicated ranging region specific for paged M2M devices in UL-MAP Extended IE message.

If the M2M device receives individual paging message (i.e., the MOB_PAG-ADV with MAC address hash) and the M2M network access type TLV is set to "0b11", M2M device can only use the normal ranging channel.

During network reentry, the M2M device may request UL BW without a contention-based bandwidth request by including M2M Bandwidth Request combined with the related SFID in an RNG-REQ message. If a BS receives the RNG-REQ message with an M2M Bandwidth Request, the BS may accept or reject the bandwidth request, and send an indication in RNG-RSP message. If the BS accepts the bandwidth request, the BS will allocate UL bandwidth to the M2M device once it is back in normal operation. This M2M Bandwidth Request in RNG-REQ message should be used only for M2M urgent data transmission.

Insert new subclause 6.3.22.11.2 as follows:

6.3.22.11.2 Idle mode optimizations for fixed M2M devices

Localized idle mode operation is used for fixed M2M devices in idle mode that do not need to perform the BS paging group based paging operation and location update operation. To eliminate the need for allocating the unnecessary paging information (i.e., Paging Group ID, Paging Controller ID), a fixed M2M device may set the Localized_Idle_Mode flag to 1 in the DREG-REQ message.

Localized idle mode for the fixed M2M device is initiated either by the M2M device or by its serving BS.

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 DREG-REQ message.

When a BS receives a DREG-REQ message with the Localized_Idle_Mode flag set to 1 from an M2M device, it sends DREG-CMD with Localized_Idle_Mode flag set to 1 or 0. Localized_Idle_Mode flag set to 1 indicates that the BS accepts the M2M device's localized idle mode operation request. In this case, the BS shall not include Paging Controller TLV in the DREG-CMD message and the M2M device shall use the

current serving BS as its preferred BS. Then the M2M device transitions to idle mode and does not perform BS paging group based paging operation and location update operation.

If Localized_Idle_Mode flag is set to 0 in the DREG-CMD message, the M2M device enters into the idle mode excluding the procedures in 6.3.22.11.2.

Using BS-initiated localized idle mode entry, a BS may signal for a fixed M2M device to begin localized idle mode by sending a DREG-CMD message in unsolicited manner. This unsolicited DREG-CMD may include Localized_Idle_Mode_flag set to 1. When a fixed M2M device receives an unsolicited DREG-CMD with Localized_Idle_Mode_flag set to 1, the fixed M2M device may start the idle mode initiation procedures by sending DREG-REQ message with Localized_Idle_Mode_flag set to 1 or 0 in response to the unsolicited DREG-CMD message. Localized_Idle_Mode_flag set to 1 in the DREG-REQ indicates that the M2M device accepts the BS's localized idle mode operation request. If Localized_Idle_Mode_flag is set to 0 in the DREG-REQ, it indicates that the M2M device does not accept the BS's localized idle mode operation request. The detail initiation procedure according to the action code follows the mechanism defined in 6.3.22.1.

Insert new subclause 6.3.22.11.3 as follows:

6.3.22.11.3 Network reentry for M2M group

In order to reduce network congestion produced by a large number of M2M devices, network reentry may be initiated as a group of M2M devices. M2M devices in an M2M device group are called as group member (GM). An M2M device in a group that is authorized to act as representative for this M2M device group is called as a group delegate (GD). A GD initiates the first ranging access for this M2M device group. A BS assigns a dedicated ranging code to a GD. When M2M devices in an M2M device group are expected to transmit UL data, the group delegate selects a ranging code from a ranging code set based on M2MCID and transmits the selected ranging code to a BS. On receiving this ranging code, the BS sends a RNG-RSP message in response, which includes one of three ranging status (success, abort, and continue) for the group. All group members shall receive ranging status response to the dedicated ranging code transmitted by the GD in RNG-RSP message. There are three possible ranging status responses from the BS provided in the RNG-RSP message. They are as follows:

— If ranging status is "success", all GMs in this group start its network reentry procedure by transmitting a ranging code. The GMs may select a ranging code from legacy ranging code set or a new ranging code set dedicated for M2M devices. The GMs may also select a ranging channel from legacy ranging channels or new ranging channels dedicated for M2M devices. 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 GMs in this group shall start the ranging abort timer and abort the ranging process until the ranging abort timer expires. After abort timer expires, all M2M devices in this group shall restart the ranging process as done on the first entry defined in this subclause.

— If ranging status is "continue", the GD in this group shall adjust its parameters accordingly and continue the ranging process.

Upon detection of an event specific for a group (i.e., M2MCID), the GMs of this group shall start the T32 timer. Within the T32 timer the GMs of this group await the RNG-RSP message transmitted by a BS in response to the ranging code sent by this group's GD. If GMs receive the RNG-RSP message, every GM initiates further action for network reentry. If GMs do not receive the RNG-RSP message within the duration of T32, the GMs perform voluntary network reentry upon expiry of T32 timer.

Insert new subclause 6.3.22.11.3.1 as follows:

6.3.22.11.3.1 Selection of M2M group delegate

M2M group delegate selection should be supported by both fixed and mobile devices that support group delegate function, and the selection rule is described as follows.

When members of an M2M group need to report UL data, each member of the group should receive the value of a random selection probability, θ, from broadcast message UCD, and every member should compare the value of θ with a self-generated random number *m*.

If $m \leq \theta$, the device is designated as group delegate.

If $m > \theta$, the device cannot be designated as group delegate.

The designated group delegate should choose a certain frame based on M2MCID, and then send dedicated ranging code to BS in this frame. If the group delegate receives "continue" or "abort" instructions from the information in RNG-RSP message for the dedicated ranging code it has sent for this group, it should continue to act as a group delegate. If the group delegate receives "success" instructions from the information in RNG-RSP message for the dedicated ranging code it has sent for this group, it should resign from the position of group delegate and begin to act as an ordinary group member.

If group member cannot receive any information in RNG-RSP message for dedicated ranging code for this group, the BS may have failed to detect the dedicated ranging code for this group. In this case, the BS should increase the value of θ, and the selection procedure elaborated above should be repeated.

The value of θ is broadcasted by the BS via the broadcast message (UCD). The BS also controls the variety of θ, the value of which remains fixed during the interval between two UCD messages. M2M device calculates the random data and probability based on the following equation:

$$\mathrm{Yrand} = (\mathrm{Xrand} \times m + n) \bmod \mathrm{j}$$

Both *m* and *n* are integers, and one of these two parameters has to be a prime number; j is the max of Y_{rand} and prime number; $2^{16} - 15 = 65521$;

$$P_{selection} = \mathrm{Yrand} / \mathrm{j}$$

Insert new subclause 6.3.22.11.3.2 as follows:

6.3.22.11.3.2 Dedicated Ranging codes and ranging channel set for M2M group

When a M2M group is expected to report their data, the group delegate of the group selects a ranging code from the ranging code set based on M2MCID and transmits the selected ranging code to BS.

The calculation equation for selection of dedicated ranging code is as follows:

$$\Gamma_{\text{dedicated ranging code}} = \mathrm{mod}(\mathrm{floor}(\mathrm{M2MCID}/\mathrm{M}), N_{\text{M2M group}})$$

The next $N_{\text{M2M group}}$ codes are produced for dedicated ranging code of M2M group network reentry based on group delegate. Clock the PRBS generator 144 ((H + I + J + K + N + M + L + O + S) mod 256) times to 144 ((H + I + J + K + N + M + L + O + S + $N_{\text{M2M group}}$) mod 256) – 1 times. $N_{\text{M2M group}}$ is the total number of the available additional RP codes set for M2M group ($N_{cont} + N_{dedi} \sim N_{cont} + N_{dedi} + N_{\text{M2M group}} - 1$) where maximum possible $N_{\text{M2M group}}$ per sector is 256.

$$\mathrm{mod}(\mathrm{M2MCID},\mathrm{M}) - \mathrm{mod}(\mathrm{C},\mathrm{M}) = 0$$

$$M = \lfloor M2MCID_{total} \times \alpha_{multiplexing\ factor\ of\ dedicated\ ranging\ code} / N_{M2M\ group} \rfloor$$

M is required resource of time domain (ranging channel). $\alpha_{multiplexing\ factor\ of\ dedicated\ ranging\ code}$ can be carried in MGMC message. C is frame number with ranging opportunity. $M2MCID_{total}$ is the total number of M2MCID.

Insert new subclause 6.3.22.11.4 as follows:

6.3.22.11.4 Location update for M2M devices

Insert new subclause 6.3.22.11.4.1 as follows:

6.3.22.11.4.1 Location update conditions

An M2M device in idle mode may also perform location update when it detects that an M2M GROUP ZONE ID of the selected preferred BS is changed.

Insert new subclause 6.3.22.11.4.1.1 as follows:

6.3.22.11.4.1.1 M2M Group Zone based update

An M2M device shall perform a Location Update process when an M2M device detects that the selected preferred BS does not support its currently assigned M2M GROUP ZONE ID. The M2M device shall detect this by monitoring M2M GROUP ZONE ID in the DCD message, which is transmitted by the preferred BS. During location update, M2M device's M2MCIDs may be updated.

Insert new subclause 6.3.34 as follows:

6.3.34 Support of multicast operation for M2M applications

A BS may provide a multicast service for group of M2M devices that share a downlink multicast service flow. The BS shall initiate the establishment of a service flow using the DSA procedures. During the establishment of the service flow, the service flow is assigned an M2MCID, which uniquely identifies the service flow. The M2M device shall retain these identifiers in idle mode (see 6.3.1). The BS shall provide the mapping between the service flow and the M2MCID during the DSA signaling and may modify this mapping using the DSC procedures or by using M2MCID Update TLV during network reentry.

Insert new subclause 6.3.34.1 as follows:

6.3.34.1 M2M multicast operation in idle mode

A BS may provide a multicast service for M2M devices in idle mode with or without requiring network reentry of the M2M devices. Before a BS sends DL multicast data, the BS shall transmit the paging message including the multicast traffic indication to the 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 and the paging message does not include the Multicast transmission start time TLV, the M2M device shall start receiving the DL multicast data without the idle mode termination.

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

When the multicast data transmission ends, the BS shall notify the end of multicast data transmission to the group of M2M devices by sending the MOB_MTE-IND message. Upon receiving the MOB_MTE-IND message, the M2M devices may enter the paging unavailable interval as specified in 6.3.22.4.

In order to receive the M2M multicast data during idle mode M2M devices in idle mode shall use M2M Multicast Traffic Reception timer. If Multicast transmission start time TLV is included in the MOB_PAG-ADV message indicating the multicast traffic reception (Action code = 0b10), M2M devices receiving the MOB_PAG-ADV message shall start the Multicast Traffic Reception timer at the frame indicated by the Multicast transmission start time TLV. Otherwise, the M2M device shall start the Multicast Traffic Reception timer when the M2M device receives the MOB_PAG-ADV. The M2M device shall reset this timer whenever the multicast data is received and stop the timer when it receives the MOB_MTE-IND message. If the M2M Multicast Traffic Reception timer expires, the M2M device shall enter the paging unavailable interval as specified in 6.3.22.4.

Insert new subclause 6.3.35 as follows:

6.3.35 Abnormal power down

When an abnormal or involuntary power down has occurred, an M2M device may attempt to report the abnormal power down event.

Insert new subclause 6.3.35.1 as follows:

6.3.35.1 Abnormal power down reporting in normal operation

If the M2M device is in normal operation with uplink bandwidth already allocated and available, then it may use the available bandwidth to send an M2M Abnormal Power Down Report header (as defined in 6.3.2.1.2.2.3.1).

If the M2M device 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 M2M Abnormal Power Down Report header.

The M2M device may start its Abnormal Power Down Confirmation timer at the transmission of the M2M Abnormal Power Down Report header in order to wait for Abnormal Power Down Confirmation signaling header. If the M2M device has not received the M2M Abnormal Power Down Confirmation header until the Abnormal Power Down Confirmation timer expires, it may restart the abnormal power down reporting procedure.

Insert new subclause 6.3.35.2 as follows:

6.3.35.2 Abnormal power down reporting in idle mode

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 BS shall select a ranging opportunity within a backoff window starting at the next frame. The M2M device shall set the backoff 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 $t = 1, \ldots, b$, within the backoff window according to the following 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 10-1). At the selected ranging

opportunity, the M2M device shall transmit the Abnormal Power Down Ranging Code, which is also a configurable system parameter (see Table 10-1).

The BS, upon receiving the ranging code, may include a CDMA Allocation IE in the next frame identifying the M2M device and provide an allocation sufficiently large to allow the M2M device to transmit a RNG-REQ message including a Ranging Purpose Indication TLV and the CMAC/HMAC Tuple. Upon receiving this allocation, the M2M device shall transmit a RNG-REQ message including a Ranging Purpose Indication TLV with bits 5–7 set to 001 (power outage) and a valid HMAC/CMAC Tuple. The M2M device shall not repeat sending of a ranging code if it does not receive an allocation from the BS.

If the target BS evaluates the HMAC/CMAC Tuple as valid and can supply a corresponding authenticating HMAC/CMAC Tuple, then the target BS may reply with a RNG-RSP message including the Location Update Response TLV and HMAC/CMAC Tuple completing the abnormal power down reporting process.

Insert new subclause 6.3.36 as follows:

6.3.36 M2M Short Data Burst transmission

If an M2M device receives a bandwidth allocation that is sufficient for piggybacking M2M Short Data Burst contents in a RNG-REQ message during network reentry, it may send the RNG-REQ message with a piggybacked M2M Short Data Burst with SFID for Short Data Burst.

If the data is received successfully, the BS shall send a RNG-RSP message with an M2M Short Data Burst Confirmation TLV. This concludes the Short Data Burst transaction.

If an M2M device receives a bandwidth allocation that is not sufficient for piggybacking M2M Short Data Burst contents, it may include an M2M Bandwidth Request combined with the related SFID in a RNG-REQ message during network reentry. If the allocation allows for it, it may additionally include the Bandwidth Request Size in the RNG-REQ message. If the BS receives the RNG-REQ message with an M2M Bandwidth Request, the BS shall include M2M Bandwidth Request ACK in the RNG-RSP message. If the BS accepts the bandwidth request, the BS shall allocate UL bandwidth to the M2M device after network reentry completion.

To transmit short data DL bursts, the BS may include an M2M Short Data Burst TLV in a RNG-RSP message when the action code of MOB_PAG-ADV indicates location update.

For DL short data burst transmission, the BS should send a Basic CID and a Temp CID Timer in a RNG-RSP message. When the M2M device successfully receives a RNG-RSP message with an M2M Short Data Burst, a Basic CID, and the Temp CID Timer, it shall set T3 timer (see Table 10-1) and wait for bandwidth allocation on the Basic CID. If UL bandwidth is allocated before expiration of T3 timer, the M2M device transmits a RNG-REQ message containing an M2M Short Data Burst Confirmation TLV. If T3 timer expires, the M2M device shall perform bandwidth request procedure to transmit a RNG-REQ message containing an M2M Short Data Burst Confirmation TLV.

7. Security sublayer

7.2.2.2.10 Key hierarchy

Insert the following text at the end of the 7.2.2.2.10:

Figure 7-8a outlines the M2M multicast authentication key hierarchy starting from the MAK.

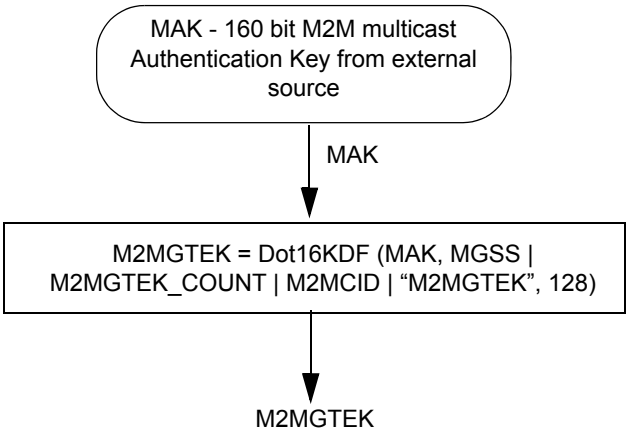

Figure 7-8a—M2MGTEK derivation from MAK

Insert new subclause 7.2.2.2.14 as follows:

7.2.2.2.14 M2M Group Traffic Encryption Key (M2MGTEK)

The M2MGTEK, which is shared among all M2M devices that belong to the multicast group, is used to encrypt data packets of the multicast service flow. MGTEK is also used to encrypt MAC management message transmitted to a group of M2M devices.

The M2MGTEK is generated based on the MAK, M2M service Group Security Seed (MGSS), M2MCID, and the M2MGTEK_COUNT. The generation and transport of the MAK is outside the scope of IEEE Std 802.16. It is provided through means defined at higher layers.

The M2MGTEK is derived as the following:

M2MGTEK <= Dot16KDF(MAK, MGSS | M2MGTEK_COUNT | M2MCID | “M2MGTEK”, 128)

— Here, the MAK is generated by network side, which is outside the scope of IEEE Std 802.16.

— Here, MGSS is a M2M service Group Security Seed that is common for a M2M device group.

— Here, the M2MGTEK_COUNT indicates the index of the currently used M2MGTEK, which the M2M devices should apply to derive the M2MGTEK. The update of the M2MGTEK depends on the M2MGTEK_COUNT.

— Here, M2MCID is the M2M device group ID.

The M2MGTEK is updated when the 3 MSB of ROC concatenated with the frame number reaches 0x7FFFFF or an M2M device of the M2M device group cancels its subscription. In case the 3 MSB of ROC concatenated with the frame number reaches 0x7FFFFF, the current M2MGTEK_COUNT is incremented by one by which the M2M devices perform local derivation to derive the new M2MGTEK.

If an M2M device cancels subscription from a group, the BS shall transmit a newly generated MGSS to each M2M device in the group via the unsolicited PKM-RSP message and initialize the M2MGTEK_COUNT. The MGSS value shall be encrypted within the PKM-RSP message. The BS shall exclude the unsubscribed M2M device from such security context update. For M2M devices in connected mode, the BS shall send the new security context via the unsolicited PKM-RSP message. For M2M devices in idle mode, the BS shall page the entire group (i.e., M2MCID) via the MOB_PAG-ADV message with "Action Code" set to 0b10. For each M2M device that successfully performed network reentry, the BS shall send an unsolicited PKM-RSP message including the new MGSS.

When the M2MCID update is triggered and a new M2MCID is provided to M2M devices in the M2M device group (see 6.3.1 for M2MCID update triggers and method to assign new M2MCID), the M2MGTEK_COUNT is initialized. A new MGTEK is generated with the new M2MCID and the M2MGTEK_COUNT.

The M2M device may request current M2MGTEK parameters by transmitting a PKM-REQ message to the BS. Here, the M2M device shall include its M2MCID. After authenticating the M2M device, the BS shall respond with the current MGSS and the M2MGTEK_COUNT that are in use via the PKM-RSP message.

Every M2M device that receives a PKM-RSP message with the new MGSS for updating the M2MGTEK shall respond with a PKM-REQ message for successful update acknowledgement.

Insert new subclause 7.2.2.2.14.1 as follows:

7.2.2.2.14.1 Encrypted M2M multicast MPDU format

Unique initial counter and M2MGTEK 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 M2MGTEK. The first three most significant bits of the ROC is the rollover counter for the frame number, i.e., when the frame number reaches 0x000000 (from 0xFFFFFF) it is incremented by 1 mod 8. The five 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 M2MGTEK have the same ROC value.

Using this method, up to 32 PDUs per frame using the same M2MGTEK can be supported. A new encryption key (M2MGTEK) is required every $2^3 \times 2^{24} = 2^{27}$ 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 M2M device and the BS shall ensure that a M2MGTEK_COUNT is incremented by one, and a new M2MGTEK 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 7-3a.

A 32-bit nonce NONCE = n0 | n1 | n2 | n3 is made of ROC and 24 bits frame number (see Table 7-3a). 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.

Table 7-3a—Construction of 32-bit nonce

Byte number	0	1 3
Field	ROC	Frame number
Contents	ROC	24 bits of frame 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 M2MGTEK.

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 7-8b.

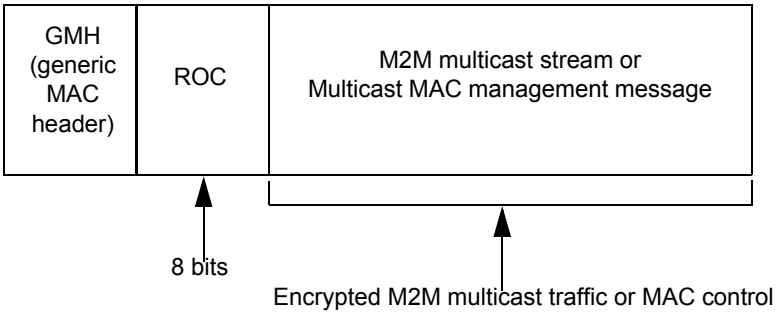

Figure 7-8b—M2M multicast MAC PDU ciphertext payload format

Insert new subclause 7.10 as follows:

7.10 M2M device validity check

An M2M device that has device validity checking implemented and has failed its validity test shall refrain from accessing the network. During the PKM exchange an EAP based authentication procedure (IETF RFC 3748) may be used to carry a device validity certificate to the network.

8. Physical layer (PHY)

8.4.5.4.4 UL-MAP Extended IE

8.4.5.4.4.1 UL-MAP Extended IE format

Change Table 8-177 as indicated:

Table 8-177—Extended UIUC code assignment for UIUC = 15

Extended UIUC (hexadecimal)	Usage
0x0	Power Control IE
0x1	*Reserved*
0x2	AAS UL IE
0x3	CQICH Allocation IE
0x4	UL Zone IE
0x5	UL-MAP Physical Modifier IE
0x6	*Reserved*
0x7	UL-MAP Fast Tracking IE
0x8	UL PUSC Burst Allocation in Other Segment IE
0x9	Fast Ranging IE
0xA	UL Allocation Start IE
0xB	UL Burst Receive IE
0xC	Dedicated Ranging Channel for M2M IE
0x~~C~~D ... 0xF	*Reserved*

Insert new subclause 8.4.5.4.33 as indicated:

8.4.5.4.33 M2M Ranging Allocation UL-MAP Extended IE format

The M2M Ranging Allocation UL-MAP Extended IE is used to indicate if the allocated ranging channel is used for M2M devices or to restrict new ranging accesses from M2M devices.

Table 8-225a—M2M Ranging Allocation UL-MAP Extended IE format

Syntax	Size (bit)	Notes
M2M Ranging Allocation UL-MAP Extended IE(){	—	—
Extended UIUC	4	M2M Ranging Allocation UL-MAP Extended = 0xC
Length	4	Length is 2 or 6
Access restriction indicator	1	When this bit is set to 1, it indicates that M2M devices are not allowed to access this BS. When this bit is set to 0, this IE specifies the ranging allocation for M2M devices.
Padding	7	Set to 0 for byte alignment
If (Access restriction indicator == 0) {		
OFDMA Symbol offset	8	—
Subchannel offset	7	—
No. OFDMA Symbols	7	—
No. Subchannels	7	—
Ranging Method	2	0b00: Initial ranging/Handover Ranging over two symbols 0b01: Initial ranging/Handover Ranging over four symbols 0b10–0b11: *Reserved*
Dedicated ranging indicator	1	0: The OFDMA region and ranging method defined are used for the purpose of normal ranging 1: The OFDMA region and ranging method defined are used for the purpose of ranging using dedicated CDMA code and transmission opportunities assigned in the MOB_PAG-ADV message
}		
}		

10. Parameters and constants

10.1 Global values

Change the contents of Table 10-1 as indicated:

Table 10-1—Parameters and constants

System	Name	Time reference	Minimum value	Default value	Maximum value
SS, MS	T3	Ranging response reception timeout following the transmission of a ranging request	—	OFDMA: 60 msec: RNG-RSP after CDMA ranging or RNG-REQ during initial or periodic ranging ... 100 ms: 1) RNG-RSP after RNG-REQ following usage of Initial Ranging Code set 1 during initial ranging, 2) RNG-RSP after RNG-REQ following usage of HO Ranging code set 1 or 2 during handover to negotiated target BS, or 3) RNG-RSP after RNG-REQ on the Primary Management Connection during initial ranging/handover to negotiated target BS /location update/ reentry from idle mode. 30 msec: UL bandwidth allocation for RNG-REQ after receiving RNG-RSP during M2M small burst transmission.	200 ms
M2M device	T32	RNG-RSP reception timeout following the transmission of a ranging preamble code sent by a group delegate.	—	—	—

Table 10-1—Parameters and constants *(continued)*

System	Name	Time reference	Minimum value	Default value	Maximum value
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 Mode. Refer to 6.3.35.2.	—	—	—
M2M device, BS	Abnormal Power Down Ranging Code	Ranging code used to indicate an abnormal power down event. Refer to 6.3.35. This code is selected from the initial ranging code set.	—	—	—
M2M device	Abnormal Power Down Confirmation timer	Abnormal power down confirmation reception timeout following the transmission of an abnormal power down report.	—	50 msec	—

10.4 Well-known addresses and identifiers

Change the contents of Table 10-5 as indicated:

Table 10-5—CIDs

CID	Value	Description
Transport, Secondary Man-agement, Tunnel or Manage-ment Tunnel, Multicast management CID	2*m*+1– ~~*n*0xFE9F~~	For the secondary management connection, the same value is assigned to both the DL and UL connection. Tunnel CID is used for tunnel transport connections. Management Tunnel CID is used for tunnel management connections. Multicast management CID is used for the downlink multicast management services.
M2MCID	*n* + 1 – 0xFE9E	M2M multicast connection identifiers.
M2M management CID	0xFE9F	Used in DL-MAP to denote bursts for transmission of DL broadcast information to M2M devices. May also be used in MOB_MTE-IND/MGMC messages.

11. TLV encodings

11.1.8.3 Paging information

Change the contents of the table in 11.1.8.3 as indicated:

Type	Length	Value	Scope
134	7	Bits 0–15: PAGING_CYCLE—Cycle in which the paging message is transmitted within the paging group. Bits 16–31: PAGING_OFFSET—Determines the frame within the cycle from which the paging interval starts. Shall be smaller than PAGING_CYCLE value. Bits 32–47: Paging-group-ID—ID of the paging group to which the MS is assigned. Reserved and set to 0 if M2M device is in Localized Idle Mode or Localized_Idle_Mode flag is set to 1. Bits 48–55: Paging Interval Length—Max duration in frames of Paging Listening interval. Used in calculation of Paging listening interval; value shall be between 1 and 5 frames (default=2).	RNG-RSP DREG-CMD

11.3 UCD management message encodings

11.3.1 UCD channel encodings

Insert the following parameter at the end of Table 11-12 as indicated:

Table 11-12—UCD channel encodings

Name	Type (1 byte)	Length	Value
M2M Ranging Region	31	6/12	The value of TLV consists of up to two concatenated sections (one section per Ranging method), each having the following structure: Bit 0: dedicated ranging indicator, indicating an M2M ranging region allocated for M2M devices only Bits 1–2: ranging method Bits 3–9: num subchannels Bits 10–16: num OFDMA symbols Bits 17–23: subchannel offset Bits 24–31: OFDMA symbol offset Bits 32–34: Parameter d that defines periodicity of 2^d frames Bits 35–39: Allocation phase expressed in frames, $0 \le \text{Allocation Phase} < periodicity (= 2^d)$ Bits 40–47: *Reserved*

11.3.1.1 Uplink burst profile encodings

Change the contents of Table 11-18 as indicated:

Table 11-18—UCD PHY-specific channel encodings—WirelessMAN-OFDMA

Name	Type (1 byte)	Length	Value
Start of ranging codes group	155	1	Indicates the starting number, S, of the group of codes used for this UL. If not specified, the default value shall be set to zero. All the ranging codes used on this UL shall be between S and ((S+O+N+M+L+K+J+I+H+G+F+$N_{M2Mgroup}$) mod 256) where N is the number of initial ranging codes M is the number of periodic ranging codes L is the number of BR codes O is the number of HO ranging codes K is the number of Initial ranging codes in Initial Ranging Code set 1 J is the number of BR ranging codes in BR Ranging Code set 1 I is the number of HO ranging codes in HO Ranging Code set 1 H is the number of HO ranging codes in HO Ranging Code set 2 G is the number of RS initial ranging codes F is the number of RS dedicated codes $N_{M2Mgroup}$ is the number of M2M group dedicated codes The range of values is $0 \leq S \leq 255$
Dedicated codes set for M2M group	225	1	Number of dedicated codes for M2M group. Possible values are 0–255. Default value is 0
Probability threshold of M2M group delegate selection	226	2	Bits 0–9: Probability threshold Value of quantized in 0.001 steps as from 0 to 1. Bits 10–15: *Reserved*
Multiplexing factor of dedicated ranging code	228	1	Bits 0–2: 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 Bits 3–7: *Reserved*

11.4 DCD management message encodings

11.4.1 DCD channel encodings

Change the contents of Table 11-19 as indicated:

Table 11-19—DCD channel encodings

Name	Type (1 byte)	Length	Value (variable length)	PHY scope
M2M GROUP ZONE ID	158	2	This parameter is applied only for M2M applications Bits 0–14: M2M group zone identifier Bit 15: *Reserved*	OFDMA

11.5 RNG-REQ management message encodings

Change the contents of Table 11-26 as indicated:

Table 11-26—RNG-REQ message encodings

Name	Type (1 byte)	Length	Value (variable length)	PHY scope
Ranging Purpose Indication	6	1	Bit 0: HO indication (when this bit is set to 1 in combination with other included information elements indicates the MS is currently attempting to HO or network reentry from idle mode to the BS) Bit 1: Location update request (when this bit is set to 1, it indicates MS action of idle mode location update process) Bit 2: Seamless HO indication (when this bit is set to 1 in combination with other included information elements indicates the MS is currently initiating ranging as part of the seamless HO procedure) Bit 3: Ranging Request for Emergency Call Setup (when this bit is set to 1, it indicates MS action of Emergency Call Process) Bit 4: MBS update. When this bit is set to 1, the MS is currently attempting to perform location update due to a need to update service flow management encodings for MBS flows. Bit 5: Network Reentry from idle mode of MS which has entered idle mode in AAI-only ABS Bit~~s~~ 6~~–7~~: *Reserved* Bit 7: Abnormal Power Down Indication. When this bit is set to 1, M2M device indicates that an abnormal or involuntary power down occurs.	—
M2M Short Data Burst	38	*variable*	M2M Short Data Burst message content up to 140 bytes Padding bits to align boundary of byte.	OFDMA
M2M Short Data Burst Confirmation	39	1	Bit 0: Short Data Burst confirmation 0—NACK 1—ACK Bits 1–7: *Reserved*	OFDMA
Ranging Retries	40	1	The number of ranging retries in this ranging process Bits 0–1: Indicates the number of retries 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	OFDMA
MIMO feedback information	41	1	Bit 0: Matrix indicator. This field suggests the preferred STC/MIMO matrix for the M2M device: 0b0: Matrix A 0b1: Matrix B Bits 1–4: DL effective CINR as defined in Table 8-332 Bits 5–7: *Reserved*	All

Table 11-26—RNG-REQ message encodings *(continued)*

Name	Type (1 byte)	Length	Value (variable length)	PHY scope
M2MCID Update Acknowledgement Indicator	42	1	Bit 0: set to 1 to indicate that new M2MCID was received Bits 1–7: *Reserved*	OFDMA
M2M Bandwidth Request	43	2	Bits 0–10: BR size Bits 11–15: *Reserved*	OFDMA
SFID	44	4	—	OFDMA

M2MCID update request	45	Variable 3+ 2* Num M2MCID	Bits 0–15: current M2M GROUP ZONE ID
			Bits 16–19: Num_M2MCID
			Bits 20–23: *reserved*
			for(*i*=0; *i*<Num_M2MCID; *i*++) {
			current M2MCID value (16 bits)
			}
				OFDMA

11.6 RNG-RSP management message encodings

Change the contents of Table 11-29 as indicated:

Table 11-29—RNG-RSP message encodings

Name	Type (1 byte)	Length	Value (variable length)	PHY scope
...	...	...	...	...
Temp CID Timer	46	1	Life time duration for the Basic CID assigned by BS	OFDMA
M2M Short Data Burst Confirmation	47	1	Bit 0: Short Data Burst confirmation b0—NACK b1—ACK Bits 1–7: *Reserved*	OFDMA
M2M Short Data Burst	48	*variable*	M2M Short Data Burst message content up to 140 bytes Padding bits to align boundary of byte.	OFDMA

M2MCID Update	49	*variable* 1 + 12 * (Num_M2MCID)	Bits 0–3: Num_M2MCID
			Bits 4–7: *reserved*
			for(*i*=0; *i*<Num_M2MCID; *i*++) {
			current M2MCID value (16 bits)
			new M2MCID value (16 bits)
			new MGSS (64 bits)
			}
				OFDMA

M2M Bandwidth Request ACK	50	1	Bit 0: 0b0: accept bandwidth request 0b1: reject bandwidth request Bits 1–7: *Reserved*	OFDMA

11.7 REG-REQ/RSP management message encodings

Insert new subclause 11.7.26 as follows:

11.7.26 GD scheme support

The GD scheme support field indicates the availability of M2M device and BS support for GD (Group delegate) scheme.

Type	Length	Value	Scope
56	1	0: Not support GD scheme 1: Support GD scheme 2–255: *Reserved*	REG-RSP

11.9 PKM-REQ/RSP management message encodings

Change the contents of Table 11-36 as indicated:

Table 11-36—PKM attribute types

Type	PKM attribute
...	...
47	GKEK-Parameters
48	MIH Cycle
49	MIH Delivery Method and Status Code
53	M2M Multicast SA-Descriptor
54	M2MGTEK-Parameters
~~50~~55–255	*Reserved*

Insert new subclause 11.9.43 as follows:

11.9.43 M2M Multicast SA-Descriptor

The SA-Descriptor attribute is a compound attribute whose subattributes describe the properties of a security association (SA). These properties include the SAID, the SA type, the SA service type, and the cryptographic suite employed within the SA.

Type	Length	Value (compound)
53	*variable*	The Compound field contains the subattributes shown in Table 11-51a

Table 11-51a—SA-Descriptor subattributes

Attribute	Contents
SAID	Security association identifier.
SA-Type	Type of security association.
SA Service Type	Service type of the corresponding security association type. This shall be defined only when SA type is Static SA or Dynamic SA.
Cryptographic-Suite	Cryptographic suite employed within the SA.

Insert new subclause 11.9.44 as follows:

11.9.44 M2MGTEK-Parameters

This attribute is a compound attribute, consisting of a collection of subattributes. These subattributes represent all the security parameters relevant to a particular generation of a M2MGTEK for encrypting multicast or broadcast data. A summary of the M2MGTEK-Parameters attribute format is shown below.

Type	Length	Value (compound)
54	*variable*	The Compound field contains the subattributes shown in Table 11-51b

Table 11-51b—M2MGTEK-Parameters subattributes

Attribute	Contents
MGSS	Randomly generated seed value for generating M2MGTEK
M2MGTEK_COUNT	The current M2MGTEK_COUNT value that the M2M device uses to derive the M2MGTEK
ROC	8-bit Rollover counter (ROC)

11.13 Service flow management encodings

Insert new subclause 11.13.46 as follows:

11.13.46 M2MCID

The value of this field specifies M2MCID that is used for the associated flow. During connected mode, the M2MCID may be added by DSA-REQ message and may be changed by DSC-REQ message.

Name	Type	Length	Value	Scope
M2MCID	146.57	2	Bits 0–14: Indicates M2MCID; Bit 15: Padding, Shall be set to 0	DSA-REQ DSC-REQ

Insert new subclause 11.13.47 as follows:

11.13.47 Minimal Access Window Size

The Minimal Access Window Size is the size of a window within which the M2M device shall select the start time for the network entry procedure. The M2M device shall use a uniform random selection process to select the network entry start time.

Name	Type	Length	Value	Scope
Minimal Access Window Size	146.58	2	The size in units of 1 second of the Minimal Access Window	DSA-REQ/RSP DSC-REQ/RSP

Insert new subclause 11.13.48 as follows:

11.13.48 M2M Multicast Traffic Reception timer

M2M Multicast Traffic Reception timer TLV may be added in DSA-REQ message and be changed by DSC-REQ message if this service flow is related with M2M multicast service flow.

Name	Type	Length	Value	Scope
M2M Multicast Traffic Reception timer	146.59	1	The maximum time interval that M2M devices in idle mode wait to receive the M2M multicast data, in unit of frames (0~255).	DSA-REQ/RSP DSC-REQ/RSP

11.14 DREG-CMD/REQ message encodings

Insert new subclause 11.14.1 as follows:

11.14.1 M2M device-specific parameter

Name	Type	Length	Value	Scope
M2M device-specific Idle mode timer	53	3	Length of the maximum interval between two consecutive location updates while the M2M device is in idle mode, expressed in units of frames	DREG-CMD
Transmission Type	54	1	Bit 0: Transmission type indicator of the UL data transmission 0b1: allowed to send data only after receiving a paging message with M2M report code Bits 1–7: Reserved.	DREG-CMD
Max number of paging cycle	55	2	This is max number of paging cycle for M2M device to wait for MOB_PAG-ADV with M2M report code. The unit is the duration of the paging cycle.	DREG-CMD

Name	Type	Length	Value	Scope
Localized_Idle_Mode_Accepted_Flag	56	1	Bit 0: Indicator of the Localized Idle Mode for fixed M2M device 0b0:The M2M device enters the idle mode except the procedures in 6.3.22.11.2 0b1:The M2M device enters the localized idle mode Bits 1–7: Reserved	DREG-REQ DREG-CMD

11.17 MOB_PAG-ADV management message encodings

Insert new subclause 11.17.5 as follows:

11.17.5 M2M device group paging parameter

The following M2M device group paging parameter TLV may be included in MOB_PAG-ADV message.

Name	Type	Length	Value	Scope
M2M device group paging parameter	156	*variable*	Compound TLV to be used in M2M device group paging operation	MOB_PAG-ADV

The following TLV element shall appear in each M2M device group paging parameter TLV.

Name	Type	Length	Value
M2MCID	156.1	2	Bits 0–14: Indicates M2M device group ID for which the multicast traffic is scheduled Bit 15: Padding, Shall be set to 0
Action code	156.2	1	Bits 0–1: Indicates Action code for the M2M device group ID 0b00—Performing network reentry 0b01—Performing location update 0b10—Receiving multicast traffic without requiring network reentry 0b11—Reassignment of M2MCID Bits 2–7: Padding, Shall be set to 0

The following TLV element may appear in each M2M device group paging parameter TLV only when the value of Action code TLV is set to 0b10.

Name	Type	Length	Value
Multicast transmission start time (MTST)	156.3	1	Least significant 8 bits of the frame number in which the BS starts sending DL multicast data

The following TLV element shall appear in each M2M device group paging parameter TLV if Action code is set to 0b11 (which identifies reassignment of M2MCID).

Name	Type	Length	Value
M2MCID Reassignment for M2M	156.4	2	New M2MCID (16 bits)

The following TLV element may appear in each M2M device group parameter TLV.

Name	Type	Length	Value
Ranging backoff start	156.5	1	Initial backoff window size for ranging contention during network reentry or location update, expressed as a power of 2. Range: 0~15

The following TLV element may be included in MOB_PAG-ADV message.

Name	Type	Length	Value
M2M network access type	156.6	1	Indicate the network access scheme for M2M device; 0b0: Resource allocation (i.e., UL MAP IE offset) for RNG-REQ 0b1: No dedicated ranging channel

The following TLV element may be included in MOB_PAG-ADV message when the M2M network access type is set to 0b00.

Name	Type	Length	Value
UL MAP start offset for RNG-REQ	156.7	1	This parameter indicates the offset in units of frames that M2M device starts to monitor the resource (i.e., UL MAP IE offset) for the RNG-REQ message, where the reference point of this offset value is the frame in which the MOB_PAG-ADV is transmitted. 8-bit Fast Ranging IE offset.
Resource monitor timer	156.8	1	Time duration that M2M device monitors the resource for RNG-REQ message.

Insert new subclause 11.17.6 as follows:

11.17.6 M2M report code

The following TLV may be used by a BS to indicate action instruction to fixed M2M device.

Name	Type	Length (bits)	Value	Scope

M2M report code	157	*variable*	Bits 0–7:
			Num_MAC_Address_Hash, the number of paged devices;
			Subsequent (Num_MAC_Address_Hash + padding) bits:
			for (*i* = 0, *i* < Num_MAC_Address_Hash, *i*++) {
			1 bit M2M report code
			0b0: *Reserved*
			0b1: send the uplink report
			}
			padding
				MOB_PAG-ADV

Insert new subclause 11.17.7 as follows:

11.17.7 M2M paging parameter

The following M2M paging parameter TLV may be included in MOB_PAG-ADV message.

Name	Type	Length	value	Scope
M2M paging parameter	158	*variable*	Compound TLV to be used in M2M individual paging operation	MOB_PAG-ADV

The following TLV element may be included in MOB_PAG-ADV message when the Action code is set to 0b01 (i.e., Perform ranging to establish location and acknowledge message) or 0b10 (i.e., Enter network).

The following TLV element may be included in MOB_PAG-ADV message when the M2M network access type is set to 0b00.

The following TLV element shall be included in MOB_PAG-ADV message when the M2M network access type is set to 0b01 or 0b10:

Note that the Length equals to $1 + 2 \times n$ bytes. The order of the assignments is the same as the order of appearance of M2M devices' MAC address hash being paged in the same MOB_PAG-ADV message.

Insert new subclause 11.17.8 as follows:

11.17.8 Ranging backoff start

The ranging backoff start TLV may be included in MOB_PAG-ADV message to indicate a new initial backoff start to be used for network reentry or location update. If this TLV is included in MOB_PAG-ADV message, all M2M devices that perform network reentry or location update in response to individual paging notification shall use this ranging backoff start TLV for initial ranging.

Name	Type	Length	Value

M2M network access type	158.1	*variable*	Indicate the M2M network access type for M2M device:
			Bits 0–7: Num_MAC_Address_Hash, Number of M2M devices
			Subsequent (Num_MAC_Address_Hash × 2 + padding) bits:
			For (*i*=0; *i*< Num_MAC_Address_Hash; *i*++){
			2-bit M2M network access type
			0b00: Resource allocation (i.e., UL MAP IE offset) for RNG-REQ
			0b01: dedicated ranging channel allocation in MOB_PAG-ADV
			0b10: dedicated ranging channel allocation in UL-MAP Extended IE
			0b11: no dedicated ranging channel
			}
			padding

Name	Type	Length	value

UL-MAP offset for RNG-REQ	158.2	*variable*	Indicate offset that UL-MAP IE containing Fast Ranging IE for RNG-REQ message is transmitted.
			Bits 0–7: Num_MAC_Address_Hash, Number of M2M devices
			Subsequent (Num_MAC_Address_Hash × 8) bits:
			For (*i*=0; *i*< Num_MAC_Address_Hash; *i*++){8-bit UL-MAP offset for RNG-REQ
			}

Name	Type	Length	Value

Ranging code and ranging slot assignment	158.3	*variable*	Specify the ranging code and ranging slot assignment.
			Bits 0–7: Num_MAC_Address_Hash, Number of M2M devices
			Subsequent (Num_MAC_Address_Hash × 16) bits:
			for (*i*=0; *i*< Num_MAC_Address_Hash; *i*++){
			8-bit code index assigned to an paged device
			8-bit transmission opportunity offset assigned to an paged device
			}

Type	Length	Value	Scope
159	1	Initial backoff window size for ranging contention during network reentry or location update, expressed as a power of 2. Range: 0 ~ 15	OFDMA

11.18 MOB_NBR-ADV management message encodings

Insert new subclause 11.18.3 as follows:

11.18.3 M2M Group Zone Change

Type	Length (bits)	Value	Scope

160	Variable;
	2 + Num_M2M_Zones *(16 + Num_M2MCID_Mapping*32)
		Bits 0–1: Num_M2M_Zones
		for(*i*=0; *i*<Num_M2M_Zones; *i*++) {
		M2M_GROUP_ZONE_ID (16 bits)
		Num_M2MCID_Mapping (16 bits)
		for (*m*=0; *m*<Num_M2MCID_Mapping; *i*++)
		{
		Current M2MCID to New M2MCID mapping (32 bits)
		}
		}
			OFDMA

Num_M2M_Zones

This field denotes the number of neighboring M2M Zones.

M2M_GROUP_ZONE_ID

Denotes the neighbor M2M_GROUP_ZONE_ID

Num_M2MCID_Mapping

This denotes the number of mappings of current M2MCID and new M2MCID between the serving M2M Zone and the neighbor M2M Zone, where the current M2MCID is not the same as the new M2MCID.

Current M2MCID to New M2MCID mapping

The 16 LSBs denote the M2MCID in current M2M Zone and the 16 MSBs denote the corresponding M2MCID in the associated neighboring M2M Zone.

A value of 0 for 16 MSBs denotes that the associated service is not supported in the corresponding neighboring M2M Zone.

Insert new subclause 11.18.4 as follows:

11.18.4 Neighbor M2M Group Zone Indication

Type	Length (bits)	Value	Scope

161	Variable;
	8 + N_NEIGHBORS *16
		M2M_GROUP_ZONE_ID supported by neighbor BSs. The order of neighbor BSs included in this TLV is same as the order of neighbor BSs included in MOB_NBR-ADV message.
		Bits 0–7: N_NEIGHBORS
		for(*i*=0; *i*< N_NEIGHBORS; *i*++) {
		M2M_GROUP_ZONE_ID (16 bits)
		}
			OFDMA