IEEE P802.11
Wireless LANs

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| P802.11ah LB200 some proposed resolutions for Clause 4 and ToD accuracy |
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Abstract

This document proposes resolutions for following comments of P802.11ah D1.0 LB200.

CID for Clause 4: 2540, 2541, 2542, 2593

CID for Time of Departure accuracy: 2543, 2544

Also, the proposed resolutions may be applicable to CID 1627, 1933 and 2607.

# Proposed changes for Clause 4

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| **CID** | **Clause** | **Comment** | **Proposed Change** |
| 2540 | 4 | As the S1G PHY is based on the VHT PHY, most of the features and behaviors of VHT STAs specified in Clause 8 to Clause 10, and Clause 13 apply to S1G STAs as well.It is necessary to add description of S1G STA in subclause 4.3 to specify the application of VHT features and behaviors. | Insert a new subclause 4.3.10c "Sub 1GHz (S1G) STA" following 4.3.10b "Television very high throughput (TVHT) STA".Detailed proposed changes are provided in 11/13-1316. |
| 2607 | 4.3 | There is no description of S1G STA in clause 4.3. Need to add a general description of a S1G STA similar to those of HT and VHT STAs | Add a description of S1G STA in clause 4.3 |

## Detailed proposed change for CID 2540 and 2607

*(Instruction to Editor) Insert a new subclause 4.3.10c as follows:*

### 4.3.10c Sub 1GHz (S1G) STA

The IEEE 802.11 Sub 1 GHz (S1G) STA provides PHY and MAC features that can support transmission range up to 1 km with data rates higher than 100 kbit/s and more than 6000 STAs in a BSS. An S1G STA operates in license-exempt bands below 1 GHz, excluding the TV White Space bands.

An S1G STA supports S1G features identified in Clause 8, Clause 9, Clause 10, Clause 13 and Clause 24. Many of the features and behaviors of VHT STAs and HT STAs specified in Clause 8, Clause 9, Clause 10 and Clause 13 also apply to S1G STAs as well unless stated otherwise.

The main PHY features in an S1G STA are the following:

* Mandatory support for 1 MHz and 2 MHz channel width
* Mandatory support for S1G single user (SU) PPDU
* Optional support for 4 MHz, 8 MHz and 16MHz channel widths
* Optional support for S1G multi-user (MU) PPDU
* Optional support for Beamforming sounding by sending an S1G NDP
* Optional support for S1G-MCSs 8 and 9
* Optional support for travelling pilot

An S1G STA mandatory supports following MAC features:

* Short MAC frame format
* NDP MAC frame format
* Controlled transmission to an energy limited STA
* Reception of Short Beacon
* Aggregate MPDU (A-MPDU) operation
* Reception of an Aggregate MSDU (A-MSDU) frame
* Immediate Block Ack operation

An S1G STA optionally supports following MAC features of an S1G STA, a VHT STA and an HT STA:

* Transmission of Short Beacon
* Restricted Access Window (RAW)
* Non-TIM STA operation
* Synchronization frame operation
* Relay operation
* Target Wake Time (TWT)
* Speed Frame Exchange
* TIM and page segmentation
* Dynamic AID assignment operation
* Sectorized beam operation
* Subchannel Selective Transmission (SST)
* Sensor only BSS operation
* Notification as an energy limited STA
* Flexible Multicast
* OBSS Mitigation operation
* AP Power management
* Authentication control
* Asymmetric Block Ack operation
* Delayed Block Ack operation
* Transmission of an Aggregate MSDU (A-MSDU) frame
* Reverse Direction (RD)
* SM power save
* Power save multipoll (PSMP) operation

An S1G STA shall not support following MAC features:

* Use of RIFS
* Transmission of S1G PPDUs protected by dual CTS protection
* Phased coexistence operation (PCO)

For Clause 6, Clause 7, Clause 8, Clause 9, Clause 10 and Clause 13, the following replacements are applied for S1G STAs:

* ”2/4 MHz” replaces “20/40 MHz”
* ”2/4/8/16 MHz” replaces “20/40/80/160 MHz”
* ”2 MHz”, “4 MHz”, “8 MHz”, and “16 MHz” replace “20 MHz”, “40 MHz”, “80 MHz”, and “160 MHz” respectively
* ”CBW2” replaces “CBW20”
* ”CBW4” replaces “CBW40”
* ”CBW8” replaces “CBW80”
* ”CBW16” replaces “CBW160”
* ”S1G STA” replaces “VHT STA”
* ”S1G AP” replaces “VHT AP”
* ”S1G BSS” replaces “VHT BSS”
* “S1G PPDU” replaces “VHT PPDU”
* “S1G-MCS” replaces “VHT-MCS”
* ”S1G Capabilities” replaces “VHT Capabilities”
* ”S1G Operation” replaces “VHT Operation”
* ”dot11S1GOptionImpelemented” replaces “dot11VHTOptionImplemented”
* “dot11ShortGIOptionIn2MActivated” replaces “dot11ShortGIOptionInTwentyActivated”
* “dot11ShortGIOptionIn4MActivated” replaces “dot11ShortGIOptionInFourtyActivated”
* "dot11ShortGIOptionIn8MActivated" replaces "dot11VHTShortGIOptionIn80Activated"
* "dot11ShortGIOptionIn16MActivated" replaces "dot11VHTShortGIOptionIn160and80p80Activated"
* "dot11S1GSUBeamformerOptionImplemented" replaces "dot11VHTSUBeamformerOptionImplemented"
* "dot11S1GSUBeamformeeOptionImplemented" replaces "dot11VHTSUBeamformeeOptionImplemented"
* "dot11S1GMUBeamformerOptionImplemented" replaces "dot11VHTMUBeamformerOptionImplemented"
* "dot11S1GMUBeamformeeOptionImplemented" replaces "dot11VHTMUBeamformeeOptionImplemented"
* "dot11S1GSUBeamformeeActivated" replaces "dot11VHTSUBeamformeeActivated"
* "dot11S1GTXOPPowerSaveOptionImplemented" replaces "dot11VHTTXOPPowerSaveOptionImplemented"
* "dot11S1GOBSSScanCount" replaces "dot11VHTOBSSScanCount"
* Reference to 8.4.2.170k (S1G Capabilities element) replaces both reference to 8.4.2.160 (VHT Capabilities element) and reference to 8.4.2.58 (HT Capabilities element)
* Reference to 8.4.2.170w (S1G Operation element) replaces reference to 8.4.2.161 (VHT Operation element).
* Reference to 9.17b (Group ID and partial AID in S1G PPDUs) replaces reference to 9.17a (Group ID and partial AID in VHT PPDUs)
* Reference to 9.20.2.9 (EDCA channel access in a S1G BSS) replaces reference to 9.19.2.8 (EDCA channel access in a VHT BSS).
* Reference to 10.47 (S1G BSS operation) replaces reference to 10.39 (VHT BSS operation)
* Reference to Clause 24. (Sub 1 GHz (S1G) PHY specification) and its corresponding subclauses replace reference to Clause 22. (Very High Throughput (VHT) PHY specification) and its subclauses.

For subclause 9.3 (DCF) and 9.27 (PSMP Operation), "S1G AP" replaces "HT AP".

For subclause 8.4 (Management frame body components), 9.13 (PPDU duration constraint), 9.27 (PSMP Operation), 10.7 (DLS operation) and 10.19 (RSNA A-MSDU procedures), "S1G STA" replaces "HT STA".

These S1G features are available to S1G STAs associated with an S1G AP in a BSS. A subset of the S1G features is available for use between two S1G STAs that are members of the same IBSS or MBSS.

| **CID** | **Clause** | **Comment** | **Proposed Change** |
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| 2541 | 4 | It is better to provide a general description of a Sensor type STA to describe recommended capabilities of the Sensor type STA. | Add new subclause 4.11f which describes Sensor type STA.Detailed proposed changes are provided in 11/13-1316. |
| 1627 | 3.2 | The sensor type station definition is too vague. Why do we need a new type of STA? | Add a section describing what a sensor type station is and why there are specific capabilities in the amendment to address this station type. |
| 1933 | 9.49 | Where is 'Sensor type STA defined? I can't find it. | Define what a "Sensor type STA" is |

## Detailed proposed change for CID 2542 and 1627

*(Instruction to Editor) Insert a new subclause 4.3.11d as follows:*

### 4.3.11d Sensor type STA

A Sensor type STA is a non-AP S1G STA that has following characteristics.

* Large number of STAs (more than 6000) within a BSS
* Small data size and low traffic per STA
* Operating with limited energy (e.g. battery operation)
* Limited bandwidth (e.g. 1MHz / 2MHz BSS)

Large number of STAs within a BSS may increase a size of TIM information and a probability of collisions. TIM and Page segmentation in 9.45 can be used to reduce the size of TIM information, and Restricted Access Window (RAW) in 9.20.5 can be used to reduce collisions.

Small data size and low traffic per STA may increase relative overhead of MAC header signalling. A short MAC frame format in 8.7, a NDP and NDP MAC frames in 8.3.5 and Short Beacon in 10.46 can reduce these overheads.

Operating with limited energy requires long sleep duration and short wake duration. Target Wake Time (TWT) in 9.41, non-TIM STA in 9.42 and Speed Frame Exchange in 9.44 can be used to enable long sleep duration and reduce wake duration. Also, support for energy limited STAs in 9.50 can be used to limit STA’s activity in certain intervals of time.

Limited bandwidth may increase probability of deep fades. Subchannel Selective Transmission (SST) in 9.46 can be used to suffer frequency selective fading.

An S1G AP may separate Sensor type STAs from other types of STAs by allocating Sensor-Only access windows as specified in 9.20.5 (Restricted Access Window (RAW) Operation) or by supporting only Sensor type STAs as specified in 9.49 (Sensor Only BSS).

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| **CID** | **Clause** | **Comment** | **Proposed Change** |
| 2542 | 4 | It is better to provide a general description of Subchannel Selective Transmission (SST) to describe the benefit (reason) of SST. | Add new subclause 4.17 which describes SST.Detailed proposed changes are provided in 11/13-1316. |

## Detailed proposed change for CID 2542

*(Instruction to Editor) Insert a new subclause 4.3.11e as follows:*

### 4.3.11e Subchannel Selective Transmission (SST)

Subchannel Selective Transmission (SST) may be used to suffer from deep fades that are much more likely to occur with transmissions over 1 MHz or 2MHz channels in an S1G BSS. Relatively narrow (1 MHz or 2MHz) channel may lose frequency diversity gain.

SST allows an S1G STA to operate on a subset of the subchannels within a wider bandwidth BSS to find the best subchannel(s) and transmit /receive on that subchannel(s).

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| **CID** | **Clause** | **Comment** | **Proposed Change** |
| 2593 | 4 | It is better to provide a general description of OBSS mitigation to describe the reason. | Add new subclause 4.18 which describes OBSS mitigation.Detailed proposed changes are provided in 11/13-1316. |

## Detailed proposed change for CID 2593

*(Instruction to Editor) Insert a new subclause 4.3.11f as follows:*

### 4.3.11f OBSS mitigation

An S1G BSS with narrow bandwidth (1MHz or 2 MHz) may cover longer range, and an S1G BSS with wider bandwidth (2MHz to 16 MHz) may cover shorter range. A narrow bandwidth BSS may have a coverage area radius that is multiples of that of a wider bandwidth BSS. If a narrow bandwidth BSS overlaps spatially with several wider bandwidth BSSs, then STAs in wider bandwidth BSSs may be hidden nodes from STAs in narrow bandwidth BSS, and may collide with STAs in narrow bandwidth BSS.

OBSS mitigation mechanism may be used to mitigate this hidden nodes problem in wider bandwidth BSSs overlapping in narrow bandwidth BSS. An OBSS mitigation enabled receiving STA may indicate usable subchannel(s) to a transmitting STA by NDP ACK.

# Proposed changes for Time of Departure accuracy

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| **CID** | **Clause** | **Comment** | **Proposed Change** |
| 2543 | 24.3.17 | A base document IEEE P802.11ac D5.0 defines 22.3.18.5 Time of Departure accuracy which is important for the Timing measurement specified in 10.24.5. The timing measurement is the base function for ranging (location) and time synchronization (IEEE Std 1588 and IEEE Std 802.1AS) and is important for Sensor STAs.It is necessary to specify the Time of Departure accuracy in 24.3.17. | Insert subclause 24.3.17.5 Time of Departure accuracy based on 22.3.18.5 of IEEE P802.11ac D5.0.Detailed proposed changes are provided in 11/13-1316. |

## Detailed proposed change for CID 2543

*(Instruction to Editor) Insert a new subclause 24.3.17.5 as follows:*

### 24.3.17.5 Time of Departure accuracy

The Time of Departure accuracy test evaluates TIME\_OF\_DEPARTURE against aTxPHYTxStartRMS and aTxPHYTxStartRMS against TIME\_OF\_DEPARTURE\_ACCURACY\_TEST\_THRESH as defined in Annex T with the following test parameters:

* MULTICHANNEL\_SAMPLING\_RATE is:

1 × 106 (1+⎾ (fH - fL)/1 MHz⏋) sample/s, for a CH\_BANDWIDTH parameter equal to CBW1

2 × 106 (1+⎾ (fH - fL)/2 MHz⏋) sample/s, for a CH\_BANDWIDTH parameter equal to CBW2

4 × 106 (1+⎾ (fH - fL)/4 MHz⏋) sample/s, for a CH\_BANDWIDTH parameter equal to CBW4

8 × 106 (1+⎾ (fH - fL)/8 MHz⏋) sample/s, for a CH\_BANDWIDTH parameter equal to CBW8

16 × 106 (1+⎾ (fH - fL)/16 MHz⏋) sample/s, for a CH\_BANDWIDTH parameter equal to CBW16

where

fH is the nominal center frequency in Hz of the highest channel in the channel set

fL is the nominal center frequency in Hz of the lowest channel in the channel set, the channel set is the set of channels upon which frames providing measurements are transmitted.

⎾x⏋ equals the smallest integer equal to or larger than x.

* FIRST\_TRANSITION\_FIELD is STF.
* SECOND\_TRANSITION\_FIELD is LTF1.
* TRAINING\_FIELD is LTF1 windowed in a manner which should approximate the windowing described in 18.3.2.5 (Mathematical conventions in the signal descriptions) with TTR = 1000 ns.
* TIME\_OF\_DEPARTURE\_ACCURACY\_TEST\_THRESH is 1600ns for a CH\_BANDWIDTH parameter equal to CBW1 and 800 ns otherwise.

NOTE —The indicated windowing applies to the time of departure accuracy test equipment, and not the transmitter or receiver.

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| **CID** | **Clause** | **Comment** | **Proposed Change** |
| 2544 | 24.3.17 | Annex T.2 needs to be modified to support S1G STA. | Add following new modification to the subclause T.2 of the IEEE P802.11ac D5.0.----Change bullet l) in the 5th paragraph as follows:l) The Time Difference of Departure accuracy test is passed if both of the following conditions are met: 1) The RMS value of e is less than aTxPHYTxStartRMS when transmitting a VHT PPDU, a TVHT PPDU and an S1G PPDU, or aTxPmdTxStartRMS otherwise. 2) aTxPHYTxStartRMS when transmitting a VHT PPDU, a TVHT PPDU and an S1G PPDU or aTxPmdTxStartRMS otherwise is less than TIME\_OF\_DEPARTURE\_ACCURACY\_TEST\_THRESH, where the units of e, aTxPHYTxStartRMS when transmitting a VHT PPDU, a TVHT PPDU and an S1G PPDU or aTxPmdTxStartRMS otherwise, and TIME\_OF\_DEPARTURE\_ACCURACY\_TEST\_THRESH are properly accounted for.---Change the associated note of bullet l) in the 5th paragraph as follows:Replace the phrase "aTxPmdTxStartRFDelay when transmitting a non-VHT PPDU or aTxPHYTxStartRFDelay when transmitting a VHT PPDU"by"aTxPHYTxStartRFDelay when transmitting a VHT PPDU, a TVHT PPDU and an S1G PPDU or aTxPmdTxStartRFDelay otherwise" |

## Detailed proposed change for CID 2544

*(Instruction to Editor) Insert new Annex T as follows;*

### Annex T Location and Time Difference accuracy test (informative)

**T.2 Time Difference of departure accuracy test**

*Change bullet l) and the associated note in the 5th paragraph as follows:*

1. The Time of Departure accuracy test is passed if both of the following conditions are met:
2. The RMS value of e is less than aTxPHYTxStartRMS when transmitting a VHT PPDU ~~and~~, a TVHT PPDU and an S1G PPDU, or aTxPmdTxStartRMS otherwise.
3. aTxPHYTxStartRMS when transmitting a VHT PPDU ~~and~~, a TVHT PPDU and an S1G PPDU, or aTxPmdTxStartRMS otherwise is less than TIME\_OF\_DEPARTURE\_ACCURACY\_TEST\_THRESH, where the units of e, aTxPHYTxStartRMS when transmitting a VHT PPDU ~~and~~, a TVHT PPDU and an S1G PPDU, or aTxPmdTxStartRMS otherwise, and TIME\_OF\_DEPARTURE\_ACCURACY\_TEST\_THRESH are properly accounted for.

NOTE 1—One possible implementation of a time of departure measurement system is a free-running oscillator clocking (a) the digital-to-analog converter(s) used to transmit the packet, (b) a 32-bit continuously counting counter and (c) a hardware finite state machine such that PMD\_TXSTART.request causes a transition within the finite state machine that in turn causes frame transmission at the DACs a fixed number of cycles later; where the time of departure is recorded as the value of the counter at that transition minus ~~aTxPmdTxStartRFDelay when transmitting a non-VHT PPDU or~~ aTxPHYTxStartRFDelay when transmitting a VHT PPDU, a TVHT PPDU and an S1G PPDU, or aTxPmdTxStartRMS otherwise (using TIME\_OF\_DEPARTURE\_ClockRate), where aTxPmdTxStartRFDelay or aTxPHYTxStartRFDelay can vary by channel. In this implementation, the principal source of time of departure error is short term oscillator imperfection (e.g., phase noise) and RF group delay variation across channels uncompensated by ~~aTxPmdTxStartRFDelay when transmitting a non-VHT PPDU or~~ aTxPHYTxStartRFDelay when transmitting a VHT PPDU, a TVHT PPDU and an S1G PPDU, or aTxPmdTxStartRMS otherwise.