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Re:	This is a response to Call for Technical Proposals regarding IEEE Project P802.16j.
Abstract	The document contains technical proposals for IEEE P802.16j that would provide a handover method on the Mobile RS.
Purpose	The document is submitted for review by 802.16 Working Group members.
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Group Handover on the Mobile RS

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ETRI

1. Introduction

The Mobile RS (MRS) is mounted on the vehicle, such as a bus or train, provides a fixed access link to MS devices riding on the platform. In general, quality of the link between MMR-BS and MRS is better than that of the link between MMR-BS and MS. Moreover, the usage of MRS needs small feedback resources (as the usage of CQI reports, BW request, MIMO feedback reports, etc.) which may cover entire feedback information of several MS riding on the vehicle.

In this usage scenario, the MRS shall endeavor to maintain reliable radio links to the MS and also the MRS must have the capability of handover.

Based on the conventional 802.16e system, we can consider the situations of handover with the MRS as the following:

- Case 1: During HO, the MSs on the vehicle can communicate with the serving MMR-BS without the MRS relay.
- Case 2: The MRS provides an isolated cell to the MSs or some discontinuation of communication between the serving MMR-BS and the MS occurs due to signal fading or interference levels at the handover region.

In MRS operation scenario, the following figures show the examples of handover procedures according to IEEE 802.16e specifications. We note that the MRS is apt to perform handover earlier than the MS. When the condition of handover occurs, all MS would start handover procedures almost at the same time.
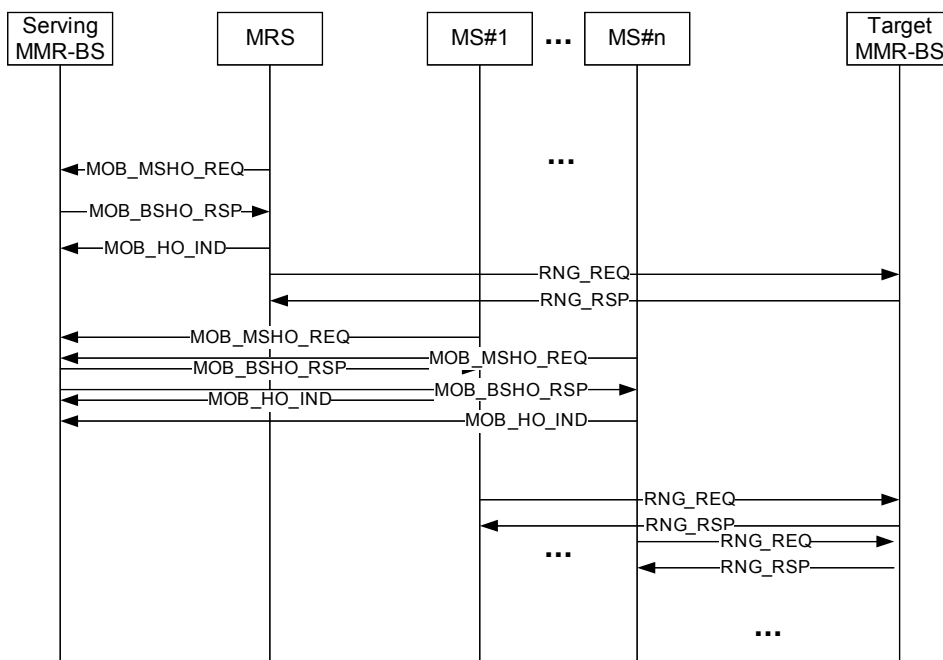

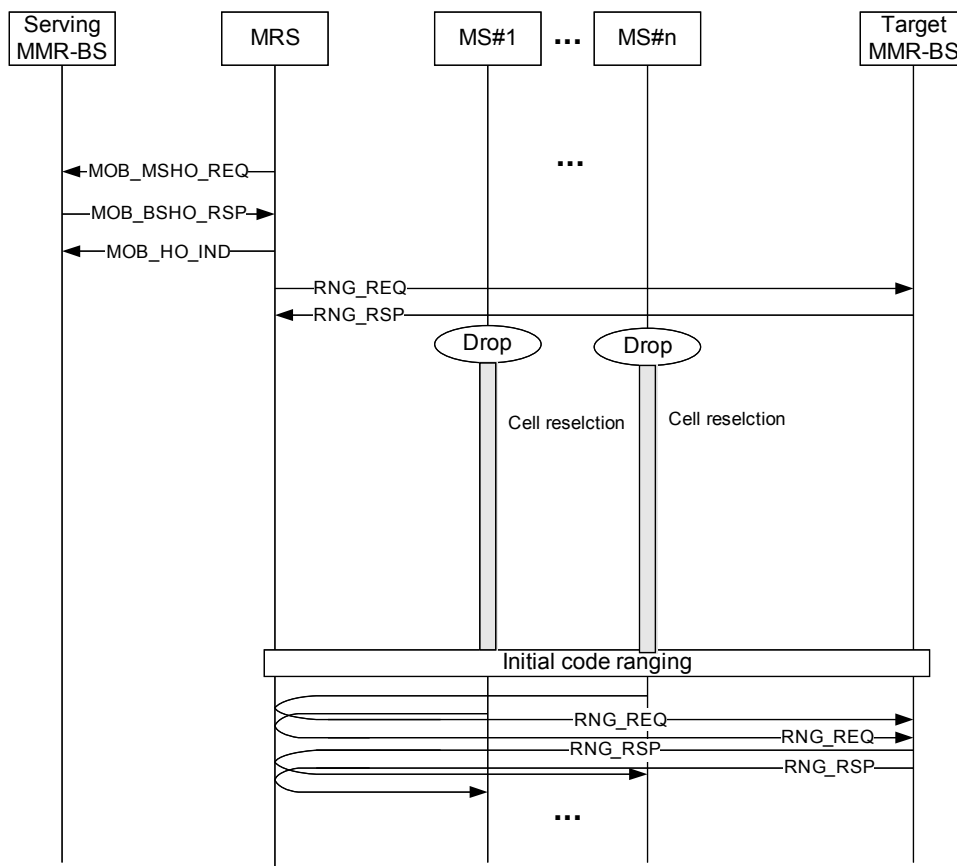Figure 1. Example of handover procedures at case 1

2

Figure 2. Example of handover procedures at case 2

In Figure 2, however, the case 2 may raise large delay access to be connected with a new MMR-BS because of cell reselection process and congestion on the random access channel for initial access.

2. Proposed Solution

IEEE 802.16 specifications support three methods to support HO for MS.

- HO (Hard HO)
- MDHO
- FBSS

The MRS may perform a handover according to the conventional HO procedures as defined in 6.3.22. In this case, MOB-related messages can be still used at both the MRS and the MMR-BS with small changes as the MRS fakes an MS. When the MMR-BS receives a HO-related message, it can recognize the sender as MRS by parsing a "basic CID" field into the generic MAC header. If the MOB-HO messages contain a "service level prediction" parameter, the MRS is set to "0b11" in those. Nevertheless, we should note that this method isn't an appropriate solution for case 2.

Then, we propose a scheme called Group HO on the MRS, which enables a MRS to control handover of MSs. We can assume that

the MMR-BS and the MRS maintain a list of MSs that are served through the corresponding relay link. During a group handover, a MRS may relay or boost up signals (preamble, FCH, MAP, etc) of target MMR-BS in order to derive MS handover.

Figure 3 shows an example of procedures of a MRS initiating group handover. When G_RSHO-REQ (Group RS HO Request) is sent by a MRS, the MRS may indicate one or more possible target MMR-BS. In addition, it contains basic CIDs of MSs which are served on the MRS relay link. When receiving this message, the MMR-BS prepares HO process for the corresponding MSs and sends a G_BSHO-RSP message to the MRS with several parameters of service level prediction, HO optimization, action time, etc.

Then, the MRS begins HO for each MS. At this time, the MRS may transmit signals of the serving MMR-BS as well as the target MMR-BS simultaneously. After the all handover request/response handshakes between a MRS and multiple MSs have completed, the MRS send a G_HO-IND message to the serving MMR-BS in order to notify the completion of Group HO and their results indicated at the HO_IND_type fields.

At the Target MMR-BS, the "Group Handover indication" parameter into RNG-REQ message sent by the MRS can be used for determining the amount of the code ranging resources for HO in order to avoid large access delay owing to congestion of random access.
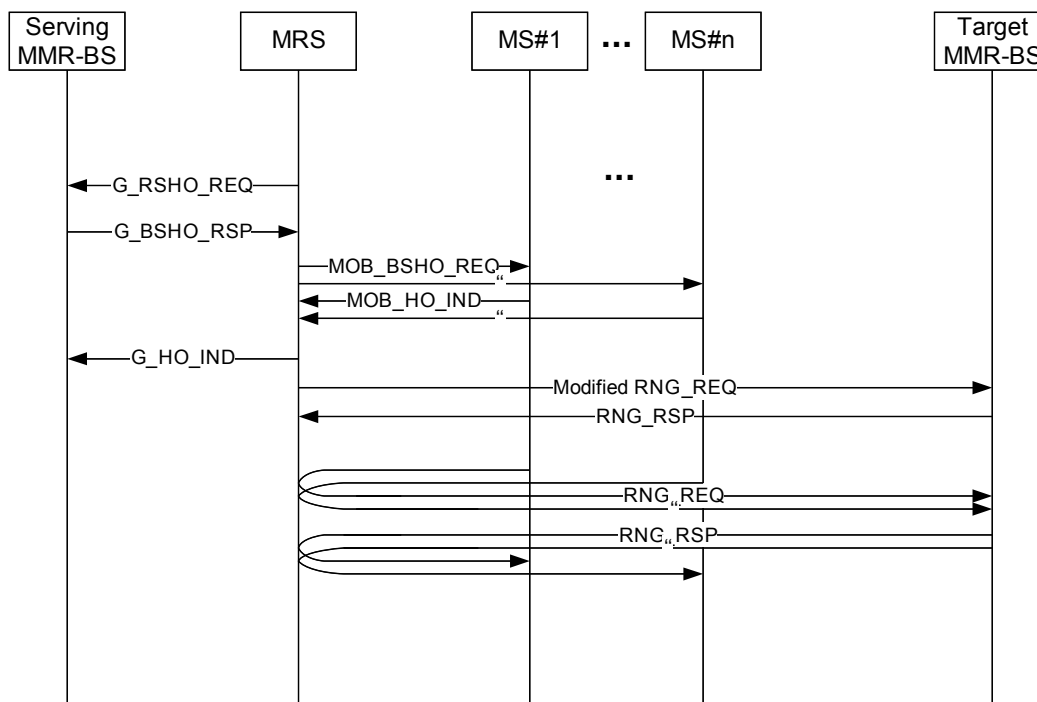

Figure 3. The example of group handover on the link between MMR-BS and MRS (MRS-initiated)

Figure 4 shows an example of procedures of a MMR-BS initiating group handover.
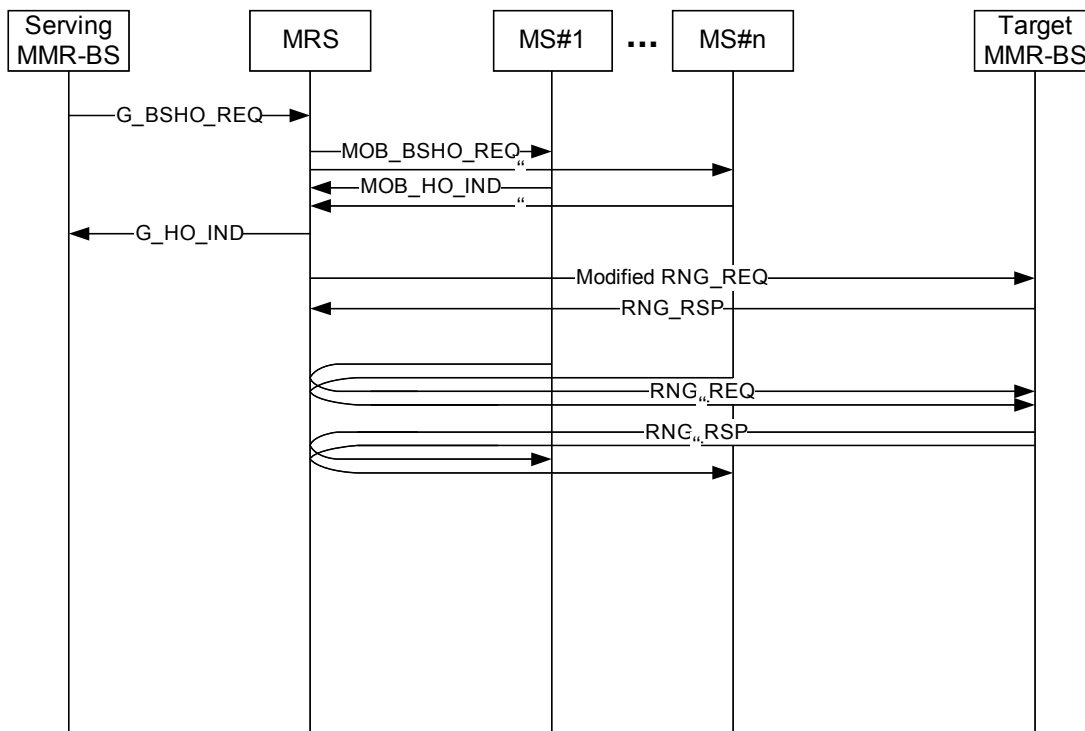
Figure 4. The example of group handover on the link between MMR-BS and MRS (MMR-BS-initiated)

When the MRS attempts MDHO or FBSS, it should not attempt a Group HO. The support of MDHO or FBSS is optional for both the RS and the MMR-BS and they are considered into the hop between MMR-BS and MRS. Moreover, for the link between MRS and MS, a MRS is able to keep the radio resources of previous MMR-BS during the MDHO or FBSS even if anchor BS or active BS set of the MRS has changed. In this case, the transmission of the MRS should be in the coverage region in order not to interfere with neighbor BSs. Figure 5 and figure 6 shows MRS-cell according to Group HO and MDHO/FBSS, respectively.
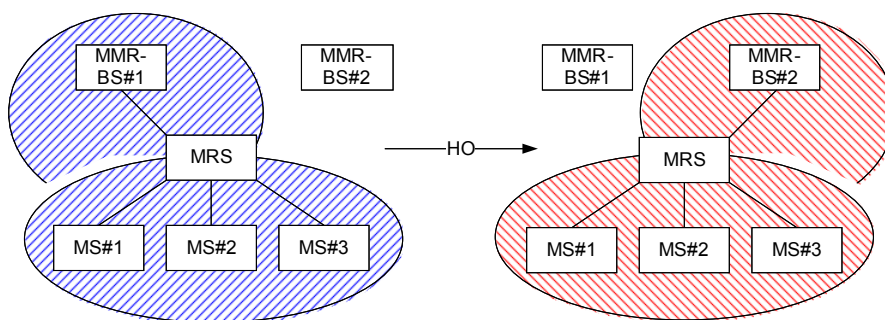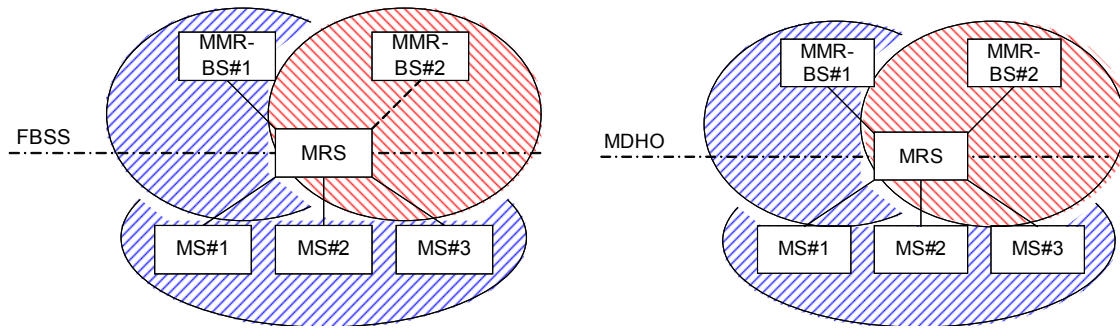

Figure 5. MRS-cell and Group HO

Figure 6. MRS-cell and FBSS/MDHO between MRS and MMR-BS

Text Proposals

[Insert new subclass 6.3.2.3.xx:]

6.3.2.3.xx Group RS HO Request (G_RSHO-REQ) message

The RS may transmit a G_RSHO-REQ message when it wants to initiate a Group HO. The message shall be transmitted on the basic CID of the RS.

Table xxx.- G_RSHO-REQ message format

Syntax	Size	Notes
G_RSHO_REQ_Message_format() {	-	-
Management Message Type = xx	8bits	-
Report metric	8bits	Bitmap indicating presence of metric in message Bit #0: BS CINR mean Bit #1: BS RSSI mean Bit #2: Relative delay Bit #3-7: Reserved; shall be set to zero.
N_BS	8bits	Number of new recommended BSs.
N_MS	8bits	The number of MSs which are considered for group handover.
For (j=0; j<N_MS;j++) {		
Basic CID of MS	16bits	
}		
For (j=0; j<N_BS;j++) {		
Neighbor_BS_ID	48bits	
Preamble index	8bits	This parameter defines the PHY specific preamble for the neighbor BS.
Measurement values	8bits	This parameter indicates the following according to the Report metric field. If (Report metric [Bit#0] == 1): BS CINR mean If (Report metric [Bit#1] == 1): BS RSSI mean If (Report metric [Bit#2] == 1): Relative delay
If (Report metric [Bit#2] == 1) {		
Arrival time difference indication	1bit	
If (Arrival time difference indication == 1) {		

Arrival Time Difference (t)	7bits	
}		
}		
}		
Padding	variable	Padding bits to ensure byte aligned.
TLV encoded information	variable	
}	-	-

A RS shall generate G_RSHO-REQ messages in the format shown in Table xxx. The following parameters shall be included in the G_RSHO-REQ message:

Report metric

Bitmap indicator of trigger metrics that the RS reports in this message. For each bit location, a value of '0' indicates the trigger metric should not be included, while a value of '1' indicates the trigger metric should be included in the message. The bitmap interpretation for the metrics shall be:

Bit #0: BS CINR mean

Bit #1: BS RSSI mean

Bit #2: Relative delay

Bit #3-7: Reserved; shall be set to zero.

N_BS

The number of neighbor BSs to be considered for group handover.

N_MS

The Number of MSs which are served with relay link of the corresponding MRS.

For each MS, the following parameters shall be included,

Basic CID of MS

Basic connection identifier of MS which served with relay link by the MRS. These MSs will attempt to perform handover by group handover procedures.

For each recommended neighbor BS, the following parameters shall be included,

Neighbor BSID

Same as the Base station ID parameter in the DL-MAP message of the Neighbor BS.

Preamble index

The PHY-specific preamble for the neighbor BS.

Measurement value

According to report metric that RS indicates, this parameter indicates the following according to the Report metric field.

If (Report metric [Bit#0] == 1): BS CINR mean

If (Report metric [Bit#1] == 1): BS RSSI mean

If (Report metric [Bit#2] == 1): Relative delay

The G_RSHO-REQ message shall include the following parameters encoded as TLV tuples:

HMAC/CMA Tuple (see 11.1.2)

[Insert new subclass 6.3.2.3.xx:]

6.3.2.3.xx Group BS HO Rseponse (G_BSHO-RSP) message

The BS shall transmit a G_BSHO_RSP message upon reception of G_RSHO_REQ message. The message shall be transmitted on the basic CID of the RS.

Table xxx-G_BSHO-RSP message format

Syntax	Size	Notes
G_BSHO_RSP_Message_format() {		
Managment Message Type = xx		
N_MS	8bits	
For(j=0;j<N_MS;j++) {		
Basic CID of MS	16bits	
Action time	8bits	For MS
}		
HO operation mode	1bit	
N_Recommended	6bits	
Resource Retain Flag	1bit	
For(j=0;j<N_Recommended;j++) {		
Neighbor BSID	48bits	
Preamble index	8bits	
Network Assisted HO supported	1bit	
HO_ID_included_indicator	1bit	
If (HO_ID_included_indicator == 1) {		
HO_ID	8bits	
}		
For(k=0;k<N_MS;k++) {		
Service level prediction	8bits	
HO process optimization	8bits	
}		
}		
Action time	8bits	For MRS
TLV encoded information	variable	
}		

A BS shall generate G_BSHO-RSP messages in the format shown in Table xxx. The following parameters shall be included in the G_BSHO-RSP message.

N_BS

The number of neighbor BSs to be considered for group handover.

N_MS

The number of MSs which are served with relay link of the corresponding MRS.

Action time

For HO, this value is defined as number of frames util the Target MMR-BS allocates a dedicated transmission opportunity for RNG-REQ message to be transmitted by the MRS or MS using Fast Ranging IE.

HO operation mode

Indicate the operation mode of this HO response as prescribed by MMR-BS.

> 0: Recommended HO response
>
> 1: Mandatory HO response

N_Recommended

Number of neighboring BSs to be considered for Group HO.

For each recommended neighbor BS and each MS, the following parameters shall be included,

Service level prediction

The service level prediction value indicates the level of service the MS can expect from this BS. The following encodings apply:

> 0=No service possible for this MS
>
> 1=Some services is available for one or several service flows authorized for the MS.
>
> 2=For each authorized service flow, a MAC connection can be established with QoS specified by the Authorized QoSParamSet.
>
> 3=No service level prediction available.

HO process optimization

HO process Optimization is provided as part of this message is indicative only.

The G_RSHO-RSP message shall include the following parameters encoded as TLV tuples:

> **HMAC/CMA Tuple** (see 11.1.2)

[Insert new subclass 6.3.2.3.xx:]

6.3.2.3.xx Group HO Indication (G_HO-IND) message

An RS shall transmit a G_HO_IND message for final indication that it is about to perform a Group HO. When the RS cancels or rejects the HO, the RS shall transmit a G_HO-IND message with appropriate G_HO_IND_type field. The message shall be transmitted on the basic CID of the RS.

Table xxx- G_HO-IND message format

Syntax	Size	Notes
G_HO_IND_Message_format() {	-	-

Management Message Type = xx	8bits	
G_HO_IND_type	2bits	0b00: serving BS release 0b01: Group HO cancel 0b10: Group HO reject 0b11: *Reserved*
If (G_HO_IND_type == 0b00) {		
Target_BS_ID	48bits	
Preamble index	8bits	
}		
N_MS	8bits	Number of Mobiles
For (j=0; j<N_MS;j++) {		
Basic CID of MS	16bits	
HO_IND_type	2bits	0b00: serving BS release 0b01: HO cancel 0b10: HO reject 0b11: *reserved*
}		
Padding	Variable	
TLV encoded information	variable	-
}	-	-

The RS shall use the handover mode signaled by the BS in the previous G_BSHO-REQ or G_BSHO-RSP message to perform handover.

A RS shall generate G_HO-IND message in the format shown in Table xxx. The following parameters shall be included in the message:

      G_HO_IND_type

      HO_IND_type

The G_HO-IND message shall include the following parameters encoded as TLV tuples:

      HMAC/CMA Tuple (see 11.1.2)

[Insert new subclass 6.3.2.3.xx:]

6.3.2.3.xx Group BS HO Request (G_BSHO-REQ) message

The BS may transmit a G_BSHO-REQ message when it wants to initiate HO. A RS receiving this message may scan recommended neighbor BSs in this message. The message shall be transmitted on the basic CID.

Table xxx-G_BSHO-REQ message format

Syntax	Size	Notes

G_BSHO_REQ_Message_format() {	-	-
Management Message Type = xx	8bits	
HO operation mode	1bits	
N_Recommended	6bits	
Resource Retain Flag	1bits	
N_MS	8bits	
For(j=0;j<N_MS;j++) {		
Basic CID of MS	16bits	
Action time	8bits	For MS
}		
For (j=0;j<N_Recommended;j++) {		
Neighbor BSID	48bits	
Preamble Index	8bits	
Network Assisted HO supported	1bit	
HO_ID_included_indicator	1bit	
If (HO_ID_included_indicator == 1) {		
HO_ID	8bits	
}		
For (k=0;k<N_MS;k++) {		
Service level prediction	8bits	
HO process optimization	8bits	
}		
}		
Action time	8bits	For MRS
Padding	variable	Padding bits to ensure byte aligned.
TLV encoded information	variable	TLV specific
}	-	-

[Insert new Table xx-RNG-REQ message encodings for RS-WirelessMAN-OFDMA:]

Name	Type	Length	Value (Variable-length)
RS MAC address		6	MAC address of RS.
Group Handover indication		1	Presence of item in message indicates the RS is currently attempting to group handover, and its value indicates the number of MS which attempts handover RNG.