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Re:	The document supports a comment in 802.16REVd Sponsor Ballot
Abstract	Implementation of AAS MAPs and AAS Network Entry procedure suggested
Purpose	The document is intended for consideration during comment resolution procedure within 802.16REVd Sponsor Ballot
Notice	
Release	
Patent Policy and Procedures	

Maps Format in AAS

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General

This document suggests a new structure and new FCH format for AAS zone in OFDM PHY.

References

[1] AIR INTERFACE FOR FIXED BROADBAND WIRELESS ACCESS SYSTEMS IEEE P802.16-REVd/D3-2004

Structure of Frame

The AAS part of the DL frame begins with an AAS specific Preamble, see Figure 1 and Figure 2.

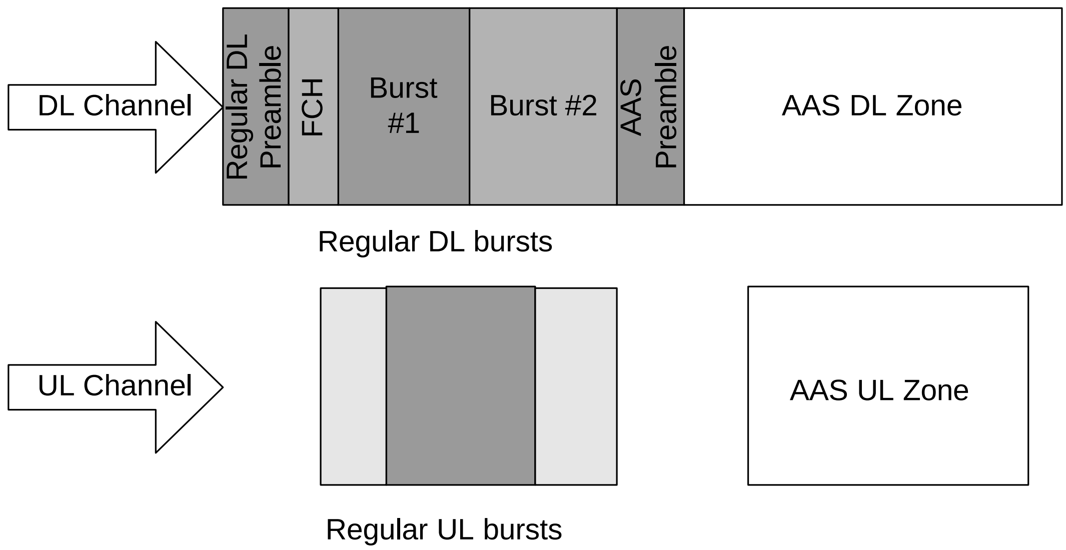

Figure 1. AAS Zone in FDD

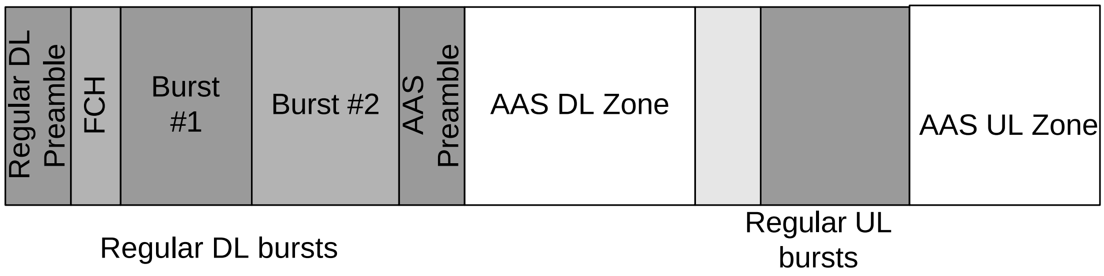

Figure 2. AAS Zone in TDD

Transmissions in AAS Zone

DL transmission to an SS or group of SSs consists of two fractions. The first fraction of the transmission consists of one or several repetitions of a short preamble followed by FCH symbol (Figure 3). The second fraction is called BODY.

FCH payload is called "ASS DL Frame Prefix" (AAS_DLFP). FCH shall be transmitted at the lowest possible modulation. Each pair preamble-FCH may be transmitted either at narrow beam or at wide beam. Optionally same preamble-FCH pair may be repeated at several beams thus implementing space diversity.

AAS_DLFP contains information (DL IEs or UL IEs) on location and transmission rate of PHY bursts. There is a possibility of more than one concatenated DL PHY bursts, each one described by a DL IE. UL IEs specify either UL PHY burst (a single burst per SS) or contention region for initial ranging or bandwidth requesting.

BODY may be transmitted at a directed beam and may start either immediately after FCH or at some distance. In the latter case, it shall start from a preamble. The payload of the burst may contain private DL-MAP and / or UL-MAP messages.

Alternatively, AAS_DLFP may contain UL IEs. There are two options:

a. A single UL IE
b. A "compressed" UL IE, which contain a network entry allocation and a regular allocation.

An example of AAS Zone layout is shown at Figure 3.

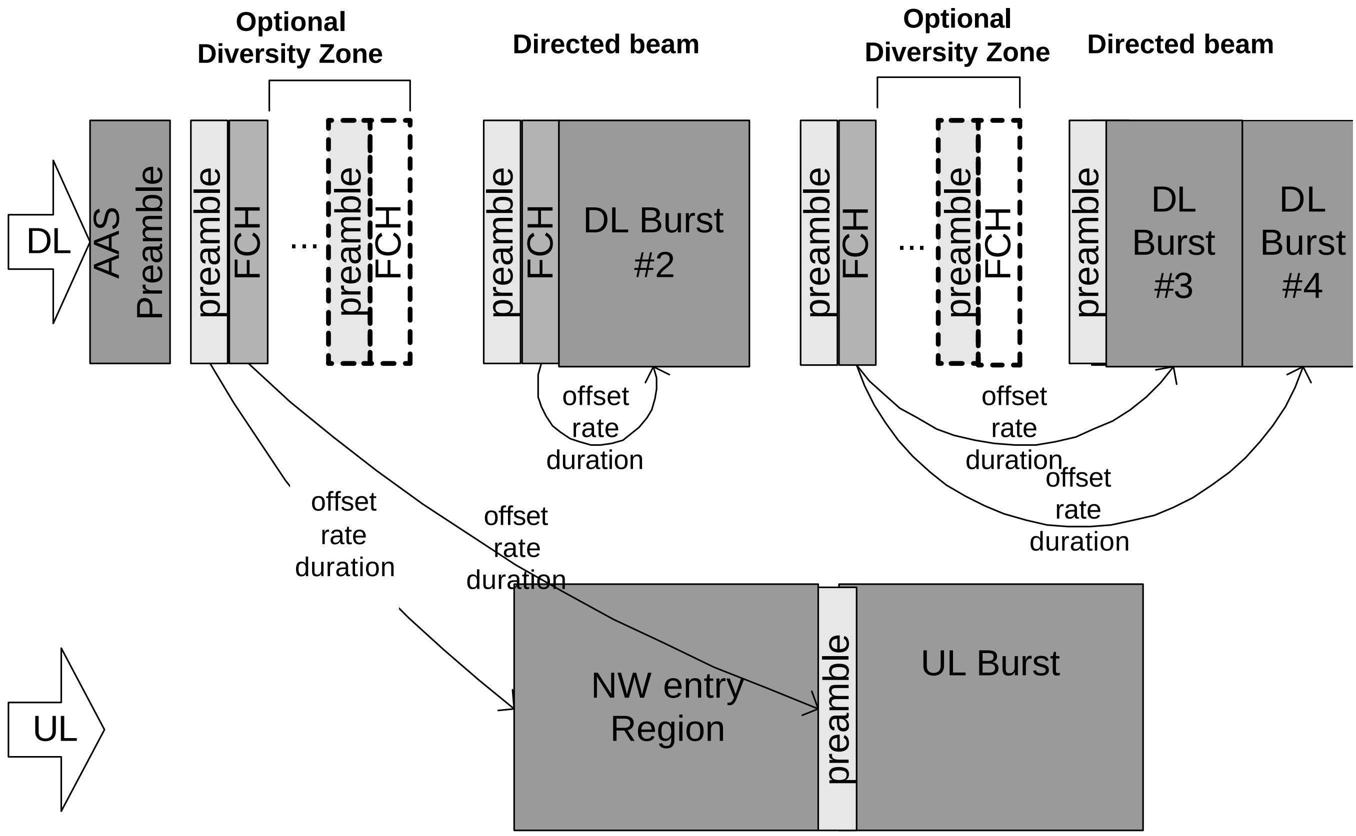

Figure 3. Structure of AAS Zone, FDD

Structure of AAS_DLFP

AAS_DLFP has structure similar to specified in [1], 8.3.4.1

Table 1. AAS_DLFP Structure

Syntax	Size	Notes
AAS_DLFP () {		
Base_Station_ID	4 bits	4 LSBs of BS ID
Frame_Number	4 bits	4 LSBs of Frame Number field as specified in Table 200
Reserved	6 bits	
Dir	1 bit	Allocation direction: Dir = ‘1’ means UL
AllocationStart	13 bits	Points to the start of BODY fraction; expressed in the terms of offset from the beginning of the AAS preamble
if(Dir == ‘1’) {		

Syntax	Size	Notes
UCD_Configuration_Change_Count	3 bits	3 LSBs of UCD Change Count value as specified in NNN
Comp_UL	1 bit	Compressed UL IE is present if bit is set to 1, else full UL IE
If (Comp_UL == ‘1’){		
AAS_COMP_UL_IE()	48 bits	
} else {		
AAS_DLFP_UL_IE()	48 bits	
}		
} else {		
Reserved	1 bits	
DCD_Configuration_Change_Count	3 bits	3 LSBs of DCD Change Count value as specified in 6.4.3.2.1
AAS_DLFP_DL_IE()	16 bits	
AAS_DLFP_DL_IE()	16 bits	
AAS_DLFP_DL_IE()	16 bits	
}		
HCS	8 bits	An 8-bit Header Check Sequence
}		
Total	11 bytes	

Table 2. Structure of AAS_DLFP_DL_IE ()

Syntax	Size	Notes
AAS_DLFP_DL_IE() {		
Rate_ID /DIUC	4 bits	For the first information element it shall be Rate_ID encoded according to the Table 195. For following IEs this field is DIUC that defines the burst profile of the corresponding burst.
Midamble present	1 bit	If ‘1’, midamble is placed before the BODY.
Length	11 bits	Number of OFDM symbols in the BODY.
}		
}		
Total	16 bits	

Table 3. Structure of AAS_DLFP_UL_IE()

Syntax	Size	Notes
AAS_DLFP_UL_IE() {		
UIUC	4	UIUC value
If (UIUC == 1) {		

Syntax	Size	Notes
AAS_NW_Entry_Response_IE()	16	
} else if (UIUC == 3) {		
Focused_Contention_Response_IE()	16	
Else {		
CID	16	If UIUC = 2, must be multicast or broadcast CID, the allocation will be used for multicast polling
}		
Reserved	9	
Subchannel_Index	5	
Midamble Present	2	Preamble repetition
Duration	12	In OFDM symbols
}		
Total	48	

AAS_COMP_UL_IE shall be used to specify two UL allocations; one of them must be for NW entry; another one is either unicast allocation or multicast / broadcast polling allocation

Table 4. Structure of COMP_UL_IE()

Syntax	Size	Notes
AAS_COMP_UL_IE() {		
UIUC	4 bits	UIUC value for regular allocation
If (UIUC == 1) {		
AAS_NW_Entry_Response_IE()	16	
} else if (UIUC == 3) {		
Focused_Contention_Response_IE()	16	TBD
else {		
CID	16 bits	For regular allocation
}		
Subchannel_Index_NW_Entry	5 bits	For NW entry allocation
Duration_NW_entry	9 bits	Duration of NW entry allocation in OFDM symbols
Subchannel_Index	5 bits	For regular allocation
Duration	9 bits	Duration of regular allocation in OFDM symbols
}		
Total	48 bits	

Note that in the case when FCH is repeated for diversity, all copies have the same content and therefore soft combining might be employed at the SS receiver.

Table 5. UIUC Usage in AAS Zone

UIUC	Usage
0	Reserved
1	AAS NW Entry Response
2	REQ Region Full

UIUC	Usage
3	REQ Region Focused
4	Focused Contention response IE
5–13	Burst Profiles

Table 6. AAS NW Entry Response IE

Field	Length, bits	Comments
AAS_NW_Entry_Respone_IE(){		
Frame Number Index	4	4 LSBs of Frame Number field
Network Entry Code	4	Random code sent by the SS in AAS Network Entry Request
Reserved	8	
}		
Total	16	

Frame Number Index
Identifies the frame in which the network entry request, which this message responds to, was transmitted.
The 4 least significant bits of the frame number are used as the frame number index.
Network Entry Code
Random code sent by the SS in AAS Network Entry Request

AAS Network Entry Procedure

In AAS mode the network entry procedure is as follows:

1. The SS detects the AAS preamble and computes the SHORT-FBCK-IE from it. (See Table).

2. The SS selects at random an AAS network entry slot and a 4 bit network entry code. The SS appends the network entry code to the SHORT-FBCK-IE and creates the AAS_NETWORK_ENTRY_REQ, as shown in Table 7.

3. In the selected slot, the SS transmits the AAS network entry request signal. The signal is composed as follows:
    a. A 2x128 preamble transmitted on the entire BW
    b. A 4x64 preamble transmitted on the entire BW
    c. The AAS_NETWORK_ENTRY_REQ message, defined below, which contains the random network entry code and the estimated phase offsets. The AAS_NETWORK_ENTRY_REQ is transmitted on the allocated subchannel using the most robust rate.

4. The BS detects the signal, extracts ranging information and decodes the message.

5. The BS responds to the network entry request by transmitting a RNG-RSP message indicating the required changes to their ranging parameters. The SS is identified by

specifying the transmit opportunity and the entry code of the AAS_NETWORK_ENTRY_REQ message. When transmitting the response, the BS may use the phase offset information to direct the beam to the SS, embedded in the SHORT-FBCK-IE.

6. The SS corrects the ranging parameters and the process of 1-5 is repeated until the ranging parameters are corrected accordingly.

7. After the ranging parameters have been corrected, the BS allocates an UL transmit opportunity. The SS is identified by the relative frame index in which the network entry was transmitted and the network entry code, using the AAS_NW_Entry_Response_IE (Table 6).

Table 7. AAS_NETWORK_ENTRY_REQ format

Field	Length, bits	Comments
Network entry code	4	A randomly selected code.
SHORT_FBCK_IE	12	Channel feedback information IE.
Total	16	

Table T7 SHORT_FBCK_IE format.

Field	Length, bits	Comments
Phase offset 1	4	The mean phase offset of antenna 1 relative to antenna 0. 4 bit signed number, in units of 360o/16.
Phase offset 2	4	The mean phase offset of antenna 2 relative to antenna 0. 4 bit signed number, in units of 360o/16.
Phase offset 3	4	The mean phase offset of antenna 3 relative to antenna 0. 4 bit signed number, in units of 360o/16.
Total	12	

Periodic Allocations

There might be a problem with arrangement of e.g. multicast polling in AAS zone because location of contention region must be transmitted to all SSs in the multicast polling group. In the case when the SSs are not located at the same beam, it must be done separately for each SS thus wasting the bandwidth.

Additional TLVs for MCA-REQ message are suggested to implement the functionality of periodic allocation of request [contention] regions.

Parameters m, k have the following meaning: multicast group gets a multicast polling allocation at the end of the frame #N if N mod k = m; size of the allocation is n.

Table 308—Multicast assignment request message encodings

Name	Type	Length	Value
…			
Multicast group type	3	1	0 = regular (not AAS), default 1 = AAS
Periodic allocation parameters	4	4	byte #0 (LS byte)= m byte #1 = k byte #2 = n byte #3 unused
Periodic allocation type	4	1	0 = REQ region Full 1 = REQ region Focused
Operation	5	1	0 = allocate 1 = deallocate
Reserved	6-255		

Note. Alternatively or complimentary allocation / deallocation of periodic request region for a multicast group might be done through AAS_Burst_Prefix_UL_IE() with special UIUC.

Appendix A: Bridging the gap in link budget between broadcast and unicast transmissions (Simulation results)

Assumptions:

?? 4 antennas at the BS
?? Independent Rayleigh fading channel at the antennas
?? Flat fading channel
?? Omni antenna radiates the same power as the multi-antenna array.
?? Downlink mean SNR with an omni-antenna is close to zero.
?? SS selects the broadcast repetition with the highest received power.

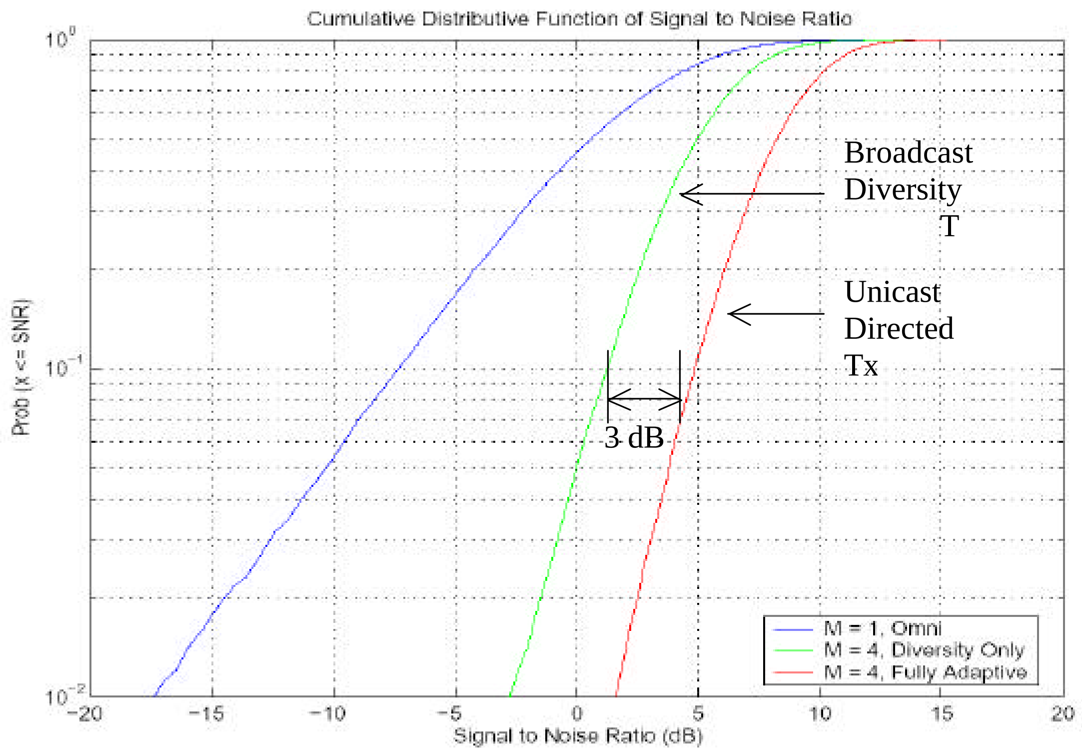

Figure 4: Downlink SNR Distribution for a cell-edge user on the broadcast and directed transmissions.

Observations:

?? Directed beam has significant coherent combining gain and diversity gain compared to an omni antenna.

?? Broadcast diversity scheme provides significant diversity gain and partial coherent combining gain.

?? A 3 dB SNR gap remains between the directed and broadcast transmissions for a 4-element array.

?? This gap can be bridged by a modulation and coding scheme that operates at an SNR 3 dB less than the directed traffic. BPSK is an obvious choice for the broadcast channel.

Specific Changes in 802.16REVd/D3

[Change in 6.4.7.6.1 "AAS MAC services", p.160 line 41]

This is achieved by dedicating part of the frame to non-AAS traffic and part to AAS traffic. The allocation is performed dynamically by the BS. Non-AAS SSs shall ignore AAS traffic, which they can identify based on the DL-MAP/UL-MAP messages.

The AAS part of the DL frame begins with an AAS specific Preamble, see Figure MMM and Figure NNN.

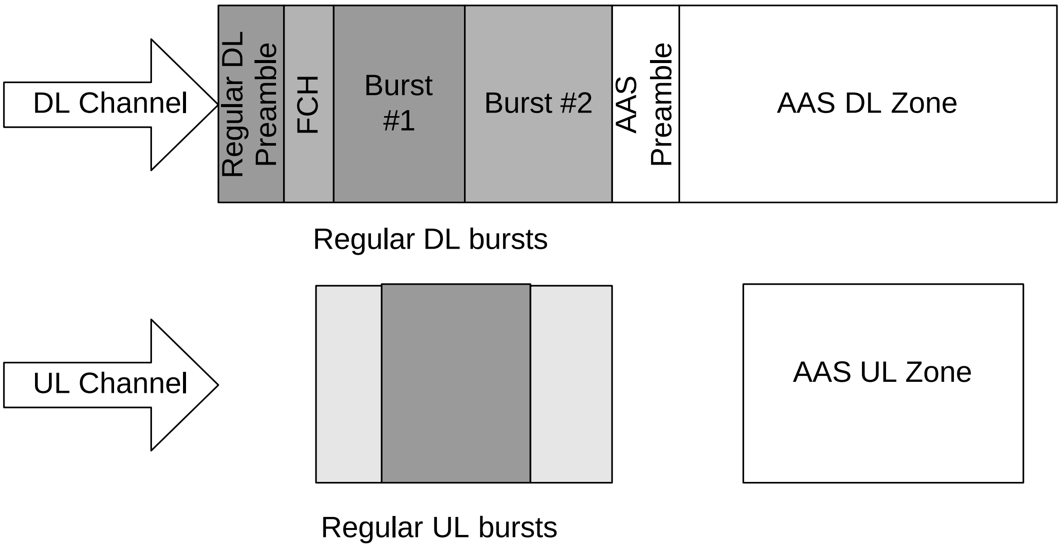

Figure MMM. AAS Zone, FDD

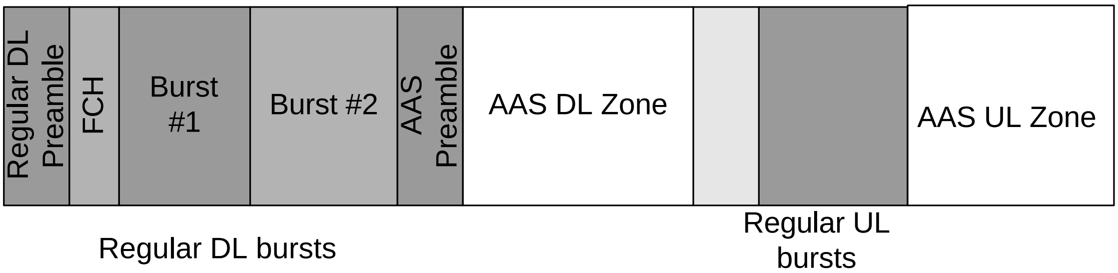

Figure NNN. AAS Zone, TDD

For bandwidth request / allocation AAS enabled SSs may use dedicated private DL-MAP/UL-MAP messages as well as tools specific for AAS (section 8.3.4.2). BS must prevent ~~and are therefore prevented~~ AAS traffic from colliding with non-AAS traffic.

Special considerations apply to those parts of the frame that are not scheduled, e.g., initial-ranging and Bandwidth-request, as discussed in 6.4.7.6.3 and 6.4.7.6.6.

[Insert a new section after 8.3.4.1]

8.3.4.2. PMP-AAS Zone

DL transmission to an SS or group of SSs consists of two fractions. The first fraction of the transmission consists of one or several repetitions of a short preamble followed by FCH symbol (Figure 3). The second fraction is called BODY.

FCH payload is called “ASS DL Frame Prefix” (AAS_DLFP). FCH shall be transmitted at the lowest possible modulation. Each pair preamble-FCH may be transmitted either at narrow beam or at wide beam. Optionally same preamble-FCH pair may be repeated at several beams thus implementing space diversity.

AAS_DLFP contains information (DL IEs or UL IEs) on location and transmission rate of PHY bursts. There is a possibility of more than one concatenated DL PHY bursts, each one described by a DL IE. UL IEs specify either UL PHY burst (a single burst per SS) or contention region for initial ranging or bandwidth requesting.

BODY may be transmitted at a directed beam and may start either immediately after FCH or at some distance. In the latter case, it shall start from a preamble. The payload of the burst may contain private DL-MAP and / or UL-MAP messages.

Alternatively, AAS_DLFP may contain UL IEs. There are two options:

1. A single UL IE
2. “Compressed” UL IE, which contains a network entry allocation and a regular allocation.

An example of AAS Zone layout is shown at Figure QQQ.

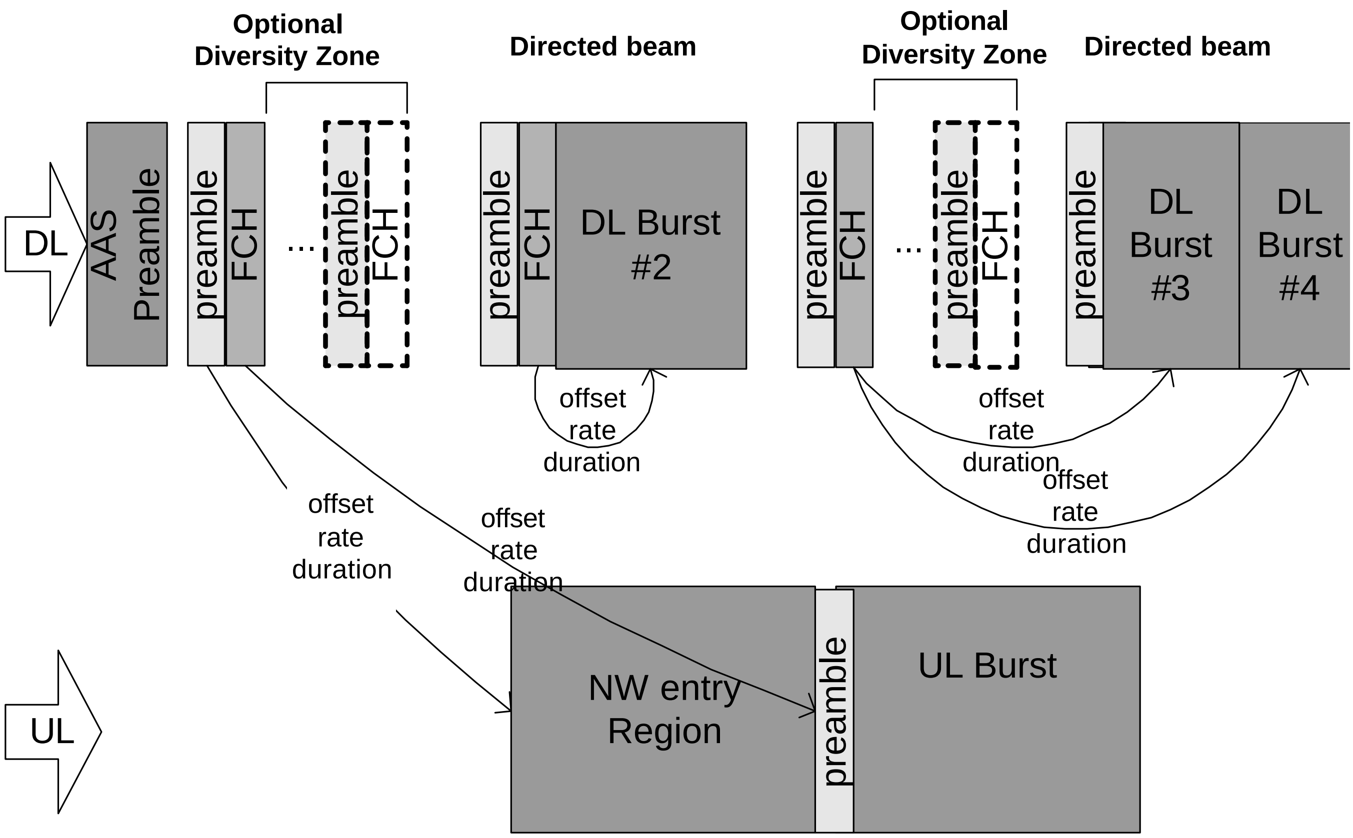

Figure QQQ. Structure of AAS Zone

The structure of AAS_DLFP is specified in Table T1; it is similar to DLFP (8.3.4.1)

Table T1. AAS_DLFP Structure

Syntax	Size	Notes
AAS_DLFP () {		
Base_Station_ID	4 bits	4 LSBs of BS ID
Frame_Number	4 bits	4 LSBs of Frame Number field as specified in Table 200
Reserved	6 bits	
Dir	1 bit	Allocation direction: Dir = ‘1’ means UL
AllocationStart	13 bits	Points to the start of BODY fraction; expressed in the terms of offset from the beginning of the AAS preamble
if(Dir == ‘1’) {		
UCD_Configuration_Change_Count	3 bits	3 LSBs of UCD Change Count value as specified in NNN
Comp_UL	1 bit	Compressed UL IE is present if bit is set to 1, else full UL IE
If (Comp_UL == ‘1’){		
AAS_COMP_UL_IE()	48 bits	
} else {		
AAS_DLFP_UL_IE()	48 bits	
}		
} else {		
Reserved	1 bits	
DCD_Configuration_Change_Count	3 bits	3 LSBs of DCD Change Count value as specified in 6.4.3.2.1
AAS_DLFP_DL_IE()	16 bits	
AAS_DLFP_DL_IE()	16 bits	
AAS_DLFP_DL_IE()	16 bits	
}		
HCS	8 bits	An 8-bit Header Check Sequence
}		

Table T2. Structure of AAS_DLFP_DL_IE ()

Syntax	Size	Notes
AAS_DLFP_DL_IE() {		
Rate_ID /DIUC	4 bits	For the first information element it shall be Rate_ID encoded according to the Table 195. For following IEs this field is DIUC that defines the burst profile of the corresponding burst.
Midamble present	1 bit	If ‘1’, midamble is placed before the burst.

Syntax	Size	Notes
Length	11 bits	Number of OFDM symbols in the burst.
}		
}		

Table T3 Structure of AAS_DLFP_UL_IE()

Syntax	Size	Notes
AAS_DLFP_UL_IE() {		
UIUC	4	UIUC value; see Table T5
If (UIUC == 1) {		
AAS_NW_Entry_Response_IE()	16	
} else if (UIUC == 3) {		
Focused_Contention_Response_IE()	16	TBD
Else {		
CID	16	If UIUC = 2, must be multicast or broadcast CID, the allocation will be used for multicast polling (see NNN)
}		
Reserved	9	
Subchannel_Index	5	
Midamble Present	2	Preamble repetition
Duration	12	In OFDM symbols
}		

AAS_COMP_UL_IE shall be used to specify two UL allocations; one of them must be for NW entry; another one is either unicast allocation or multicast / broadcast polling allocation

Table T4 Structure of AAS_COMP_UL_IE()

Syntax	Size	Notes
AAS_COMP_UL_IE() {		
UIUC	4 bits	UIUC value; see Table T5
If (UIUC == 1) {		
AAS_NW_Entry_Response_IE()	16	
} else if (UIUC == 3) {		
Focused_Contention_Response_IE()	16	TBD
else {		
CID	16 bits	For regular allocation
}		
Subchannel_Index_NW_Entry	5 bits	For NW entry allocation
Duration_NW_entry	9 bits	Duration of NW entry allocation in OFDM symbols
Subchannel_Index	5 bits	For regular allocation
Duration	9 bits	Duration of regular allocation in OFDM symbols
}		

Note that in the case when FCH is repeated for diversity, all copies have the same content and therefore soft combining might be employed at the SS receiver.

Table T5. UIUC Usage in AAS Zone

UIUC	Usage
0	Reserved
1	AAS NW Entry Response
2	REQ Region Full
3	REQ Region Focused
4	Focused Contention response IE
5–13	Burst Profiles

Table T6. AAS NW Entry Response IE

Field	Length, bits	Comments
AAS_NW_Entry_Response_IE(){		
Frame Number Index	4	4 LSBs of Frame Number field
Network Entry Code	4	Random code sent by the SS in AAS Network Entry Request
Reserved	8	
}		
Total	16	

Frame Number Index

Identifies the frame in which the network entry request, which this message responds to, was transmitted.

The 4 least significant bits of the frame number are used as the frame number index.

Network Entry Code

Random code sent by the SS in AAS Network Entry Request

[Insert before 8.4.7 a new section]

8.4.7. AAS Network Entry Procedure

In AAS mode the network entry procedure is as follows:

1. The SS detects the AAS preamble and computes the SHORT-FBCK-IE from it. (See Table T7).

2. The SS selects at random an AAS network entry slot and a 4 bit network entry code. The SS appends the network entry code to the SHORT-FBCK-IE and creates the AAS_NETWORK_ENTRY_REQ, as shown in Table T8.

3. In the selected slot, the SS transmits the AAS network entry request signal. The signal is composed as follows:
    a. A 2x128 preamble transmitted on the entire BW
    b. A 4x64 preamble transmitted on the entire BW

c. The AAS_NETWORK_ENTRY_REQ message, defined below, which contains the random network entry code and the estimated phase offsets. The AAS_NETWORK_ENTRY_REQ is transmitted on the allocated subchannel using the most robust rate.

4. The BS detects the signal, extracts ranging information and decodes the message.

5. The BS responds to the network entry request by transmitting a RNG-RSP message indicating the required changes to their ranging parameters. The SS is identified by specifying the transmit opportunity and the entry code of the AAS_NETWORK_ENTRY_REQ message. When transmitting the response, the BS may use the phase offset information to direct the beam to the SS, embedded in the SHORT-FBCK-IE.

6. The SS corrects the ranging parameters and the process of 1-5 is repeated until the ranging parameters are corrected accordingly.

7. After the ranging parameters have been corrected, the BS allocates an UL transmit opportunity. The SS is identified by the relative frame index in which the network entry was transmitted and the network entry code, using the AAS_NW_Entry_Response_IE.

Table T7. SHORT_FBCK_IE format.

Field	**Length, bits**	**Comments**
Phase offset 1	4	The mean phase offset of antenna 1 relative to antenna 0. 4 bit signed number, in units of $360^o/16$.
Phase offset 2	4	The mean phase offset of antenna 2 relative to antenna 0. 4 bit signed number, in units of $360^o/16$.
Phase offset 3	4	The mean phase offset of antenna 3 relative to antenna 0. 4 bit signed number, in units of $360^o/16$.
Total	12	

Table T8. AAS_NETWORK_ENTRY_REQ format

Field	**Length, bits**	**Comments**
Network entry code	4	A randomly selected code.
SHORT_FBCK_IE	12	Channel feedback information IE.
HCS	8	
Total	24	

[Change in table 308]

Parameters m, k have the following meaning: multicast group gets a multicast polling allocation at the end of the frame #N if N mod k = m; size of the allocation is n.

Table 308—Multicast assignment request message encodings

Name	Type	Length	Value
…			
Multicast group type	3	1	0 = regular (not AAS), default 1 = AAS
Periodic allocation parameters	4	4	byte #0 (LS byte)= m byte #1 = k byte #2 = n byte #3 unused
Periodic allocation type	4	1	0 = REQ region Full 1 = REQ region Focused
Operation	5	1	0 = allocate 1 = deallocate
Reserved	~~3~~ 6-255		