Individual Backoff Time Allocation for Each Ranging Code Set

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Discuss and Adopt

Individual Backoff Time Allocation for Each Ranging Code Set

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Introduction

- Ranging procedure is one of important key features in OFDM system and 3 types of Ranging procedures are specified
- Multiple Ranging codes can be dynamically allocated to each type of Ranging and the SS shall perform the backoff delay if when the Ranging procedures failed in Ranging code transmission.
- Both the multiple codes allocation and backoff delay are related to contention resolution procedures, and collision probability due to selecting the same code and access delay due to the range of backoff delay in the Ranging procedures strongly depend on the specified number of ranging codes and backoff value
- And also, backoff time value should be determined based on the number of allocated Ranging codes

Ranging Code Allocation

- Maximum 48 Ranging codes are divided in 3 usage groups
  - — Multiple of 53bits length and 2subchannels(default) are allocated as the Ranging channel
- The 48 Ranging codes can be allocated dynamically to the groups by the BS and default number of codes for each group is 2 (N+M+L=48)
  - — Initial Ranging Code Allocation(N)
    - For the default case of 2 subchannels, the first N codes are generated by clocking the PRBS 0 times to 106*N-1 times
  - — Periodic Ranging Code Allocation(M)
    - For the default case of 2 subchannels, the next M codes are generated by clocking the PRBS 106*N times to 106*(N+M)-1 times
  - — BW-request Ranging Code Allocation(L)
    - For the default case of 2 subchannels, the next M code are generated by clocking the PRBS 106*(N+M) times to 106*(N+M+L)-1 times
- According to the cell status, implementation perspective or other reasons, Ranging code can be allocated dynamically

Ranging Procedures

- The BS sends an UL_MAP message containing a region of the each Ranging Code to be allocated into 3 groups(Initial, Periodic and BW-request ranging)
  - An Uplink_Burst_Profile shall be included in the UCD for each UIUC to be used in the UL_MAP message and UCD channel encoding information has the respective region of the Ranging codes for 3 groups
- The SS transmits a randomly selected Ranging code in a randomly selected Ranging Slot from available Ranging region to be indicated in UL_MAP message
- After receiving a Ranging Code successfully, the BS sends a response with original Ranging code and slot (e.g., OFDM symbol number and subchannel) which has been identified in Ranging code sent out previously from the SS
- If the response message is not matched to the Ranging request information sent out previously, the SS shall perform the contention resolution procedures based on the backoff delay time transmitted in UCD message.
- If matched, SS shall enter either Periodic or BW-request ranging with ranging codes randomly chosen from the periodic or BW-request domain.

Contention Resolution Procedures

- The initial and maximum backoff window size are controlled by BS and the values are specified as a part of the UCD message
- When the SS wants to enter the contention resolution process, it shall randomly select a number within its backoff window to decide the transmission opportunities that the SS shall defer before transmitting
- If the SS receives a response (Data Grant Burst Type IE or RNG_RSP message), the contention resolution is completed and a next sequential process will be started.
- If not received an anything by timer expired, the SS shall enter the retry process and continue the retransmission until the maximum number of retries has been reached
  - In case of initial ranging, the SS shall perform the power ramping
  - In case of BW-request ranging, the SS shall discard the PDU after maximum number of retries

Problem Statement (1/2)

- 1st contention resolution step : Multiple Ranging Code allocation
  - — If the number of allocated Ranging Codes for 3groups are N, M and L, respectively,the collision probability of each group due to selecting the same code could be 1/N, 1/M and 1/L, intuitively
  - — The number for N, M and L controlled by the BS can be determined based on the cell status and the number of SS in each state of the cell.
  - — The transition probability to the backoff procedures is in inverse proportion to the number of allocated ranging code
    - Generally, the collision probability is nearly close to transition probability
- 2nd contention resolution : Backoff time delay allocation
  - — According to the range of the Backoff time delay, the retransmission instance and its collision probability can be determined
  - — If the longer range of backoff delay is allocated, the collision probability due to selecting the same transmission instance with the same code will be in reduction. However, the average access delay will be increased inherently

Problem Statement (2/2)

- In the current specification, IEEE P802.16a/D3-2002, the number of Ranging codes can be dynamically allocated to the 3 groups by the BS
  - — UL_MAP message carries the region of the ranging code for each groups
- However, a single backoff time value has been designated to the all 3 groups
  - — UCD message carries a single backoff time delay value
- Even though Ranging code can be dynamically allocated to each group, a single backoff value can not adopt the variety of the Ranging code allocation
  - — The backoff time value should be carefully determined considering the 1st contention resolution step (multiple Ranging code allocation)
    - If higher contention occurs in multiple Ranging code allocation(a small number of Ranging code), longer range backoff time delay should be needed to avoid next contention.
    - On the contrary, if lower contention occurs in multiple Ranging code allocation, shorter range backoff time delay should be needed to avoid the additional access delay

Proposed Modification (1/2)

- The individual backoff time value should be allocated to each 3groups to incorporate and reflect the dynamic allocation of the Ranging code set
- The following description and table 16 should be added and modified to incorporate the proposed modification in section 6.2.2.3.3 of IEEE P802.16/D5-2001
  - — The change of the information field name as follows
    - Ranging Backoff Start/End to **Initial Ranging Backoff Start/End**
  - — The addition of the new information fields
    - **Periodic Ranging Backoff Start/End**: Initial/Final backoff window size for periodic ranging contention, expressed as a power of 2. Values of n range 0 — 15 (the highest order bits shall be unused and set to 0)
    - **BW-request Ranging Backoff Start/End**: Initial/Final backoff window size for BW-request ranging contention, expressed as a power of 2. Values of n range 0 — 15 (the highest order bits shall be unused and set to 0)

Proposed Modification (2/2)

- Table 16-Uplink Descriptor(UCD) Message Format
  - Red highlighted information fields are newly added to incorporate the proposed modification

Syntax	Size	Note
UCD_Message_Format() {		
Management Message Type=0	8-bit	
Uplink channel ID	8-bit	
Configuration Change Count	8-bit	
Mini-slot size	8-bit	
Initial Ranging Backoff Start	8-bit	
Initial Ranging Backoff Start	8-bit	
Periodic Ranging Backoff Start	8-bit	
Periodic Ranging Backoff End	8-bit	
BW-request Ranging Backoff Start	8-bit	
BW-request Ranging Backoff End	8-bit	
Request Backoff Start	8-bit	
Request Backoff End	8-bit	
TLV Encoded Information for the overall channel	Variable	TLV specific
Begin PHY Specific Section {		See applicable PHY section
for(I=1; I<n; I+n)		For each uplink burst profile 1 to n
Uplink_Burst_Profile	Variable	PHY Specific
}		
}		
}		

Conclusions

- The Individual backoff time value allocation for each 3 kinds of Ranging codes has been proposed
- Major changes are not required
  - No require the change (only the name of information field has been changed)
  - Some information fields(4 information fields) with 8bit length have been added
- No signaling message overhead (only 32 bits have been added in the existing UCD message)
- Significant performance gain expected with minor change
  - Simulation Results will be provided