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Re:	Sponsor ballot on document ***IEEE P802.16REVd/D3-2004***
Abstract	Provides text describing support for AAS under WirelessMAN-SCa
Purpose	For consideration of adoption during Sponsor Ballot Resolution for REVd/D3.
Notice	
Release	
Patent Policy and Procedures	

WirelessMAN-SCa Support of AAS

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8.2.1.5 Duplex framing

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Insert the following text at the end of section 8.2.1.5 Duplex Framing

8.2.1.6 Support for AAS

Discussion in 8.2.1.4 and 8.2.1.5 specifies the requirements for implementation of systems supporting unicast BS transmissions on the downlink, and except in special cases, non-overlapped SS transmissions on the uplink. AAS techniques provide the ability to relax some of those contraints with the benefit of enhancing overall system performance. This subclause describes WirelessMAN-SCa support for AAS. In instances regarding system operation using AAS where there is conflict between requirements imposed by other portions of this document and this subclause, the specifications provided by this subclause shall take precedence.

Implementation of support for AAS at either BS or SS is optional.

8.2.1.6.1 Preamble definitions

Two classes of AAS Preambles are defined, based on the baseline preamble definition with $r = 1$ and $r = 3$. Within each class are four preambles, indexed $p \in \{0, 1, 2, 3\}$.

An AAS preamble shall consist of a base preamble (parameterized by $r = 1$ or $r = 3$) multiplied by one of four different phase ramp sequences, selected by the index *p*.

A base preamble shall be constructed from 5 Unique Words, each of length *U* and parameterization $r = 1$ or $r = 3$ (see 8.2.1.4.2.1). *U* shall be the same as that used by Unique Words in the downlink broadcast FCH preamble. The AAS transmission context determines selection of the $r = 1$ or $r = 3$ parameterization.

The multiplicative phase ramp sequence associated with a preamble of index *p* is

$$c_p[n] = \exp\left(\frac{j2\pi np}{4U}\right) \quad (1)$$

where $j = \sqrt{-1}$, $[n]$ is the discrete time index of a symbol-spaced sampler, $n = 0$ is the time index of the first symbol, and $n = 5U-1$ is the time index of the last symbol.

8.2.1.6.2 Power ramp-up

Transmitter power shall be ramped up over the first 4 symbols in the preamble. When creating a ramp-up element, the transmit filter memory is initialized with zero-valued (null) symbols. The preamble symbols shall then be sequentially fed into the transmit filter input stream. The transient samples preceding the first ramp-up symbol shall be suppressed at the transmit filter output until the central sample time of the first preamble symbol. A ramped power buildup shall be achieved by superimposing a multiplicative raised cosine half-window of duration 4 symbols upon the samples leaving the transmit filter.

8.2.1.6.3 Power ramp-down

All AAS elements, including bursts and burst sets, shall ramp down their power at the end of transmission. Power is ramped down by using-the natural response of the pulse-shaping filter to gradually drive the transmitter output to zero once source symbols are exhausted.

8.2.1.6.4 Frame element formats

Elements associated with AAS transmission include an AAS-indicator, an AAS-alert slot, AAS-formatted downlink subframes, and AAS-formatted uplink bursts. An example of the content of MAC frames when AAS elements are included is presented in Figure 1.

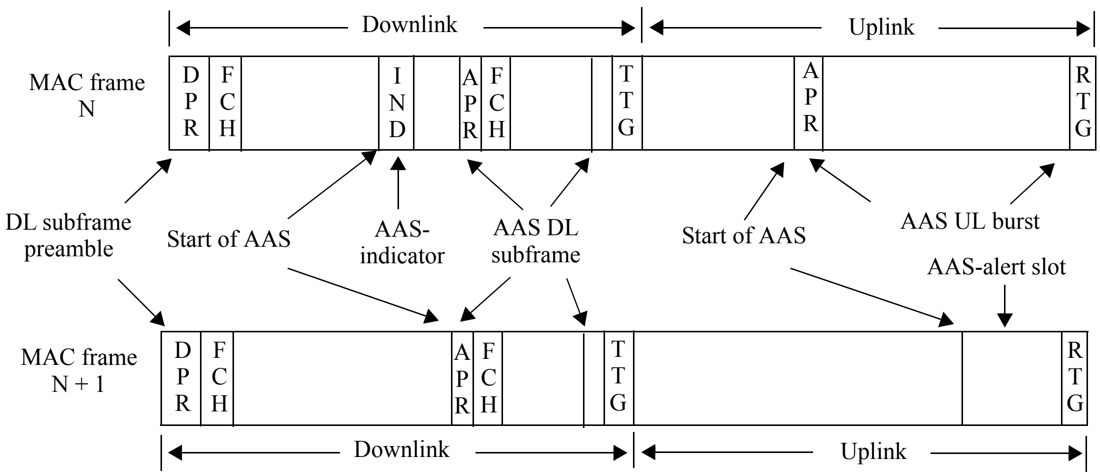

Figure 1—MAC frame contents with AAS elements

8.2.1.6.4.1 AAS-indicator

An AAS-indicator shall be composed of class $r = 3$ AAS preambles (one preamble per transmission antenna) and no payload.

An AAS-indicator is simultaneously transmitted on up to 4 BS antennas, with each antenna using a different multiplicative phase ramp index p. A larger total number of BS antennas may be accommodated by varying the set of antennas used from transmission to transmission.

An AAS-enabled SS shall be capable of phase deramping to separate each of the concurrent BS antenna transmissions and then estimating the CINR, RSSI, and carrier phase (measured over 4 UWs) for each transmission. Carrier phase measurement precision shall be no less than 11.25 degrees.

When it is included, the AAS-indicator shall appear as the first element of the AAS portion of the downlink subframe at the offset specified by the downlink subframe FCH DL-MAP AAS extended IE.

8.2.1.6.4.2 AAS-alert slot

An AAS-alert is transmitted within an AAS-alert slot on the uplink. An AAS-alert consists of an $r = 1$ AAS preamble followed by a payload of fixed length known to the MAC. The payload is encoded using the baseline concatenated FEC, with rate 1/2 BPSK convolutional code.

The index, p, of the preamble is selected randomly by the SS.

The alert slot, when it is present, is located at the end of the uplink subframe, immediately before the MAC frame RTG.

8.2.1.6.4.3 Downlink AAS subframe

A downlink AAS subframe contains payload data directed to one or more AAS subscribers. Subject to the capabilities of the BS, multiple AAS subframes may be transmitted within the AAS portion of the downlink subframe. Those subframes may be concurrent or sequential in time.

A downlink AAS subframe transmission consists of an AAS preamble followed by payload data consisting of one or more bursts or burst sets (standard or STC). The preamble parameter *r* is set to 3. Before and during initial network entry, the value of the index *p* shall be the same as the index value used by the SS for its uplink alert slot transmission. Once network entry has been achieved and the SS is receiving DL-MAPs, use of the original value employed during network entry is maintained until it is overridden by a notification from the BS. The modulation type, length, and FEC are determined by the AAS DL-MAP. The first burst following the preamble shall be an FCH that is encoded using the baseline concatenated FEC, with rate 1/2 BPSK convolutional code.

8.2.1.6.4.4 Uplink AAS burst

An uplink AAS burst is transmited in the AAS portion of the uplink subframe. Subject to the capabilities of the BS, multiple AAS bursts may be transmitted within the AAS portion of the uplink subframe. Those bursts may be concurrent or sequential in time.

An AAS burst contains payload data from an AAS-enabled subscriber with formatting of the transmission specified by the contents of a UL-MAP arriving at the SS in either a downlink subframe FCH or an AAS-FCH. Burst types transmitted in the AAS portion of the uplink frame may be any of the frame types available to non-AAS enabled SS: standard, subchannel, or STC. For standard bursts, an AAS preamble shall be used with the value of *r* set to 1 and the value of *p* specified in the UL-MAP. For STC or subchannel bursts, the preamble used shall conform to the preamble format prescribed for the corresponding burst type.

8.2.1.6.5 AAS-enabled operations

WirelessMAN-SCa support for AAS follows the general discussion appearing in 6.4.7.6.

8.2.1.6.5.1 Downlink synchronization

Downlink network synchronization of AAS-enabled SS shall be accomplished by detecting and synchronizing with the FCH burst set preamble transmitted at the start of each downlink subframe.

8.2.1.6.5.2 Network entry

For AAS-enabled SS that can decode the downlink subframe FCH, network entry shall be carried out as prescribed in 6.4.9.

For situations where the FCH contents cannot be decoded, the procedure outlined in 6.4.9 shall apply except for the actions taken to initiate and complete the first initial ranging RNG-REQ/RSP dialog.

When FCH contents cannot be decoded, the SS shall monitor each downlink subframe transmission for the occurrence of an AAS-indicator sequence. The presence of this sequence shall indicate the availability of an AAS-alert slot in the frame following the frame containing the sequence.

An AAS-alert slot is similar to an initial ranging slot used for conventional network entry and shall be sized to allow transmission of a RNG-REQ message (the size prescribed in 6.4.2.3.5 and 6.4.9 for intial ranging request message plus the size of the SCa AAS feedback and AAS broadcast capability TLVs) and the appropriate burst preamble, and shall also account for the maximum round-trip propagation delay between a BS and the most distant SS to be serviced. The size and location of the of the slot in the uplink subframe shall be well-known. The SS shall initiate transmission in the alert slot assuming the SS is colocated with the BS.

The following discussion references start and end parameters for the exponential backoff algorithm used for the initial ranging dialog of AAS subscribers. The well-known values for these parameters shall be *start = 3*, and *end = 8*.

8.2.1.6.5.2.1 AAS-alert transmissions decodable at BS

Upon reception of an alert slot transmission, if the BS can decode the transmission, it shall format a response in the form of a RNG-RSP message based on the information provided in the AAS-alert RNG-REQ message and data collected during reception. The response shall be transmitted in the AAS portion of a subsequent DL frame using the same preamble index (*p*) as that used for the AAS alert RNG-REQ transmission. The RNG-RSP response is equivalent to the response to a decodable initial ranging RNG-REQ message as described in 6.4.9, terminating the initial net entry RNG-REQ dialog. The transmission containing the RNG-RSP message shall also include DCD and UCD messages.

Once an alert slot transmission has been made, the SS shall await a response as specified by 6.4.9. If no response is received, a new alert slot is selected in accordance with the exponential back-off algorithm specified in 6.4.8. The starting and end backoff values shall be well-known (8.2.1.6.5). Once the new alert slot has been selected, the RNG-REQ alert slot transmission process is repeated.

8.2.1.6.5.2.2 AAS-alert transmissions undecodable at BS

In the event a transmission is detected but the uplink alert message cannot be decoded, the BS shall format a RNG-RSP message based on the data collected during reception and specify the frame in which the alert was sent using the Frame number TLV. The message shall not include the Initial ranging opportunity TLV. The response shall be transmitted in the AAS portion of a subsequent DL frame using the same preamble index (*p*) as that used for the AAS-alert RNG-REQ transmission. The RNG-RSP response is similar to the response to an undecodable initial ranging RNG-REQ message as described in 6.4.9. The transmission containing thet RNG-RSP message shall also include DCD and UCD messages.

Once the alert slot transmission has been made, the SS shall await a response as specified by 6.4.9. If no response is received, a new alert slot is selected in accordance with the exponential back-off algorithm specified in 6.4.8. The starting and end backoff values shall be well-known (8.2.1.6.5). Once the new alert slot has been selected, the RNG-REQ alert slot transmission process is repeated.

If the RNG-RSP message with the Frame number TLV is received, the SS shall await notification in an arriving AAS-FCH UL-MAP that an initial ranging contention slot grant has been scheduled. The size of this slot shall be the same as the AAS-alert slot. The SS shall respond to the grant by formatting and sending a RNG-REQ message (with SCa AAS feedback and AAS broadcast capability TLVs) in that slot. The preamble index shall be the same as that used in the most recent AAS-alert slot transmission.

If the transmission is detected at the BS, an appropriate RNG-RSP message is formatted based on whether or not the BS was able to decode the content of the transmission and the message is transmitted in the AAS portion of a subsequent DL frame using the same preamble index (*p*) as that used for the RNG-REQ transmission.

Successful reception of a response to a RNG-REQ decoded by the BS is equivalent to the response to a decodable initial ranging RNG-REQ message as described in 6.4.9, terminating the initial net entry RNG-REQ dialog.

Successful reception of a response to a RNG-REQ that could not be decoded by the BS indicates that the SS shall wait for another contention initial ranging grant opportunity and repeat the process described in this subclause.

If the SS does not receive a response to its contention slot transmission, in accordance with the timeout limits specified in 6.4.9, a new alert slot is selected in accordance with the exponential back-off algorithm specified in 6.4.8. The starting and end backoff values shall be well-known (8.2.1.6.5). Once the new alert slot has been selected, the RNG-REQ alert slot transmission process is repeated.

8.2.1.6.5.3 Data exchange

When AAS operations are active, the downlink and uplink subframes shall be partitioned into portions dedicated to AAS and non-AAS usage. The first part of each subframe shall be allocated to non-AAS operations, with any remainder allocated for AAS activities. AAS extended IEs are included in the FCH DL-MAP and the UL-MAP to specify the location of the boundary between the partitions.

Downlink AAS transmissions including responses to alert slot RNG-REQ messages shall consist of a preamble followed by an FCH burst, and optionally, one or more data bursts and/or additional burst sets. The BS shall not allow concurrent AAS transmissions that are initiated by the same AAS preamble.

The format of the content of an AAS FCH shall conform to the format of the FCH appearing at the start of the downlink subframe with the exception that RNG-RSP messages may be carried in the AAS-FCH rather than in a subsequent burst. The order of appearance of messages in the AAS-FCH shall be DL-MAP, UL-MAP, DCD, UCD, and, RNG-RSP. In addition, WirelessMAN-SCa AAS implementations shall not support private maps where broadcast CID values are replaced with the basic CID of an SS.

For AAS-capable SS able to decode the downlink subframe FCH, the SS shall enable its receiver for all non-AAS transmissions it is capable of receiving. It shall also enable its receiver at the start of the AAS portion of the downlink subframe, and having detected an appropriate preamble, it shall receive and decode the data stream (AAS-FCH and data bursts) following each such preamble. The receiver shall be disabled at the start of the TTG at the end of the DL subframe.

For AAS-capable SS unable to decode the downlink subframe FCH, the SS shall enable its receiver at an offset into the frame at or before the location corresponding to the end of the XFCH portion of the FCH, and having detected an appropriate preamble, it shall receive and decode the data stream (AAS-FCH and data bursts) following each such preamble. The receiver shall be disabled at the earlier of the following three frame locations: if known, at the end of the downlink subframe; at the start of the AAS-alert slot, if one is present; or at the start of the RTG at the end of the uplink frame.

Just as in the non-AAS case, AAS uplink transmissions after net entry are governed by the BS through bandwidth allocations. For AAS-capable SS able to decode the downlink subframe FCH, the SS may respond to either grants indicated in the downlink subframe FCH UL-MAP or in the UL-MAP appearing in an AAS-FCH burst. For AAS-capable SS unable to decode the downlink subframe FCH, the SS shall transmit only in grants indicated in the UL-MAP appearing in an AAS-FCH burst.

8.2.1.6.6 Channel measurement

8.2.1.6.6.1 DL subframe preamble

Measurments regarding the DL subframe preamble used for network synchronization and network entry shall be collected by the SS and reported to the BS using the REP-REQ/RSP message dialog. Reports to the BS may occur in response to a request from the BS or may be issued asynchronously by the SS.

8.2.1.6.6.2 AAS feedback

Information on BS AAS transmissions shall be collected by the SS each time it detects an AAS-indicator transmission. At the initial phase of network entry, this information shall be provided to the BS in the alert transmission.

Following network entry, the information shall be provided using the AAS-FBCK message dialog. Reports to the BS may occur in response to a request from the BS or may be issued asynchronously by the SS.

The format of the AAS Feedback Request message body is shown in Table 82.

Table 1—SCa AAS Feedback Request message body

Syntax	Size	Notes
SCa-AAS-FBCK-REQ_Message_Body() {		
Frame Number	8 bits	
Number of Frames	8 bits	
Feedback Request Number	8 bits	
Data Source	2 bit	0 - Preamble of AAS transmissions holding data for SS 1 - AAS-indicator sequence. 2, 3 *reserved*
Measurement Requests	6 bits	Bit #0 - Report relative phase offsets Bit #1 - Report CINR mean Bit #2 - Report CINR std dev Bit #3 - Report RSSI mean Bit #4 - Report RSSI std dev Bit #5 - *reserved*
}		

Frame Number
The least significant 8 bits of the frame number in which to start the measurement.

Number Of Frames
The number of frames over which to measure.

Feedback Request Number
Incremented each time an AAS-FBCK-REQ is sent to an SS. Valid values are 0 - 254. Unique counters shall be maintained for each SS.

Data Source
Specifies the frame entity to be measured.

Measurement Requests
Specifies the measurements to be performed on the indicated data source.

The format of the SCa AAS Feedback Response message body is shown in Table 2..

Table 2—SCa AAS Feedback Request message body

Syntax	Size	Notes
SCa-AAS-FBCK-RSP_Message_Body() {		
Feedback Request Number	8 bits	
Number of Observations	8 bits	
Data Source	2 bit	0 - Preamble of AAS transmissions directed at SS 1 - AAS-indicator sequence. 2, 3 *reserved*
Measurements Reported	6 bits	Bit #0 - Relative phase offsets Bit #1 - CINR mean Bit #2 - CINR std dev Bit #3 - RSSI mean Bit #4 - RSSI std dev Bit #5 - *reserved*
if (Relative phase offsets reported) {		
Phase offset - antenna 1 vs 0	5 bits	Units of $360^o/32$
Phase offset - antenna 2 vs 0	5 bits	Units of $360^o/32$
Phase offset - antenna 3 vs 0	5 bits	Units of $360^o/32$
reserved	1 bits	Set to zero
}		
if (CINR mean reported)		
CINR mean	8 bits	See 8.2.2
if (CINR std dev reported)		
CINR std dev	8 bits	See 8.2.2
if (RSSI mean reported)		
RSSI mean	8 bits	See 8.2.2
if (RSSI std dev reported) {		
RSSI std dev	8 bits	See 8.2.2
}		

Feedback Request Number

Frame Request Number from the AAS-FBCK-REQ messages to which this is the response. A value of 255 indicates that measurements reported were not requested by the BS.

Number of Observations

Nunber of instances of the data source item contributing to the measurements reported.

Data Source

Specifies the frame entity which was measured.

Measurements Reported

Specifies the measurements performed on the indicated data source and reported in this message.

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Insert the following at the end of section **8.2.1.5.5.2.5**

8.2.1.5.5.2.6 AAS DL preamble index extended IE

The presence of this extended IE in a DL-MAP notifies the AAS-enabled SS identified by the specified basic CID value that the preamble used for future BS transmissions to the SS shall be generated using the specified index value.

Table 3—SCa AAS DL preamble index IE format

Syntax	Size	Notes
INDX_IE() {		
Subcode	4 bits	INDX = 0x04
Length	4 bits	Length = 3
CID	16 bits	Basic CID of targeted SS
Index	8 bits	0..3
}		

==

Insert the following at the end of section **8.2.1.5.5.3.3**

8.2.1.5.5.3.4 AAS UL preamble index extended IE

The presence of this extended IE in a UL-MAP instructs the AAS-enabled SS associated with the basic CID value appearing in the parent IE CID field to use the AAS preamble associated with the specified index value for any future transmissions. This includes transmissions associated with data grants appearing later in the same UL-MAP.

Table 4—SCa AAS UL preamble index IE format

Syntax	Size	Notes
INDX_IE() {		
Subcode	4 bits	INDX = 0x03
Length	4 bits	Length = 1
Index	8 bits	0..3
}		

==

Insert the following at the end of section 11.5 and immediately before the start of 11.6 after table 292.

Table 293—SCa-specific RNG-REQ message encodings

Name	Type	Length	Value
SCa AAS feedback	150	6	Phase offsets 5 bits - Antenna 1 relative to antenna 0 signed value units of $360^{o}/32$ 5 bits - Antenna 2 relative to antenna 0 signed value units of $360^{o}/32$ 5 bits - Antenna 3 relative to antenna 0 signed value units of $360^{o}/32$ 1 bit - *reserved* Antenna CINR values (see 8.2.2) 1byte - Antenna 0 1byte - Antenna 1 1byte - Antenna 2 1byte - Antenna 3

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Insert the following after table 293 and before table 294.

Table 294—SCa-specific RNG-RSP message encodings

Name	Type	Length	Value
AAS preamble index	150	1	0, 1, 2, 3 = Index of the AAS preamble to be used on future AAS transmissions to the SS

==

Replace the contents of section 6.4.2.3.39 with the following.

6.4.2.3.39 AAS Channel Feedback Request/Response (AAS-FBCK-REQ/RSP)

The AAS Channel Feedback Request message shall be used by a system supporting AAS and operating in frequency division duplex (FDD) mode. It may also be used by a system supporting AAS and operating in TDD mode. This message serves to request channel measurement that will help in adjusting the direction of the adaptive array

Table 82—AAS Feedback Request (AAS-FBCK-REQ) message format

Syntax	Size	Notes
SCa-AAS-FBCK-REQ_Message_Format() {		
Management Message Type = 44	8 bits	
Message body	*variable*	See 8.2, 8.3, or 8.4)
}		

The AAS Channel Feedback Response message shall be sent as a response to the AAS-FBCK-REQ message after the indicated measurement period has expired.

Table 82—AAS Feedback Response (AAS-FBCK-RSP) message format

Syntax	Size	Notes
SCa-AAS-FBCK-REQ_Message_Format() {		
Management Message Type = 45	8 bits	
Message body	*variable*	See 8.2, 8.3, or 8.4
}		

===

Insert the following at appropriate locations in 8.3 and 8.4.
Change OFDMx to OFDM or OFDMA for appropriate section and remove the unused definitions for either OFDM or OFDMA..

Table 82—OFDMx AAS Feedback Request message body format

Syntax	Size	Nodes
OFDMx-AAS-FBCK-REQ_Message_Body() {		
Frame Number	24 bits	
NumberOfFrames	7 bits	
Measurement DataType	1 bit	0 = measure on downlink preamble only 1 = measure on downlink data (for this SS) only.
Feedback Request Counter	6 bits	
Frequency measurement resolution	2 bits	For OFDM: 0b00 = 4 subcarriers 0b01 = 8 subcarriers 0b10 = 16 subcarriers 0b11 = 32 subcarriers For OFDMA: 0b00 = 32 subcarriers 0b01 = 64 subcarriers 0b10 = 128 subcarriers 0b11 = 256 subcarriers
}		

Frame Number
The Frame Number in which to start the measurement.

NumberOfFrames
The number of frames over which to measure.

Feedback Request Counter
Every time an AAS-FBCK-REQ is sent to the SS. Individual counters shall be maintained for each SS.

Frequency measurement resolution
Indicates the frequency measurement points to report on. Measurement points shall be on the frequencies corresponding to the negative subcarrier offset indices -N_{used}/2 plus n times the indicated subcarrier resolution and corresponding to the positive subcarrier offset indices N_{used}/2 minus n times the indicated subcarrier resolution where n is a positive integer.

.

Table 83—OFDMx AAS Feedback Response message body format

Syntax	Size	Nodes
OFDMx-AAS-FBCK-RSP_Message_Body() {		
Reserved	2 bits	Set to 0b00
Feedback Request Number	6 bits	
for (i=0; i<**NumberOfFrequencies**; i++) {		
Re(F**requency_value[i]**)	8 bits	
Im(**Frequency_value[i]**)	8 bits	
}		
}		

Feedback Request Counter

Counter from the AAS-FBCK-REQ messages to which this is the response.

Re(**Frequency_value[i]**) and Im(**Frequency_value[i]**)

The real (Re) and imaginary (Im) part of the measured amplitude on the frequency measurement point (low to high frequency) in signed integer fixed point format ([±][4 bits].[11 bits].