16m HARQ Feedback A-MAP Design

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IEEE 802.16m-09/0020, “Call for Contributions on Project 802.16m Amendment Working Document (AWD) Content”

Target topic: “15.3.6 Downlink control structure”.

Base Contribution:

None

Purpose:

To be discussed and adopted by TGm for the 802.16m amendment.

Outline

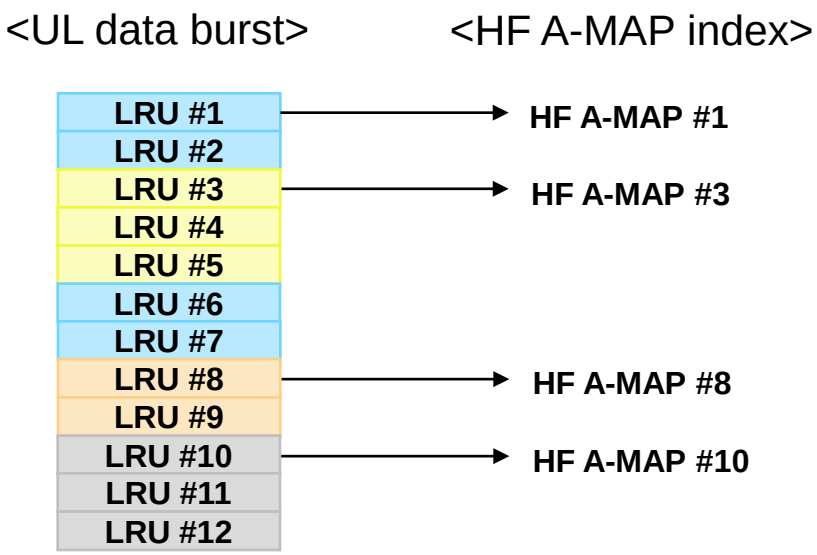
- Explicit Method vs. Implicit Method
- Overhead Analysis
- Link Performance
- Conclusion and Proposed Text
- Appendix

Basic Indexing Methods

- **HF A-MAP Indexing**
  - Corresponding to UL Burst with Synchronous HARQ
  - Explicit vs. Implicit

Explicit	Implicit
- HF A-MAP index is indicated by assignment A-MAP IE	- LRU index of UL data burst

  - Implicit Method: ex) 4 bursts, total # of LRUs=12



Performance Comparison

- **Explicit vs. Implicit**

	Explicit	Implicit: LRU index of data burst
Analysis on Spectral Efficiency	**Smaller overhead** - Addition of indexing field to A-MAP IE - Smaller HF A-MAP region . (Maximum # of UL bursts) x (required # of tones to transmit one HF A-MAP)	**Larger overhead** (especially for MU-MIMO) - No change in A-MAP IE - Larger HF A-MAP region . (# of streams) x (total # of LRUs) x (required # of tones to transmit one HF A-MAP) . Can reduce region size but reduces the granularity of scheduling unit
Link Performance for SFBC	**Easy to make SFBC pair with similar power**	**Difficult to make SFBC pair with similar power** . If power is not similar among multiplexed users, performance of de-boosted HF A-MAP degrades much
Etc		May need additional signaling for bursts with different HARQ timing (long TTI)

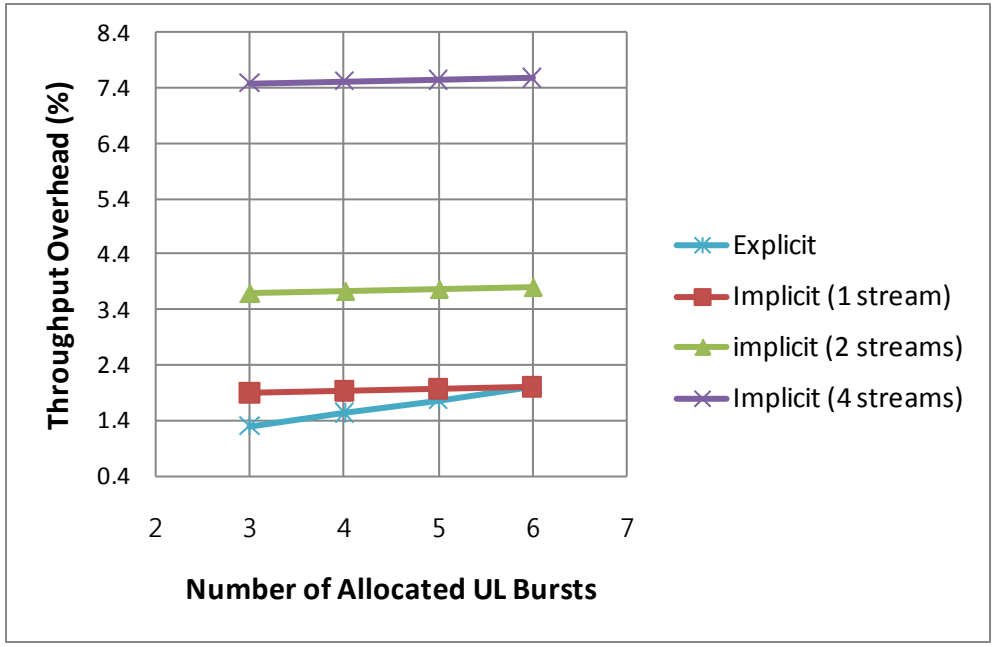
Overhead Analysis (1/2)

- **Analysis Conditions**
  - See Appendix-A for details of methodology

Parameter	Value	Note
(1) Required SNR for assignment A-MAP	2.6 dB	CC, QPSK 1/2, 48 bit info., PER=10E-2, Ped-B 3kmph
(2) Required SNR for ACK	0.8 dB	BER=10E-3, 3 repetitions, Ped-B 3kmph
(3) Total # of UL LRU per subframe	48 (per layer)	
(4) # of minimum scheduling unit	1 LRU	flexibility vs. OH in implicit method
(5) Required # of tones per ACK	3	repetition=3, BPSK with SFBC
(6) # of transmitting bursts	3, 4, 5, 6	for UL traffic
(7) Total # of tones per subframe (w/o 2TX pilot)	4608	
(8) # of maximum bursts per subframe	**16**	**4 bits indication in A-MAP IE**
(9) Prob. Of success for initial transmission	70%	initial target PER=30%
(10) # of MIMO layer	1, 2, 4	
(11) ACK region size	- **explicit: (5) x (8)** - **implicit: (3) x (5) x (10) / (4)**	
(12) Channel estimation impairment	Reflected when boosting value is calculated	
(13) Implementation power margin	1 dB	

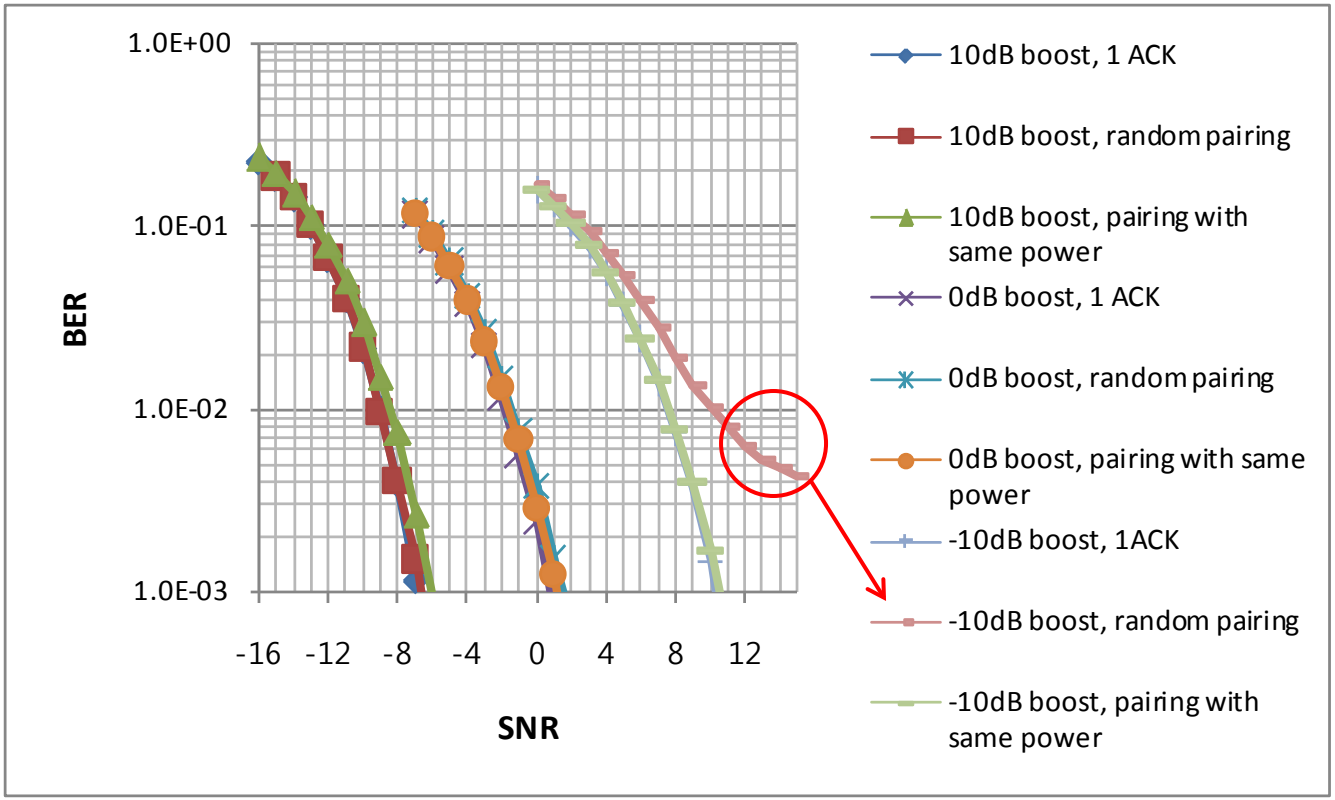
Overhead Analysis (2/2)

- **Analysis Results**
  - ***Explicit requires less overhead*** ← smaller HF A-MAP region
  - Implicit requires larger overhead especially for MU-MIMO



Link Performance

- **Condition and Result for LLS**
  - BPSK with SFBC, Repetition=3, Ped-B 3kmph
  - If power is not similar between multiplexed users, the performance of deboosted HF A-MAP degrades much



Text Proposal

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

15.3.6.4.2.3 UL basic assignment A-MAP IE

Table 662 describes the fields in a UL Basic Assignment A-MAP IE used for resource assignment in the UL.

Table 662—UL basic assignment A-MAP IE

Syntax	Size in bits	Description/Notes
A-MAP IE Type	[4]	TBD types distinguish between UL/DL, MIMO/non-MIMO operation, persistent/non-persistent allocation, basic/extended IEs
⋮		
ACID	[4] [5]	HARQ channel identifier
HFA	[4]	HARQ Feedback Allocation TBD
Padding	variable	Padding to reach byte boundary
MCRC	[16]	16 bit CRC masked by Station ID

---------- Text End ----------

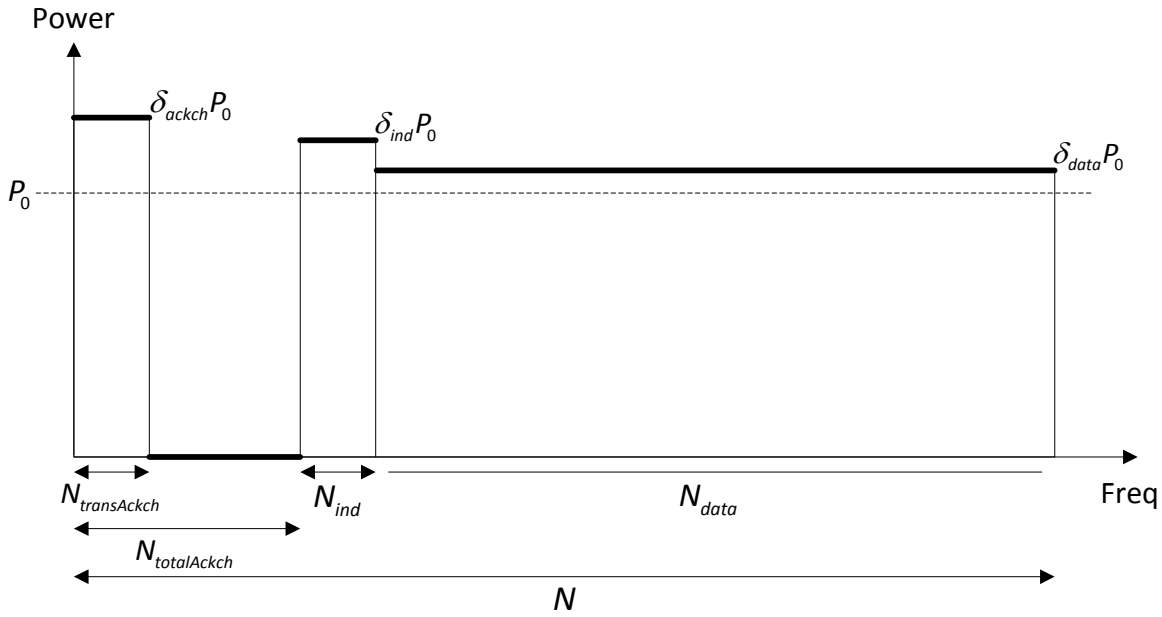
Appendix-A

- Evaluation Methodology for Overhead Analysis

Evaluation Methodology (1)

- **Methodology**

$$\delta_{ackch} P_0 N_{transAckch} + \delta_{ind} P_0 N_{ind} + \delta_{data} P_0 N_{data} = P_0 N \quad \rightarrow \text{Find } \delta_{data}$$



P_0	BS average power spectral density
$N_{transAckch}$	# of tones for transmitted ack channels
$N_{totalAckch}$	# of tones for total ack channels
N_{ind}	# of tones for ackch index indication bits in assignment blocks (explicit only)
N_{data}	# of tones for data traffic

Evaluation Methodology (2)

- 1) Find geometry distribution (PDF), $f\left(SINR(i)\right)$
- 2) Find required SINR for ACK transmission, $SINR_{ackchReq}$
- 3) For transmitted ACK region, obtain boosting (+) or deboosting (-) value
  - A) For *i*-th *SINR(i)* [dB], $\delta_{achch,i} = g_{ack}\left(SINR_{ackchReq} - SINR(i) + \Delta_{margin}\right)$
    where $g_{ack}(\cdot)$ is power effectiveness for boosting (degradation by channel estimation)
  - B) Calculate average boosting or deboosting value [linear]

    $$\delta_{ackch} = \sum_i 10^{\left(\delta_{ackch,i}/10\right)} f\left(SINR(i)\right)$$
- 4) [Explicit only] Find required SINR for assignment A-MAP IE transmission, $SINR_{indReq}$
- 5) [Explicit only] For ACK index in IE, obtain boosting (+) or deboosting (-) value
  - A) For *i*-th *SINR(i)* [dB], $\delta_{ind,i} = g_{ind}\left(SINR_{indReq} - SINR(i) + \Delta_{margin}\right)$
  - B) Calculate average boosting or deboosting value [linear]

    $$\delta_{ind} = \sum_i 10^{\left(\delta_{ind,i}/10\right)} f\left(SINR(i)\right)$$

Evaluation Methodology (3)

- 6) Obtain gain/loss for data traffic [linear]
  - $\delta_{data} = \frac{N - \delta_{ackch} N_{transackch} - \delta_{ind} N_{ind}}{N_{data}}$
- 7) Find required SINR [dB] values that meets PER 1% for every MCS levels
  - For the *j*-th MCS, $SINR_{mcs}(j)$
  - Spectral efficiency for the *j*-th MCS, $S(j)$
- 8) Shift the values obtained in 7) as
  - $SINR_{mcs,adj}(j) = SINR_{mcs}(j) - 10\log_{10}(\delta_{data})$
- 9) For adjusted SINR values in 8),
  - Calculate the portion of users that are included in the *j-th* MCS, $R_{user}(j)$
- 10) Find sector throughput, $T_{w-ack} = \sum_{j} S(j) R_{user}(j) N_{data}$
- 11) Calculate $OH_{throughput}$
  - $OH_{throughput}[\%] = \frac{T_{wo-ack} - T_{w-ack}}{T_{wo-ack}} \times 100$