

# 16m HARQ Feedback Allocation Design

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Source:

Hyunkyu Yu, Jaeweon Cho, Heewon Kang  
Hokyu Choi

Voice: +82-31-279-4964

E-mail: [hk.yu@samsung.com](mailto:hk.yu@samsung.com)

Samsung Electronics Co., Ltd

416 Maetan-3, Suwon 443-770, Korea

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None

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# Outline

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- **Summary: DL, UL HARQ Feedback Allocation Method**
- **Proposed HARQ Feedback Allocation Method**
- **Proposed Text**
- **Appendix**

# DL: HARQ Feedback A-MAP Indexing

## ▪ Candidates (Explicit vs. Implicit)

	Explicit	Implicit	Note
DL HF A-MAP ↔ UL data burst	- HF A-MAP index is indicated by assignment A-MAP IE	- LRU index of UL data burst	Refer IEEE C802.16m-09/1004

## ▪ Comparison Summary

	Explicit	Implicit: LRU index of data burst
Analysis on Spectral Efficiency	Smaller overhead	Larger overhead (especially for MU-MIMO)
Link Performance for SFBC	Easy to make SFBC pair with similar power	Difficult to make SFBC pair with similar power
Allocation Collision between HF A-MAPs	No	HF A-MAPs of Long TTI burst and default TTI burst can be collide each other due to different HARQ timing

# UL: HARQ Feedback Channel Indexing

## ▪ Candidates (Explicit vs. Implicit)

	Explicit	Implicit	Note
UL HF Channel ↔ DL data burst	- HARQ feedback channel index is indicated by assignment A-MAP IE	- Assignment A-MAP order	Refer Appendix

## ▪ Comparison Summary

	Explicit	Implicit: Assignment A-MAP order
Analysis on Spectral Efficiency	Smaller overhead	Larger overhead (especially when GRA/PA portion is high)
Allocation Collision between HF A-MAPs	No	HARQ feedback channel of Long TTI burst and default TTI burst can be collide each other due to different HARQ timing

# Proposed HARQ Feedback Allocation (1/2)

- **For both DL and UL,**
  - Recommend to use explicit-based signaling
  
- **In order to reduce signaling overhead in assignment A-MAP IE, especially for large bandwidth,**
  - Propose to add simple implicit mechanism based on explicit signaling
  - [3][4] bits HFA field in the Basic A-A-MAP IE all for 0.5k/1k/2k FFT
  
- **No collision for HARQ feedback allocation**
- **No addition burden to scheduler to avoid collision**

# Proposed HARQ Feedback Allocation (2/2)

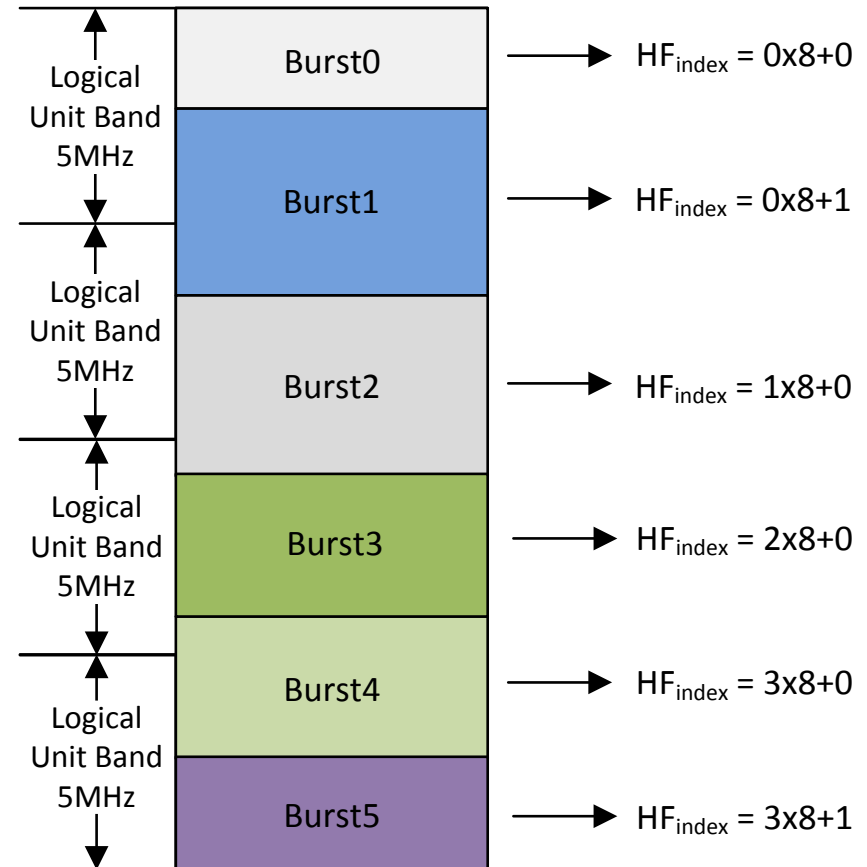
## Hybrid Explicit & Implicit

- $HF_{index} = n \times N_{HF} + m$

- $HF_{index}$ : allocated HARQ feedback index
- $n$ : logical unit band index ( $0 \leq n < N_{UB}$ )
- $N_{HF}$ : # of supportable HF channels in a unit band
- $m$ : value signaled by assignment A-MAP ( $0 \leq m < N_{HF}$ )

- Example

- 20MHz with 5MHz unit band ( $0 \leq n < 4$ )
- $N_{HF}$ : 8 bursts ( $0 \leq m < 8$ )



# Text Proposal (1/4)

----- Text Start -----

## 15.3.6.3.2.3 HARQ Feedback A-MAP

...

Each HF-A-MAP IE ... is FFS.

HF-A-MAP resource unit index is given by  $HF_{index} = n \times N_{HF} + m$ , where  $n$  ( $0 \leq n < N_{UB}$ ) is the logical unit band index in which the start LRU index of corresponding UL burst is located,  $N_{HF}$  is the number of supportable HF-A-MAP resource units in a logical unit band, and  $m$  ( $0 \leq m < N_{HF}$ ) is the value signaled by the HFA field in the UL basic assignment A-MAP IE.  $N_{UB}$  is [1, 2, 4] or [1, 1, 2] for 0.5k, 1k, 2k FFT size, respectively.

For group resource allocation, HF-A-MAP resource unit index is given by  $HF_{index} = m + p$ , where  $m$  ( $0 \leq m < N_{UB} \times N_{HF}$ ) is the value signaled by the ACK Channel Offset field in the UL group resource allocation A-MAP IE, and  $p$  indicates the allocated burst order of a corresponding AMS in a group.

# Text Proposal (2/4)

## 15.3.6.5.2.2 DL basic assignment A-MAP IE

Table 668 describes ... are listed following Table 668

Table 668—DL basic assignment A-MAP IE

Syntax	Size in bits	Description/Notes
DL-MAP() {		
		⋮
}		
HFA	<del>[4]</del> [3][4]	HARQ Feedback Allocation <a href="#">Indicates the HARQ feedback control channel resource unit index</a> <del>TBD</del>
AI_SN	1	HARQ identifier sequence number
		⋮



# Text Proposal (3/4)

## 15.3.6.5.2.3 UL basic assignment A-MAP IE

Table 670 describes the fields in a UL Basic Assignment A-MAP IE used for resource assignment in the UL.

Table 670—UL basic assignment A-MAP IE

Syntax	Size in bits	Description/Notes
UL-MAP_IE() {		
		⋮
}		
HFA	<del>[4]</del> [3][4]	HARQ Feedback Allocation <a href="#">Indicates the HARQ feedback A-MAP resource unit index</a> <del>TBD</del>
AI_SN	1	HARQ identifier sequence number
		⋮

# Text Proposal (4/4)

## 15.3.9.2.2 HARQ feedback control channel

...

When each ... in Table 724

HARQ feedback control channel unit resource index is given by  $HF_{index} = n \times N_{HF} + m$ , where  $n$  ( $0 \leq n < N_{UB}$ ) is the logical unit band index in which the start LRU index of corresponding DL burst is included,  $N_{HF}$  is the number of supportable HARQ feedback control channel resource units in a logical unit band, and  $m$  ( $0 \leq m < N_{HF}$ ) is the value signaled by the HFA field in the DL basic assignment A-MAP.  $N_{UB}$  is [1, 2, 4] or [1, 1, 2] for 0.5k, 1k, 2k FFT size, respectively.

For group resource allocation, HARQ feedback control channel resource unit index is given by  $HF_{index} = m + p$ , where  $m$  ( $0 \leq m < N_{UB} \times N_{HF}$ ) is the value signaled by the ACK Channel Offset field in the DL group resource allocation A-MAP IE, and  $p$  indicates the allocated burst order of a corresponding AMS in a group.

----- **Text End** -----

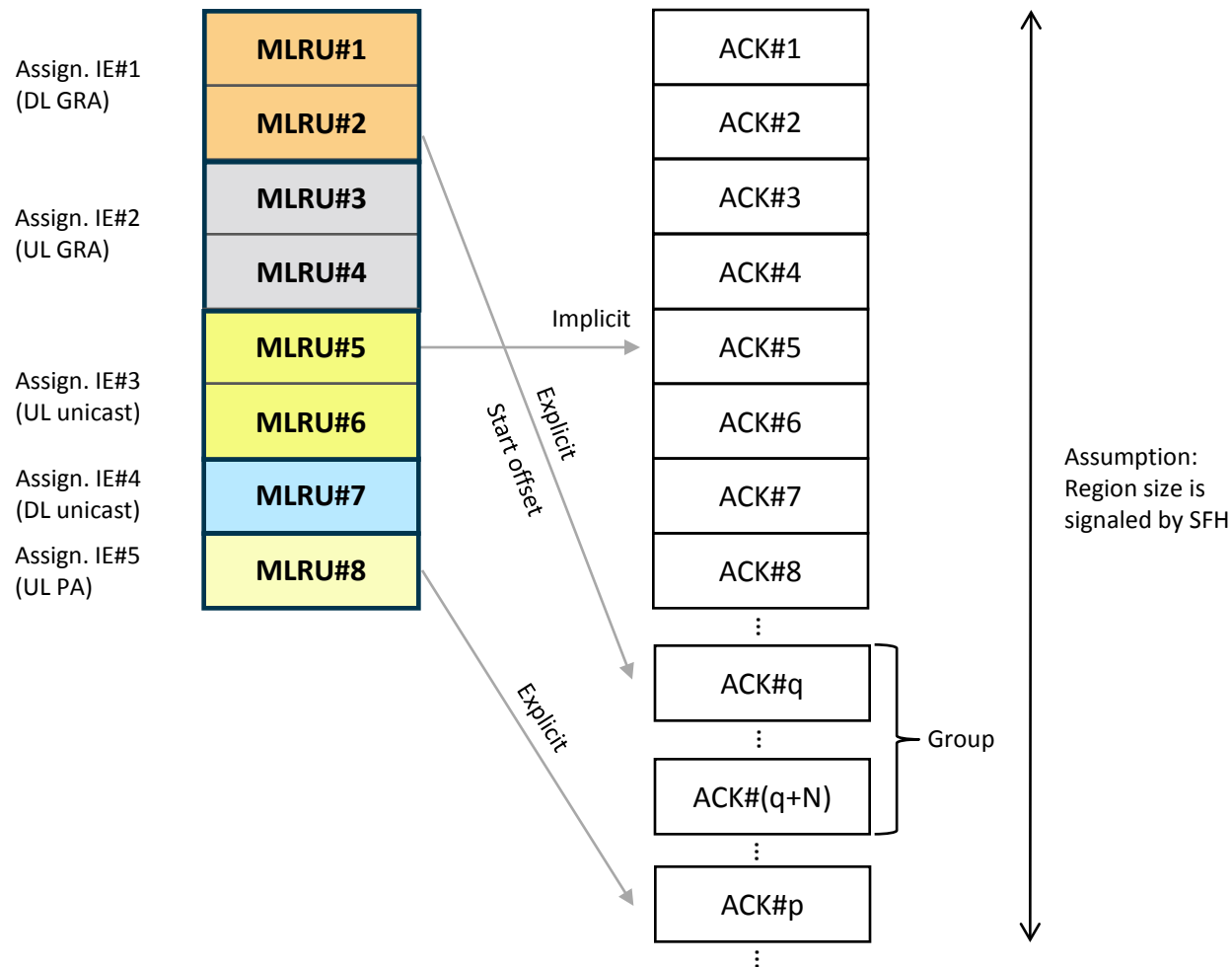
# **Appendix**

- **Overhead analysis for HFCH indexing**
- **Allocation collision in implicit method**

# Overhead Analysis (1/3)

## Implicit Method for UL HFA

- Explicit signaling is required for GRA and PA



# Overhead Analysis (2/3)

## Overhead Comparison (Implicit vs. Explicit)

	Implicit MLRU index of assignment A-MAP	Explicit
(1) Portion of GRA (explicit)	<ul style="list-style-type: none"> <li>- <b>20%, 40%, 60% (# of bursts)</b></li> <li>- Assumption: ACK for GRA+PA cannot be allocated in implicit-region</li> </ul>	
(2) # of A-A-MAP IEs for DL	<ul style="list-style-type: none"> <li>- During superframe, # of DL A-A-MAP can be <b>2/4/8 (w/o GRA): 2~8</b></li> <li>. 20% GRA, (2) = <b>1.6/3.2/6.4</b></li> <li>. 40% GRA, (2) = <b>1.2/2.4/4.8</b></li> <li>. 60% GRA, (2) = <b>0.8/1.6/3.2</b></li> <li>- Not consider GRA IE itself</li> </ul>	
(4) # of bits in IE	- <b>3</b> bits (maximum 8 DL bursts): 2 tones/bit (QPSK, 1/4)	
(5) Total # of UL ACK	- Constant during superframe	- Constant during superframe - <b>8</b> (signaled by SFH)
(6) # of tones per UL ACK	- 6 tones	
Req. DL resources (bits)	.	<b>(4)x(2)</b>
Req. UL resources (tones)	<b>16x(6)+8x(1)x(6)</b> - 16: maximum # of IEs (DL+UL) - 8: maximum # of DL bursts	<b>(6)x(5)</b>

# Overhead Analysis (3/3)

- Required DL+UL Overhead (# of tones)

GRA (portion)	average # of DL IEs	implicit (tones)	explicit (tones)
0.2	1.6	105.6	57.6
0.2	3.2	105.6	67.2
0.2	6.4	105.6	86.4
0.4	1.2	115.2	55.2
0.4	2.4	115.2	62.4
0.4	4.8	115.2	76.8
0.6	0.8	124.8	52.8
0.6	1.6	124.8	57.6
0.6	3.2	124.8	67.2

- As # of A-A-MAP IEs is smaller, explicit is better
- As portion of GRA+PA is larger, explicit is better



# Allocation Collision in Implicit Method (1/2)

## ▪ HF A-MAP for UL Burst

- Implicit method (LRU index of an allocated burst) cannot guarantee collision-free between default TTI and long TTI
  - As an example below, even if bursts are allocated in a different frame, HF A-MAP can be assigned in the same subframe
- Implicit signaling may cause collision in HF A-MAP allocation

BS's RX Processing time = 3, MS's TX Processing time = 3

frame	i					i+1					i+2													
sub	0	1	2	3	4	0	1	2	0	1	2	3	4	0	1	2	0	1	2	3	4	0	1	2
5:3	D	D	D	D	D	U	U	U	D	D	D	D	D	U	U	U	D	D	D	D	D	U	U	U
default TTI														0										
Long TTI						0																		

 : A-MAP (assignment or HARQ feedback)  
 : UL data burst




# Allocation Collision in Implicit Method (2/2)

## ▪ HARQ Feedback Channel for DL Burst

- Implicit method (A-MAP order) cannot guarantee collision-free between default TTI and long TTI
  - As an example below, even if A-MAPs are allocated in a different frame, HFCH can be assigned in the same subframe
- Implicit signaling may cause collision in HFCH allocation

BS's RX Processing time = 3, MS's TX Processing time = 3

frame	i						i+1						i+2											
sub	0	1	2	3	4	0	1	2	0	1	2	3	4	0	1	2	0	1	2	3	4	0	1	2
5:3	D	D	D	D	D	U	U	U	D	D	D	D	D	U	U	U	D	D	D	D	D	U	U	U
default TTI								0																
Long TTI	0																							

	: UL HARQ feedback channel
	: DL data burst
	: A-MAP and DL data burst