

Group Resource Allocation for 802.16m

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Jason Junsung Lim, Seho Kim, Jaeweon Cho,

Hokyu Choi, Heewon Kang

Samsung Electronics Co., Ltd.

416 Maetan-3, Suwon, 443-770, Korea

Voice: +82-31-279-7467

E-mail: junsung.lim@samsung.com

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IEEE 802.16m-09/0012, “Call for Contributions on Project 802.16m Amendment Working Document (AWD) Content”.

Target topic: “Group resource allocation”

Base Contribution:

None

Purpose:

The contribution proposes text for group resource allocation to be included in the 802.16m amendment.

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Group Resource Allocation for IEEE 802.16m

*Jason Junsung Lim, Seho Kim, Jaeweon Cho,
Hokyu Choi, Heewon Kang*

Samsung Electronics Co., Ltd.

Outline

▪ **Intro**

- This contribution provides material to add new text for describing mechanism of group resource allocation in section 15.2.x, IEEE 802.16m Amendment Working Document.

▪ **Goal and scope of this presentation**

- Outline resource allocation mechanism for GRA.
- Propose text for GRA mechanism.

▪ **Issue to be resolved in this contribution**

- Control information for affiliation/de-affiliation
- Group configurations(Group supportable MCS set, Packet size set)
- Indication of MCS and resource size for scheduled user

Group Affiliation

- **BS indication for group affiliation**

- ABS shall indicate group information when AMS is affiliated into a group.
- The information is sent through either MAC management message or user-specific unicast message (A-MAP IE.)
- Required message contents

Message Type	Bit Size	Description	Comment
Group ID	[4 or 5]	Group ID	
MCS Set	[3]	Supportable MCS set in the group	Select one MCS set among predefined [8] sets.
Packet Size Set	[2]	Supportable Packet size set in the group	Select one packet size among [4] candidates configured in additional broadcast information.
User bitmap position	[5]	Position of user within group's bitmap	
[Initial ACID]	[TBD]	Start of ACID	Reserve a range of ACID for group resource allocation.
[N_ACID]	[TBD]	# of ACID used for group allocation	

Group Configuration

When a group is initialized (BS)
 :Select a MCS set
 :Select a Packet size set
 :Calculate possible combinations of MCS and resource size (Codes for indication)

When a MS is added into group (MS)
 :Indicate selected MCS set
 :Indicate selected Packet size set
 :Calculate possible combinations of MCS and resource size (Codes for receiving indication)

Group resource allocation per subframe
 :User bitmap to indicate existence of transmission
 : Transmit format bitmap to indicate the assigned MCS and resource size. N-bit codes is used to represent the different combinations of MCSs and resource size.

Predefined candidates

MCS TYPE = 000		MCS TYPE = 001		MCS TYPE = 011	
QPSK	31/256	QPSK	31/256	QPSK	31/256
QPSK	47/256	QPSK	47/256	QPSK	47/256
QPSK	70/256	QPSK	70/256	QPSK	70/256
QPSK	98/256	QPSK	98/256	QPSK	98/256
QPSK	131/256	QPSK	131/256	MCS TYPE = 100	
QPSK	166/256	QPSK	166/256	QPSK	131/256
QPSK	199/256	QPSK	199/256	QPSK	166/256
16QAM	123/256	16QAM	123/256	QPSK	199/256
16QAM	149/256	MCS TYPE = 010		16QAM	123/256
16QAM	176/256	16QAM	149/256	MCS TYPE = 101	
16QAM	204/256	16QAM	176/256	16QAM	149/256
16QAM	229/256	16QAM	204/256	16QAM	176/256
64QAM	173/256	16QAM	229/256	16QAM	204/256
64QAM	196/256	64QAM	173/256	16QAM	229/256
64QAM	218/256	64QAM	196/256	MCS TYPE = 110	
64QAM	234/256	64QAM	218/256	64QAM	173/256
		64QAM	234/256	64QAM	196/256
				64QAM	218/256
				64QAM	234/256

Configured in additional broadcast information

Packet size Type=00	
No_packet size=4	
packet size	44
packet size	50
packet size	70
packet size	80

Group Configuration Info.: MCS set

- **A group supports multi-MCS levels**
 - Each group selects one set among several predefined candidate sets.
 - Group supportable MCS set is indicated when MS affiliating to a group.

- **Decision points**
 - Benefit if we make the supportable set is configurable?
 - Need several candidates of MCS set?
 - ➔ Refer to appendix 1 for detailed analysis.

- **Our view**
 - Predefining at most 7~8(number is TBD) candidates of MCS set is enough to cover most of cases.
 - Configuration of MCS set may not be necessary.

Candidates of MCS set

MCS TYPE = 000		MCS TYPE = 001		MCS TYPE = 011	
QPSK	31/256	QPSK	31/256	QPSK	31/256
QPSK	47/256	QPSK	47/256	QPSK	47/256
QPSK	70/256	QPSK	70/256	QPSK	70/256
QPSK	98/256	QPSK	98/256	QPSK	98/256
QPSK	131/256	QPSK	131/256	MCS TYPE = 100	
QPSK	166/256	QPSK	166/256	QPSK	131/256
QPSK	199/256	QPSK	199/256	QPSK	166/256
16QAM	123/256	16QAM	123/256	QPSK	199/256
16QAM	149/256	MCS TYPE = 010		16QAM	123/256
16QAM	176/256	16QAM	149/256	MCS TYPE = 101	
16QAM	204/256	16QAM	176/256	16QAM	149/256
16QAM	229/256	16QAM	204/256	16QAM	176/256
64QAM	173/256	16QAM	229/256	16QAM	204/256
64QAM	196/256	64QAM	173/256	16QAM	229/256
64QAM	218/256	64QAM	196/256	MCS TYPE = 110	
64QAM	234/256	64QAM	218/256	64QAM	173/256
		64QAM	234/256	64QAM	196/256
				64QAM	218/256
				64QAM	234/256

Group Configuration Info.: Packet Size Set

- **A group supports multi-packet size**
 - Each group selects one set among several configured candidate sets.
 - Candidate sets are configured and indicated through additional broadcast information.
 - Group supportable Packet size set is indicated when MS affiliated to a group.

- **Necessity of supporting multi-packet size**
 - To group various codec users.
 - To group various applications.
 - To group various length VoIP packet.

- **Necessity of configuring candidate sets**
 - To give full flexibility of utilizing GRA.
 - To open the anticipated utilization for any new applications such as HD-VoIP.

Ex) Packet size sets

Packet size Type=00	
No_packet size=4	
packet size	20
packet size	30
packet size	40
packet size	50

Packet size Type=01	
No_packet size=4	
packet size	100
packet size	200
packet size	300
packet size	400

Packet size Type=02	
No_packet size=4	
packet size	10
packet size	50
packet size	100
packet size	150

Packet size Type=03	
No_packet size=4	
packet size	10
packet size	20
packet size	100
packet size	150

Forming Transmit Format Code

- **1st step: Calculate required resource size for each possible MCS and packet size**
- **2nd step: Select effective combinations of MCS and packet size**
 - Select lower MCS level, longer packet size if the required resource size is same.

1st step

MCS	40	45	50
64 QAM 173/256	1	1	2
64 QAM 196/256	1	1	1
64 QAM 218/256	1	1	1
64 QAM 234/256	1	1	1

2nd step

MCS	40	45	50
64 QAM 173/256	X	1	2
64 QAM 196/256	X	X	1
64 QAM 218/256	X	X	X
64 QAM 234/256	X	X	X

Example : Packet size set {40, 45, 50 byte} , MCS set {64 QAM 173/256, 196/256, 218/256, 234/256}

Forming Transmit Format Code (Cont'd)

- **3rd Step: Assign code for each effective combination**
 - Ordered by higher(lower) MCS and higher(lower) packet size
 - The bit size of transmit format is implicitly determined.

Code	MCS	Packet size	Required RU
01	64 QAM 173/256	50	2
10	64 QAM 173/256	45	1
11	64 QAM 196/256	50	1

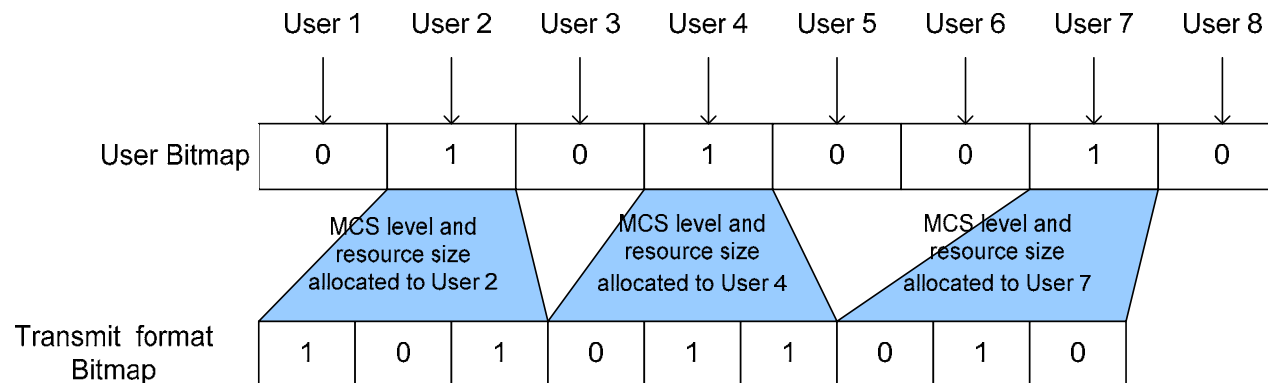
Resource Assignment in Group

- **User bitmap**

- Indicate users who are granted group resource.

- **Transmit format bitmap**

- Indicate MCS/Resource size for each granted user.
- Bitmap bit size is dependent on group supportable MCS set and packet size set.



Text Proposal to 802.16m AWD

Insert the following text into new section 15.2.x

15.2.x Mechanism for Group Resource Allocation

Group resource allocation is a scheme of grouping AMSs in order to allocate resources to one or multiple AMSs within a user group. Group scheduling requires the following three operations.

- Assignment of a user to a group.

In order to add a user to a group in the DL or UL, the ABS shall transmit a [Group Configuration MAC management message] [Group Configuration A-MAP IE]. For the assignment, ABS indicates the affiliated group index, user bitmap position, the used ACIDs for group allocation and group configuration information, i.e. group supportable MCS set and packet size set.

- Allocation of resources to users within a group.

In order to assign resources to one or more users in a group, the ABS shall transmit the DL/UL Group Resource Allocation A-MAP IE. The DL/UL Group Resource Allocation A-MAP IE is included in user-specific resource assignment in an A-MAP region. The GRA A-MAP IE contains bitmaps to indicate scheduled users and also signal resource assignment, MCS, resource size.

- Deletion of a user from a group

A AMS is deleted from a group when the connection ends or when the user's MCS changes such that it is no longer part of the MCS/Resource Size set corresponding to this group. The deletion information is signaled in the [Group Resource Allocation IE][Group Configuration MAC management message][Group Configuration A-MAP IE].

Appendix 1. Analysis for Multiple MCS set

Performance Analysis for MCS Set

- **Examine the impact of MCS types on control overhead and power consumption: Trade-off between large size and small size**
 - Large size MCS set (Comparing to small size)
 - Traded Pros: Avoid unnecessary grouping (Reduce overhead)
 - Traded Cons: Increase bitmap size for indicating MCS level, Excessive power consumption for robust transmission
- **Considering MCS set types**

MCS TYPE 1

QPSK	31/256
QPSK	47/256
QPSK	70/256
QPSK	98/256
QPSK	131/256
QPSK	166/256
QPSK	199/256
16QAM	123/256
16QAM	149/256
16QAM	176/256
16QAM	204/256
16QAM	229/256
64QAM	173/256
64QAM	196/256
64QAM	218/256
64QAM	234/256

MCS TYPE 2

QPSK	31/256
QPSK	47/256
QPSK	70/256
QPSK	98/256
QPSK	131/256
QPSK	166/256
QPSK	199/256
16QAM	123/256
16QAM	149/256
16QAM	176/256
16QAM	204/256
16QAM	229/256
64QAM	173/256
64QAM	196/256
64QAM	218/256
64QAM	234/256

MCS TYPE 3

QPSK	31/256
QPSK	47/256
QPSK	70/256
QPSK	98/256
QPSK	131/256
QPSK	166/256
QPSK	199/256
16QAM	123/256
16QAM	149/256
16QAM	176/256
16QAM	204/256
16QAM	229/256
64QAM	173/256
64QAM	196/256
64QAM	218/256
64QAM	234/256

MCS TYPE 4

QPSK	31/256
QPSK	47/256
QPSK	70/256
QPSK	98/256
QPSK	131/256
QPSK	166/256
QPSK	199/256
16QAM	123/256
16QAM	149/256
16QAM	176/256
16QAM	204/256
16QAM	229/256
64QAM	173/256
64QAM	196/256
64QAM	218/256
64QAM	234/256

Simulation Assumptions

■ Simulation Environments

- VoIP codec: AMR
 - 40 bytes: Voice(33 bytes)+GMH(2bytes)+ROHC(3bytes)+CRC(2bytes)
 - Voice activity: 0.5
- DL:UL=4:4

■ Assumptions

- GRA MAP IE is boosted to QPSK1/2.
- The transmission MCS of GRA MAP IE is decided as the lowest MCS of users belong to a group.
- If user changes a group, the user is deallocated with deallocation message in an old GRA MAP IE and allocated with allocation message in a new GRA MAP IE.

```

GRA MAP IE (){
  Type (4)
  Group ID (4)
  GRA MAP IE length (2)
  Change Flag (1)
  if (Change Flag==1)
  {
    MCS Type (4)
    Packet size Type(2)
  }
  Start offset (6)
  ACKCH index (4)
  ACID (3)
  User bitmap length (2)
  Allocation Flag(1)
  if (Allocation Flag==1)
  {
    No of Allocation (3)
    for (i=0;i< No of Allocation;++i)
    {
      CID (16)
      USER bitmap index (5)
    }
  }
  Deallocation Flag(1)
  if (Deallocation Flag==1)
  {
    No of Deallocation (3)
    for (i=0;i< No of Allocation;++i)
    {
      USER bitmap index (5)
    }
  }
  User Bitmap (variable)
  Resource Bitmap (variable)
  CRC (32)
}

```

Predefined

MCS TYPE = 0000		MCS TYPE = 0001		MCS TYPE = 0011		MCS TYPE = 0110	
QPSK	31/256	QPSK	31/256	QPSK	31/256	QPSK	31/256
QPSK	47/256	QPSK	47/256	QPSK	47/256	QPSK	47/256
QPSK	70/256	QPSK	70/256	QPSK	70/256	QPSK	70/256
QPSK	98/256	QPSK	98/256	QPSK	98/256	QPSK	98/256
QPSK	131/256	QPSK	131/256	QPSK	131/256	QPSK	131/256
QPSK	166/256	QPSK	166/256	QPSK	166/256	QPSK	166/256
QPSK	199/256	QPSK	199/256	QPSK	199/256	QPSK	199/256
16QAM	123/256	16QAM	123/256	16QAM	123/256	16QAM	123/256
16QAM	149/256	16QAM	149/256	16QAM	149/256	16QAM	149/256
16QAM	176/256	16QAM	176/256	16QAM	176/256	16QAM	176/256
16QAM	204/256	16QAM	204/256	16QAM	204/256	16QAM	204/256
16QAM	229/256	16QAM	229/256	16QAM	229/256	16QAM	229/256
64QAM	173/256	64QAM	173/256	64QAM	173/256	64QAM	173/256
64QAM	196/256	64QAM	196/256	64QAM	196/256	64QAM	196/256
64QAM	218/256	64QAM	218/256	64QAM	218/256	64QAM	218/256
64QAM	234/256	64QAM	234/256	64QAM	234/256	64QAM	234/256

Select on from 4 candidates

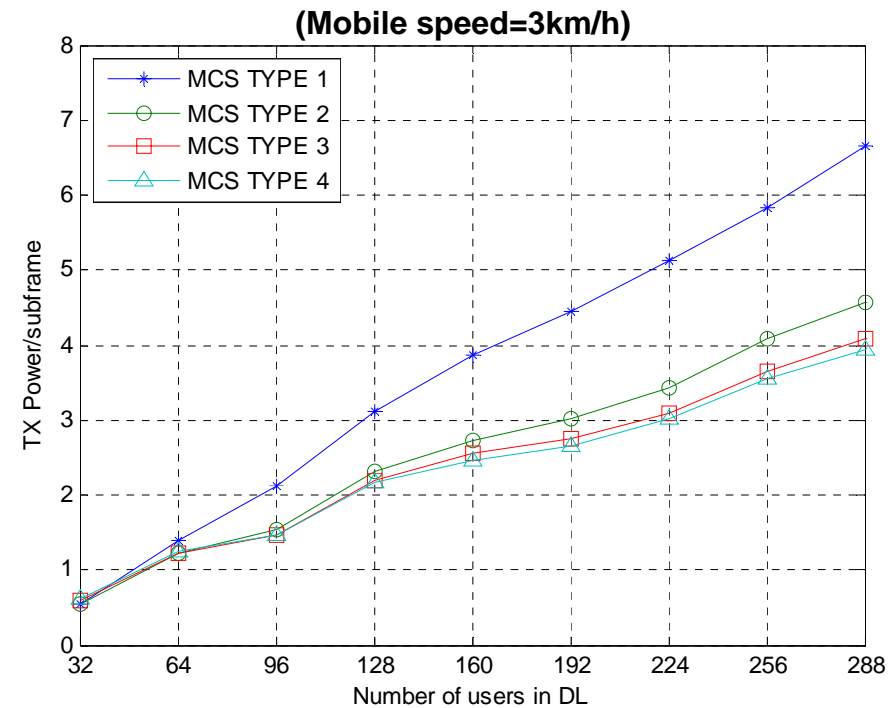
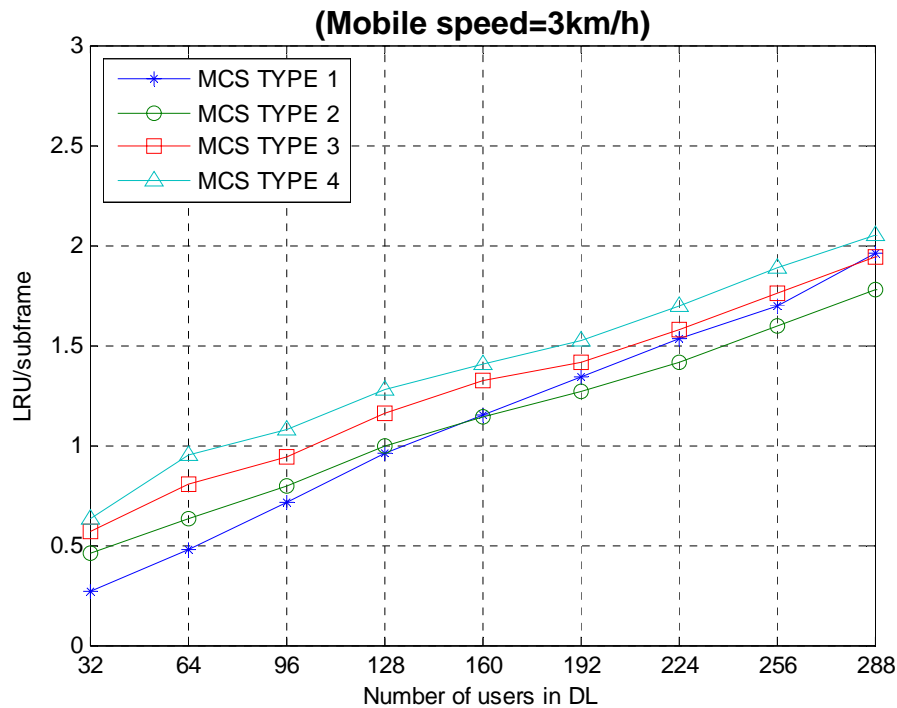
Packet size Type=00	
No_packet size=4	
packet size	44
packet size	50
packet size	70
packet size	80

Indicate MCS and LRU size with coded bit

Performance Analysis for MCS Set (Cont'd)

■ Observation

- Large size MCS set: Need for avoiding unnecessary grouping or changing group.
- Small size MCS set: Need for saving transmit power/overhead.



Performance Analysis for MCS Set (Cont'd)

