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| Report: 802.11ax dominance complaint | | | | |
| Date: 2016-11-09 | | | | |
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Abstract

This document contains the findings from the investigation into the 11ax dominance complaint contained in <https://mentor.ieee.org/802.11/dcn/16/11-16-0784-00-0000-dominance-allegation-in-tgax.doc> .

# The 11ax dominance complaint

The following complaint related to a claim of dominance in IEEE 802.11ax was received in June 2016 from Graham Smith, see <https://mentor.ieee.org/802.11/dcn/16/11-16-0784-00-0000-dominance-allegation-in-tgax.doc>.

# Investigators and the process

## Investigators

The 802.11 WG vice-chair, Dorothy Stanley declares herself to be unconflicted in this matter and led the investigation. Dorothy was appointed investigative officer for this 11ax complaint by Adrian Stephens, the 802.11 WG Chair.

Michael Montemurro, an IEEE 802.11 member declares that he is unconflicted in this matter, and assisted with data collection, analysis and report preparation.

Roger Marks, a member of the 802 executive committee (EC) agreed to support the investigation as an observer and advisor, and initially declared that he was unconflicted in this matter. Subsequently, Roger withdrew from this position due to potential employer conflicts.

James Gilb, a member of the 802 executive committee (EC) agreed to support the investigation as an observer and advisor, and declares that he is unconflicted in this matter.

## Process

The following process was identified and used in the investigation:

1. WG Chair obtained documentation of the specific complaint
2. WG Chair communicated the complaint to WG members – see <https://mentor.ieee.org/802.11/dcn/16/11-16-0784-00-0000-dominance-allegation-in-tgax.doc>.
3. WG Chair notified the IEEE 802 EC of complaint
   1. See <https://mentor.ieee.org/802.11/dcn/16/11-16-0770-01-0000-july-2016-802-11-opening-report.pptx> , from slide 20 onwards which were presented to the EC in the July session.
4. WG Chair determined who would handle the process – investigating officer (IO)
   1. The WG Chair appointed Dorothy Stanley the IO, which is in keeping with the WG chair’s responsibilities described in the WG P&P
5. IO solicited neutral volunteer to advise and observe
   1. Typically should be an EC member or IEEE-SA staff member
   2. Person should be familiar with IEEE-SA P&P
   3. Roger Marks (IEEE 802 EC member), initially agreed to fulfill this role; replaced by James Gilb (IEEE 802 EC member)
6. IO collected data, considering some or all of the following
   1. Inspected previous minutes and recorded votes
   2. Interviewed selected participants
7. IO prepared report of findings – this document

Next/ongoing steps:

1. IO communicates findings to WG chair in a public submission
2. WG Chair reports out to WG, TG at an 802.11 plenary meeting
3. WG Chair’s responsibilities include reporting findings to EC and may request instructions on how to proceed.

## Interviews

The authors conducted interviews with a subset of co-authors of document [11-15-1069r3](https://mentor.ieee.org/802.11/dcn/15/11-15-1069-03-00ax-adaptive-cca-and-tpc.pptx); with the complainant; with 2 individuals who asked to be interviewed; and with selected additional 802.11 members. All interviewees were 802.11 members and were asked a set of questions, see Section 12. The authors interviewed 13 members of 802.11. One additional 802.11 member declined to be interviewed.

The interviews were conducted in IEEE 802.11 executive session, with Dorothy Stanley and Michael Montemurro and a single interviewee present. All interviewees were told that their responses would not be individually attributed.

# Analysis of the specific dominance complaint

This section of the document contains a paragraph by paragraph analysis of the complaint, identifying the referenced documents and voting results from the minutes of meetings. The goal of this section is to confirm (or not) the accuracy of the description of the events in the complaint.

The conclusion is that with the exception of one typo in a straw poll result (see section 3.10); the submission documents and voting results are documented as described in the complaint.

## Paragraph 1

## *“I thank Adrian for presentation of the slides pertaining to dominance presented at the May 2016 midweek plenary. As a result of reading these slides I am convinced that I have been actively discriminated against in TGax. I can only describe this by citing the actual example as experienced by me, and I realize that this can get somewhat complicated, but I do not know how else to describe my experience.”*

Analysis: The presentation in the May 2016 midweek plenary session that is referenced is <https://mentor.ieee.org/802.11/dcn/16/11-16-0497-00-0000-may-2016-supplementary-material.ppt> specifically related to agenda item W5.2, slides 6 through 12.

## Paragraph 2

## *“I have been presenting my ideas on “Dynamic Sensitivity Control” (DSC) for over 2 ½ years (first presented Oct 2013 in WNG), with detailed calculations, analysis and technical discussions, based upon the set 11ax scenarios, with over 14 individual submissions (plus revisions) and in the order of 30 other presentations related to DSC including several independent (i.e. not from companies working as a consortium in a SIG) simulations. I believe that DSC has had more analysis than any other spatial reuse scheme, and it has been shown that it does provide for spatial reuse in a superior manner.”*

**Analysis:** The following submissions are related to Dynamic Sensitivity Control, over 30 (plus revisions) documents over the past 3 years from a variety of authors (first authors listed): Graham Smith (SR Technologies), Tanguy Ropitault (NIST), Eduard Garcia-Villegas (UPC), M. Shahwaiz Afaqui (UPC), Filip Mestanov (Ericsson), ChingHwa Yu (Mediatek), Masahito Mori (Sony), Yesuhiki Inoue (NTT), Gustav Wilkstrom (Ericsson), Chuck Lucaszewski (Aruba Networks), Johan Soder (Ericsson), William Carney (Sony):

1. <https://mentor.ieee.org/802.11/dcn/13/11-13-1012-04-0wng-dynamic-sensitivity-control.pptx> (5 revisions, dated Sept 2013 through Nov 2013)
2. <https://mentor.ieee.org/802.11/dcn/13/11-13-1290-01-0hew-dynamic-sensitivity-control-for-hew.pptx> ( 2 revisions, dated Oct 2013 and April 2014)
3. <https://mentor.ieee.org/802.11/dcn/14/11-14-0294-02-0hew-dsc-channel-selction-and-legacy-sharing.pptx> (3 revisions, March 2014)
4. <https://mentor.ieee.org/802.11/dcn/14/11-14-0523-00-00ax-mac-simulation-results-for-dsc-and-tpc.ppt> April 2014
5. [https://mentor.ieee.org/802.11/dcn/14/11-14-0635-01-00ax-dsc-implementation.pptx](https://mentor.ieee.org/802.11/dcn/14/11-14-0635-01-00ax-dsc-implementation.pptx%20) May 2014
6. <https://mentor.ieee.org/802.11/dcn/14/11-14-0635-01-00ax-dsc-implementation.pptx> June 2014
7. <https://mentor.ieee.org/802.11/dcn/14/11-14-0854-00-00ax-dsc-and-legacy-coexistence.pptx> July 2014
8. <https://mentor.ieee.org/802.11/dcn/14/11-14-0779-02-00ax-dsc-practical-usage.pptx> June and July 2014
9. <https://mentor.ieee.org/802.11/dcn/14/11-14-1171-01-00ax-dsc-simulation-results-for-scenario-3.pptx> September 2014
10. <https://mentor.ieee.org/802.11/dcn/14/11-14-1403-00-00ax-performance-analysis-of-bss-color-and-dsc.pptx> November 2014
11. [https://mentor.ieee.org/802.11/dcn/14/11-14-1416-00-00ax-observed-protocol-violations-caused-by-dsc-for-roaming-stas.pptx November 2014](https://mentor.ieee.org/802.11/dcn/14/11-14-1416-00-00ax-observed-protocol-violations-caused-by-dsc-for-roaming-stas.pptx%20November%202014)
12. <https://mentor.ieee.org/802.11/dcn/14/11-14-1426-02-00ax-dsc-and-legacy-coexistence.pptx> November 2014
13. [https://mentor.ieee.org/802.11/dcn/14/11-14-1427-02-00ax-dsc-performance.pptx November 2014](https://mentor.ieee.org/802.11/dcn/14/11-14-1427-02-00ax-dsc-performance.pptx%20November%202014)
14. <https://mentor.ieee.org/802.11/dcn/15/11-15-0025-00-00ax-dsc-and-roaming.pptx> January 2015
15. <https://mentor.ieee.org/802.11/dcn/15/11-15-0027-01-00ax-simulation-based-evaluation-dsc-in-residential-scenario.pptx> January 2015
16. <https://mentor.ieee.org/802.11/dcn/15/11-15-0045-00-00ax-performance-analysis-of-bss-color-and-dsc.pptx> January 2015
17. <https://mentor.ieee.org/802.11/dcn/15/11-15-0319-01-00ax-impact-of-tpc-coupled-to-dsc-for-legacy-unfairness-issue.pptx> March 2015
18. <https://mentor.ieee.org/802.11/dcn/15/11-15-0371-02-00ax-proposal-and-simulatin-based-evaluation-of-dsc-ap-algorithm.pptx> March 2015
19. <https://mentor.ieee.org/802.11/dcn/15/11-15-0548-00-00ax-enterprise-scenario-and-dsc.pptx> May 2015
20. <https://mentor.ieee.org/802.11/dcn/15/11-15-0595-02-00ax-discussion-on-the-receiver-behavior-for-ccac-dsc-with-bss-color.pptx> May 2015
21. <https://mentor.ieee.org/802.11/dcn/15/11-15-0595-02-00ax-discussion-on-the-receiver-behavior-for-ccac-dsc-with-bss-color.pptx> May 2105
22. <https://mentor.ieee.org/802.11/dcn/15/11-15-0652-01-00ax-reference-simulation-model-for-dynamic-cca-dsc-calibration.pptx> May 2015
23. <https://mentor.ieee.org/802.11/dcn/15/11-15-0801-00-00ax-dcca-dsc-reference-simulation-results.pptx> July 2015
24. <https://mentor.ieee.org/802.11/dcn/15/11-15-0804-00-00ax-outdoor-enterprise-scenario-and-dsc.pptx> July 2015
25. <https://mentor.ieee.org/802.11/dcn/15/11-15-0807-02-00ax-dsc-summary.pptx> July 2015
26. <https://mentor.ieee.org/802.11/dcn/15/11-15-0882-01-00ax-dsc-leveraging-uplink-rts-cts-control.ppt> July 2015
27. [https://mentor.ieee.org/802.11/dcn/15/11-15-0886-00-00ax-dsc-calibration-result.pptx July 2015](https://mentor.ieee.org/802.11/dcn/15/11-15-0886-00-00ax-dsc-calibration-result.pptx%20July%202015)
28. <https://mentor.ieee.org/802.11/dcn/15/11-15-1138-01-00ax-to-dsc-or-not-to-dsc.pptx> September 2015
29. <https://mentor.ieee.org/802.11/dcn/15/11-15-1316-03-00ax-dsc-calibration-results-with-ns-3.pptx> November 2015
30. <https://mentor.ieee.org/802.11/dcn/16/11-16-0212-04-00ax-enterprise-scenario-dsc-and-color.pptx> January – March 2016
31. <https://mentor.ieee.org/802.11/dcn/16/11-16-0310-02-00ax-dsc-proposed-text.docx> March – July 2016
32. <https://mentor.ieee.org/802.11/dcn/16/11-16-0350-00-00ax-enterprise-scenario-tpc-and-dsc.pptx> March 2016
33. <https://mentor.ieee.org/802.11/dcn/16/11-16-0597-01-00ax-indoor-enterprise-scenarios-color-dsc-and-tpc.pptx> May 2016
34. <https://mentor.ieee.org/802.11/dcn/16/11-16-0604-02-00ax-simulation-based-evaluation-of-dsc-in-enterprise-scenario.pptx> May 2016
35. <https://mentor.ieee.org/802.11/dcn/16/11-16-1063-03-00ax-unified-sr-text-dsc-atpc-inter-bss.docx> August – September 2016
36. <https://mentor.ieee.org/802.11/dcn/16/11-16-1064-03-00ax-unified-sr-approach-dsc-atpc-and-inter-bss.pptx> August –September 2016

The investigation confirmed that there have been several SIGs related to 11ax, and specifically that there is one key active SIG currently operating, “***companies working as a consortium in a SIG”***, see section 4.

The concluding statement in paragraph 2 of the complaint (“I believe that DSC has had more analysis than any other spatial reuse scheme, and it has been shown that it does provide for spatial reuse in a superior manner.”) is one of belief and judgment. DSC has had significant analysis, perhaps as much or more than other schemes. The “superior manner” was a topic of much debate in TGax.

## Paragraph 3

## *“In the spatial reuse ad-hoc group in particular, but also in the TG, every straw poll by me has been voted down:*

### *May 2015 “The amendment shall include one or more mechanisms to improve spatial re-use by adjustment of the sensitivity and/or CCA threshold levels.”Failed 17/6*

### *July 2015 “The amendment shall include one or more mechanisms to improve frequency re-use by adjustment of the sensitivity and/or CCA threshold level(s).”Failed 19/9”*

**Analysis:** The May 2015 spatial re-use ad-hoc minutes are here: <https://mentor.ieee.org/802.11/dcn/15/11-15-0662-01-00ax-tgax-may-2015-vancouver-spatial-reuse-ad-hoc-meeting-minutes.docx> Straw poll is on page 4:

The amendment shall include one or more mechanisms to improve spatial re-use by adjustment of the sensitivity and/or CCA threshold levels.”

Y/N/A: 17/6/11

The July 2015 spatial re-use ad-hoc minutes are here: <https://mentor.ieee.org/802.11/dcn/15/11-15-0971-01-00ax-july-meeting-minutes-of-the-spatial-reuse-ad-hoc-group.docx> Straw poll is on page 3:

**Straw Poll R20150714002**  
Do you agree to add to the TGax Specification Framework Document:  
Frequency Re-Use: “The amendment shall include one or more mechanisms to improve frequency re-use by adjustment of the sensitivity and/or CCA threshold levels.”

Result: 19/9/12 (Yes/No/Abstain)

## Paragraph 4

## *“In fact the Spatial Reuse ad-hoc group had no entries in the SFD until September 2015, having refused to agree to these quite benign polls.”*

**Analysis:** The Specification Framework document is document 11-15-132, see <https://mentor.ieee.org/802.11/dcn/15/11-15-0132-17-00ax-spec-framework.docx> . Revision 0 was posted January 2015, and Revision 17 in May 2016. The Coexistence section had no text added in revisions 0 through 7 (through July 2015). Revision 8 (September 2015) adds Coexistence section text.

## Paragraph 5

## *“Then in September, we had a presentation by 108 authors from 16 affiliations on “Adaptive CCA and TPC”.  The proposed wording for the SFD “Valid OBSS PPDU as not being received at all…if the RXPWR…is below the OBSS\_PD threshold and TBD conditions are met, noting that the OBSS\_PD threshold is accompanied by a TXPWR value and a reduction in the TXPWR may be accompanied by a TBD increase in the OBSS\_PD threshold value.” – Passed 38/1”*

**Analysis:** The September 2015 presentation on “Adaptive CCA and TPC with 108 authors and 16 affiliations is <https://mentor.ieee.org/802.11/dcn/15/11-15-1069-03-00ax-adaptive-cca-and-tpc.pptx> .

The SFD requirement straw poll in the September Spatial re-use ad-hoc minutes, <https://mentor.ieee.org/802.11/dcn/15/11-15-1206-00-00ax-sept-2015-spatial-reuse-ad-hoc-meeting-minutes.docx> page 9:

**15/1069r3, Adaptive CCA and TPC (Revisit for straw poll)**

Presenter: James Wang (Mediatek)

James Wang presented the straw poll in the revised document.

Straw Poll 8

**Do you agree to add the following text into 11ax SFD:**

An 11ax STA regards a valid OBSS PPDU as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload if the RXPWR of the received PPDU is below the OBSS\_PD threshold and TBD conditions are met, noting that the OBSS\_PD threshold is accompanied by a TXPWR value and a reduction in the TXPWR may be accompanied by an TBD increase in the OBSS\_PD threshold value.

Yes: 38 No: 1 Abstain: 18🡪 passes

Note that an earlier version of the straw poll, based on 11-15-1069r1 failed, see <https://mentor.ieee.org/802.11/dcn/15/11-15-1206-00-00ax-sept-2015-spatial-reuse-ad-hoc-meeting-minutes.docx> page 3:

Straw Poll 1 – amended after long discussion

* 1. WWhen an 11ax STA detects a valid OBSS PPDU it may terminate reception of the PPDU and reevaluate the medium condition if the RXPWR of the received PPDU is below the OBSS\_PD threshold and TBD conditions are met, noting that the OBSS\_PD threshold is accompanied by a TXPWR value and a change in the TXPWR shall be accompanied by an inverse TBD change in the OBSS\_PD threshold value.  
       
     Yes: 28 No: 11Abstain 25-🡪 fails

After the straw poll, there was a request to bring this back after changing the wording offline because the text change did not satisfy all the people.

Question: What about beacons and other management frames? Should the also be discarded because of low power?

Answer: Yes, if power is below power and from OBSS.

Comment: I have an issue with the last sentence. We have an action item to improve this sentence in the future. It’s the right direction but needs to become better.

## Paragraph 6

## *“So coupling DSC, but disguised as OBSS\_PD, with TPC (transmit power control) instantly gets accepted on the basis of one presentation.  Note that TPC only works, of course, if the OBSS network also does it (a later presentation by me showed TPC has further problems unless the OBSS AP also reduces power, a difficult concept).”*

**Analysis:** One interviewed IEEE 802.11ax participant commented that the accepted presentation in 11-15-1069r3 was heavily based on document <https://mentor.ieee.org/802.11/dcn/14/11-14-1448-02-00ax-considerations-for-adaptive-cca.pptx> . This document, 11-14-1448-02 was submitted for the November 2014 session. The minutes for that session, <https://mentor.ieee.org/802.11/dcn/14/11-14-1460-00-00ax-tgax-november-2014-san-antonio-meeting-minutes.docx> summarize the -01 proposal and identify two discussion questions, see section 9.5 on page 13. We could fiind no record of subsequent discussion of 11-14-1448 in the January 2015, March 2015, May 2015 or July 2015 TGax minutes and Spatial Re-use ad-hoc minutes documents.

## Paragraph 7

## *“Similarly in September we had a presentation by 101 authors from 15 affiliations on ignoring “inter BSS PPDU… below an OBSS PD level” - Passed 39/0.  Astonishing result considering the amount of work presented (compared to the DSC work).  This concept is related to the use of “color” which, similar to TPC, must be used by all STAs and AP in the OBSS for it to be of any use (yes I know it is proposed for 11ah, but that is a closed PHY).  Immediately accepted, of course, on the basis of one presentation.”*

**Analysis:** The presentation with 101 authors is <https://mentor.ieee.org/802.11/dcn/15/11-15-1109-01-00ax-obss-nav-and-pd-threshold-rule-for-spatial-reuse.pptx>.

The straw poll is documented in the September Spatial re-use ad-hoc notes, <https://mentor.ieee.org/802.11/dcn/15/11-15-1206-00-00ax-sept-2015-spatial-reuse-ad-hoc-meeting-minutes.docx> Page 2, and is shown below:

Straw Poll 2

* 1. **Do you agree to add the TGax Specification Framework:** 5.1 Features for operation in dense environments [802.11ax SFD]

A STA should regard an Inter-BSS PPDU with a valid PHY header and that has a receive power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload

* The OBSS PD level is greater than the minimum receive sensitivity level
  + Y: 39
  + N: 0
  + A: 12 Passes

Question: What is the intended behaviour when the channel goes from busy to idle?

Answer: If the channel goes busy to idle, whether the time is used for backoff or not depends on our decision.

There was more discussion on the intended behaviour.

## Paragraph 8

## *“Then also in September 2015 a proposal, this time by 1 author from 1 affiliation (not me), to simplify the requirement “The amendment shall include one or more mechanisms to improve spatial reuse by allowing adjustments to one or more of the CCA-ED , CCA Signal Detect , OBSS\_PD or TXPWR threshold values. The constraints on selecting threshold values are TBD.” Passed 24/0.  How this gets accepted when my earlier ones did not is strange, but, at last DSC seems to be allowed.”*

**Analysis:** The proposal from one author (Filip Mestanov – Ericsson) is <https://mentor.ieee.org/802.11/dcn/15/11-15-1138-01-00ax-to-dsc-or-not-to-dsc.pptx> .

The straw poll is documented in the September Spatial re-use ad-hoc notes, <https://mentor.ieee.org/802.11/dcn/15/11-15-1206-00-00ax-sept-2015-spatial-reuse-ad-hoc-meeting-minutes.docx> Page 2 and is listed below:

**15/1138r0, To DSC or not to DSC**

Presenter: Filip Mestanov (Ericsson AB)

Filip reviewed document 15/1138r0.

Straw Poll 5 (amended after long discussion)

**Do you agree to add to Section 5.1 of the SFD:**

**“The amendment shall include one or more mechanisms to improve spatial reuse by allowing adjustments to one or more of the CCA-ED , CCA Signal Detect , OBSS\_PD or TXPWR threshold values. The constraints on selecting threshold values are TBD.”**

Y 24   
N 0  
A 18 passes:

Comment: CCA-SD, what does it mean? How about changing it to “OBSS PPDU”?

Comment: I like current text (CCA-SD).

Question: Please clarify what is ‘CCA-SD’.

Answer: This is the level at which you determine to backoff or set the NAV

## Paragraph 9

## *“At the March meeting a presentation by 126 authors from 18 affiliations sets out some strict formulas on the OBSS\_PD and TXPWR settings, but still with TBDs and no actual description on how to do it in practice, passes 22/1.”*

**Analysis:** The presentation referenced is <https://mentor.ieee.org/802.11/dcn/16/11-16-0414-01-00ax-adjustment-rules-for-adaptive-cca-and-tpc.pptx> . The minutes of the March 2016 spatial re-use ad-hoc are in <https://mentor.ieee.org/802.11/dcn/16/11-16-0537-00-00ax-spatial-reuse-ad-hoc-group-march-2016-minutes.docx>. The referenced straw poll and discussion is shown below:

At 2016-03-15T16:02 James Wang presents 11-16/414r0. At 2016-03-15T16:18 James Wang concludes his presentation and attendees form a queue to ask questions.

COMMENT: You may want to have a different value for start of the curve for AP.

RESPONSE: This is still open to decide.

COMMENT: Do you want to communicate a min and max value through the AP?

RESPONSE: This is still open.

COMMENT: Is this PD or ED?

RESPONSE: This is carrier sense from OBSS, PPDU detection.

COMMENT: What is the relationship between transmit power and sensing threshold? Why do you link them together? These values are not connected.

RESPONSE: This is a natural, conservative behaviour. If you lower your voice you can talk to your neighbor.

COMMENT: This doesn’t solve the problem. Lowering your power to increase your sensing threshold doesn’t help.

RESPONSE: This is meant to introduce freedom to in selecting thresholds.

COMMENT: Can you explain to me how this is better than DSC?

RESPONSE: This rule does not preclude you from setting your threshold from basing on beacon power reception level.

COMMENT: No, this scheme does limit a station to a fixed rule.

COMMENT: If you are sharing with legacy networks they are not going to lower their transmit power.

COMMENT: But if we accept this we enforce that both are linked together.

COMMENT: I don’t think that DSC and this technology conflict with each other.

At 2016-03-15T16:23+08:00 James Wang asks the following Straw Poll:

“Do you support to replace the text in 5.1 of SFD P35L1 ‘and a reduction in the TXPWR may be accompanied by an TBD increase in the OBSS\_PD threshold value’ with the following adjustment rules:

Adjustment Rule for OBSS\_PD

where TX\_PWRref is an absolute power level.

* Preserves fairness for the lower devices
* TX\_PWRref can be a TBD level (preferred value is 23 dBm)
* Class A: TX\_PWR=transmit power
* Class B: TX\_PWR=transmit power+TBD dB”

Attendees form a queue to ask questions.

COMMENT: Is this a shall or a may condition?

RESPONSE: There are two TBDs in this. So it still gives some freedom.

Straw Poll result: Yes/No/Abstain: 22/1/8

This Straw Poll is recorded as R20160315001. The approval rate of this straw poll exceeds 75%. As a consequence the straw poll and the result will be reported to the 802.11ax TG.

## Paragraph 10

## *“Now, reaching out to several members with affiliations to companies within the SIG, they confirm that DSC appears to be covered, so I write a presentation investigating and analyzing DSC, Color and TPC, and write full text for DSC.  These I first present in a teleconference, and then formally at the May meeting. After the presentation of an independent detailed DSC simulation that showed very positive results, I try a simple poll: “Text describing DSC may be considered for inclusion into the 11ax amendment.” Failed 2/1/many.”*

**Analysis:** The referenced DSC presentation is <https://mentor.ieee.org/802.11/dcn/16/11-16-0597-01-00ax-indoor-enterprise-scenarios-color-dsc-and-tpc.pptx> . The straw poll is recorded in the 11ax May 2016 Task Group minutes, <https://mentor.ieee.org/802.11/dcn/16/11-16-0686-00-00ax-tgax-may-2016-waikoloa-meeting-minutes.docx> , and shown below:

* 1. Straw Poll from 11-16-0597-01 by Graham Smith (SR technologies).

* + 1. Straw Poll: DSC text should be incorporated into the Draft 11ax Amendment.

Note: 16/0310 may be used as a basis.

* + - 1. Discussion.
         1. The point of the straw poll is inclusion of DSC into the draft.
         2. A member commented that 16/310 amends clause 18, 19 and 20. Graham responded that there is no reason that those devices cannot use this feature.
      2. Result: Y/N/A = 12/28/38

The result shown in the minutes is “Failed 12-28-38” (rather than “2/1 many”).

## Paragraph 11

## *“I am convinced that I have been subjected to deliberate exclusion, that my presentations have not been taken on merit, and I believe that a block of members have deliberately agreed among themselves to exclude my idea. Similar proposals, with much less analysis or description and with higher levels of complication and introduced about 18 months after DSC was first described in detail, pass with big margins.  I therefore can only conclude that this is due to the companies working together in the SIG in TGax which has exercised its influence by reason of superior leverage, strength, and representation to the exclusion of fair and equitable consideration of other viewpoints, and in particular, mine.”*

**Analysis:** The reference to “the SIG in TGax” raises questions about the existence of one or more SIG(s) related to 11ax. The investigation gathered information about SIG existence and operation, see below.

# Additional information about 11ax related SIGs

## SIG Identification and membership

We obtained the following information related to 11ax related SIGs from interviewees.

Since the formation of the 11ax Task Group, there have been 4 SIGs related to 11ax:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SIG name** | **Activity level** | **Public Website?** | **Number of member companies** | **Membership and voting** |
| **Axelerate** | Low at peak, none currently | No | 6-8 | No voting |
| **AXept** | Low at peak, none currently | No | Unknown | Unknown |
| **DensiFi** | High | No | 4-18 (varies with time) | 2 tier membership level – Voting (vote on motions) and non-voting (express opinion in straw poll only) |
| **UniFi** | Low at peak, none currently | No | 6-8 | Unknown |

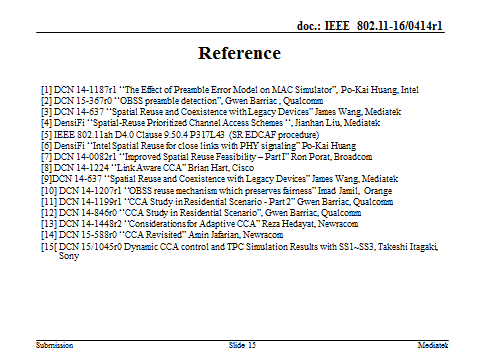
The SIG referenced in the 11ax complaint (<https://mentor.ieee.org/802.11/dcn/16/11-16-0784-00-0000-dominance-allegation-in-tgax.doc>) is probably DensiFi.

Several interviewees indicated that they were bound by NDA agreements to not state anything about member companies or SIG operation. One 802.11 member declined to be interviewed.

Based on an analysis of the 11ax documents with a large number of authors (see section 11),

1. In March 2015 the SIG members appear to be Intel, LGE, Broadcom, Marvell, Mediatek, Qualcomm, Huawei, Orange, NTT, NTT Docomo, Samsung, ZTE, Apple and Cisco (14 companies).
2. By March 2016, additional members appear to be Sony, Toshiba, Newracom and Quantenna.

DensiFi does not have a public website. No information about the DensiFi SIG is available publicly. There are references to DensiFi documents in an IEEE 802.11 submission, see <https://mentor.ieee.org/802.11/dcn/16/11-16-0414-01-00ax-adjustment-rules-for-adaptive-cca-and-tpc.pptx> , Slide 15, shown below includes reference 4 and 6 to two DensiFi documents: **DensiFi “Spatial-Reuse Prioritized Channel Access Schemes “, Jianhan Liu, Mediatek** and DensiFi **“Intel Spatial Reuse for close links with PHY signaling” Po-Kai Huang**. From this it can be inferred that both Intel and Mediatek are members of the DensiFi SIG.



There is also mention of DensiFi in Clause [0010] (Technical field) of patent application US 2015/0139091: "Some embodiments relate to wireless local area networks (WLANs) and Wi-Fi networks operating in accordance with one of the IEEE 802.11 standards, such as the IEEE 802.11ac standard or the IEEE 802.11ax SIG (named Densifi)." There are similar statements in <https://www.google.com/patents/US20150139206> ,

<https://www.google.com/patents/US20160056943> , and <https://www.google.com/patents/US20160227532>.

Note: The complainant indicated that he was unaware of the existence of the DensiFi SIG until September 2015.

## SIG structure and internal operation

We obtained the following information related to 11ax related operation of the DensiFi SIG from interviewees:

1. DensiFi meets for 3 days prior to each IEEE 802.11 meeting to discuss and review presentations, and determine documents that are submitted to IEEE 802.11ax. Teleconferences are also held.
2. The SIG has not entertained proposals from non-members. One interviewee commented that there were no rules against entertaining proposals from non-SIG members, but no requests have been received.
3. In terms of progress, the SIG work is ahead of 11ax; sometimes by months, days or hours.
4. The leadership structure of the SIG was described as consisting of a Management and Technical component, with membership decisions taken by the Management component.
5. There are two levels of membership in the SIG: Voting (principal) and non-voting. 7-8 companies are principal/voting members. Non-voting members can indicate opinions on straw polls, but apparently are not allowed to vote on motions within the SIG. SIG motions determine which presentations or submissions are taken to IEEE 802.11ax with SIG members listed as authors.
6. The criteria for joining the SIG were described as “ability to contribute”, “implementer of the technology”, and “viewed as providing value”. The joining process was described as lengthy for several companies, with delays of 6 months to over a year from application to (non-voting) membership. 2 companies were admitted per 802.11 cycle. This resulted in a delay such that a company actively working on a product design may not have had access to critical information needed for fundamental design decisions or the ability to participate in the surrounding discussion (and at least one interviewee suggested that this happened). Companies that were admitted to the SIG later in time “missed out on a lot of technical discussions” as the technical discussions didn’t happen in the IEEE meetings. One member described this as “Principal companies are controlling access” to the DensiFi SIG membership and thus the discussions and contributions there.
7. The rationale for joining as a non-voting member of the SIG was primarily to get visibility into and participate in the technical discussions and decisions that were being made in the SIG. These decisions would determine the submissions brought to 802.11ax and potentially adopted there.
8. One company was identified that applied for membership and could not join, due to an inability to agree to the SIG’s IPR policy. We have not seen a copy of the SIG’s IPR policy, but that policy evidently requires SIG participants to “agree to the IEEE IPR policy” (apparently without offering the “do not agree to provide an LOA” option). Another interviewee asked to join but was denied, with a reason that he/his company would not “provide value”.
9. All individuals interviewed indicated that they were **not** instructed to vote a certain way by the SIG or by their affiliated companies. Several individuals commented that there was an implicit expectation that once a document was agreed in the SIG, that members would act in accordance with the interest of the group and not argue anymore about it, and support it in IEEE 802.11. It was also noted that once members had been part of the discussion around a document, they would naturally be more likely to support the included proposal.
10. Several interviewees commented that once a document was voted in the SIG to be sent to IEEE 802.11, that “the author lists would be automatically added” and that “names were added to submitted documents by default with the understanding that people support it.” In at least 2 cases, when an individual changed companies, the individual remained listed in the author list of submitted documents after the change. For example, Thomas Derham was affiliated with Orange, but he moved to Broadcom 2015-11-30. Many 2016 submissions continue to list him as an Orange employee. Here are examples:

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0024>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0036>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0037>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0050>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0051>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0056>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0059>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0068>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0088>

- <https://mentor.ieee.org/802.11/dcn/16/11-16-0089>

Likewise Philip Barber (Huawei)’s name and Huawei affiliation was included on documents submitted after he left Huawei. 11-16/947r18 and 11-16-1403 list Rakesh Taori as employee of Samsung although he left Samsung some months ago.

## SIG impact on the IEEE 802.11ax TG

We obtained the following information related to 11ax related to the impact of the DensiFi SIG from interviewees:

1. One interviewee commented that a proposal needs to be vetted through the SIG to get into the specification; if an idea has not been agreed internally within the SIG, it is difficult to get that idea or proposal adopted. The process followed in 11ax is that non-SIG members present a proposal in an IEEE 802.11ax ad-hoc group first, and then a straw poll is taken. If the straw poll does not pass, then there might be further discussion in the SIG, and SIG proposals brought to IEEE 802.11ax.

The interviewee described that there are one of three SIG responses to any proposal:

* The SIG members are against the proposal: A lot of discussion and very low likelihood of proposal passing.
* The SIG members are for the proposal: minimal discussion and very high likelihood of proposal passing.
* The SIG members are for the proposal but have not finalized internal discussions: A lot of discussions and low likelihood of proposal passing. Proposal will pass at a later date when the SIG members have decided internally.

The following example was provided: In March 2016, document 11-16-0397 titled “HE-SIG-B Signaling Discussions” was presented by individuals whose affiliation was not a SIG member. The Ad-hoc straw poll passed 10-2-many (see minutes in 11-16-0509, page 7, item 4.1). The corresponding motion in TGax failed 40-14-41 (see minutes in 11-16-235r7 Page 57). In the subsequent May 2016 meeting, the same basic idea was presented by members whose affiated company was a SIG member, and both the straw poll and motion passed without objection (see 11-16-755r0 page 12 and 11-16-512r4 page 70).

1. One situation was identified in which a presentation had to be rescheduled as none of the coauthors could present the material: May 2016 in the Wednesday PM1 session of the TGax combined MAC and Spatial Reuse ad hoc group sessions, see <https://mentor.ieee.org/802.11/dcn/16/11-16-0701-00> , an author was scheduled to present during Wednesday PM1, see the agenda <https://mentor.ieee.org/802.11/dcn/16/11-16-0698-03>. Although submission <https://mentor.ieee.org/802.11/dcn/16/11-16-0657> lists eight pages of authors (and five pages of content), the presentation had to be re-scheduled as the indicated author was not present; none of the co-authors in attendancewas able to present the material and the presentation ended up in the last session, see <https://mentor.ieee.org/802.11/dcn/16/11-16-0698>.
2. A number of interviewees described abnormal delays in the voting process. One group of interviewees described this as a “skype delay”: There was a brief but noticeable delay before voters would raise their hands or stand to be counted for a vote, which indicated to them that some coordination was taking place. Another group of interviewees described the following behaviour during votes: no one would stand up to be counted for some delay period, then one person would stand, and others would follow.

# Additional input related to TGax

The information below related to TGax was provided by interviewees in response to our questions regarding claims of dominance in 802.11ax.

## TGax process and status

To date, there have been three phases in the TG operation:

Phase 1: May 2014 and lasted till January 2015. During this period the TG members focused on developing TG documents; simulation Scenarios, Evaluation Methodology, Channel Models, and Functional Requirements.

Observation: DensiFi SIG activity appears to occur largely after Phase 1 is complete.

Phase 2: November 2014 until May 2016: Development of a Specification Framework Document. The latest version of this document 11-15-132, see <https://mentor.ieee.org/802.11/dcn/15/11-15-0132-17-00ax-spec-framework.docx>.

Phase 3: May 2016 to present: Development of P802.11ax Draft 1.0.

## Specification Framework Document (SFD) development

The following additional information related to SFD development was provided:

The first specification requirements motion occurred during the November 2014 meeting and was related to the acceptance of the TG specification frame work document (SFD). There were two proposals. The two proposals were nearly equal in the sense that they only presented a skeleton and lacked details. The first proposal, <https://mentor.ieee.org/802.11/dcn/14/11-14-1429-01-00ax-proposed-802-11ax-specification-framework-document.docx> and was a single author proposal. A straw poll on this document had less than a majority support 47-66-32. The second proposal was <https://mentor.ieee.org/802.11/dcn/14/11-14-1453-02-00ax-spec-framework-proposal.docx>, with many authors. The motion to approve this second document passed 109-25-15.

In January 2015, submissions with large numbers of authors passed (61-17-22 <https://mentor.ieee.org/802.11/dcn/15/11-15-0099-04-00ax-payload-symbol-size-for-11ax.pptx>) and (66-0-38 <https://mentor.ieee.org/802.11/dcn/15/11-15-0101-01-00ax-preamble-structure-for-11ax-system.pptx> ). See the January 2015 TGax meeting minutes, <https://mentor.ieee.org/802.11/dcn/15/11-15-0090-01-00ax-tgax-january-2015-atlanta-meeting-minutes.docx> section 12, page 17.

Also during the January 2015 session, a straw poll related to *DL BA/ACKs in response to UL MU transmission* from an individual affiliated with a non-SIG member passed 60-1-51, see section 4.4, page 21. Another proposal from an individual affiliated with a non-SIG member company passed in straw poll (8-1-many), but failed in TGax WG motion (7-41-16), see sections 4.2.3.2 page 21 and section 11.1.2 page 24 also in <https://mentor.ieee.org/802.11/dcn/15/11-15-0090-01-00ax-tgax-january-2015-atlanta-meeting-minutes.docx> .

## SFD motion analysis

One interviewee provided the following description and analysis of motions in the period indicated.

Due to the large number of motions every meeting, motions in the TG are tried first using unanimous consent. Most motions were approved with no objection. There were few incidents where motions were debated in the TG and a vote was conducted.

The following table classifies motions as total SIG and Non-SIG motions during the peak time for developing the SFD. The number in parentheses indicates the number of failed motions. As shown in the table, non-SIG members had 11 failed motions out of a total of 52 (21%). 3 motions proposed by SIG members failed out of a total of 287 motions (1%).

One interviewee commented that “There are groups of non-SIG members that have the capability to reject a SIG proposal, and this has happened in TGax in the past.”

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Meeting | PHY | MAC | MU | SR | Non-SIG PHY | Non-SIG MAC | Non-Sig MU | Non-SIG-SR |
| March 16 | 23 | 17 | 12 |  | 1(1) | 4 | 3 | 0 |
| Jan 16 | 30 | 9 | 7 |  | 4 | 2 | 0 | 0 |
| Nov 15 | 34 | 16 | 12 | 1 | 5(2) | 2 | 4 | 1 |
| Sept 15 | 30(1) | 15 | 16 | 4 | 1 | 8(3) | 4 | 2 |
| July 15 | 21 | 4 | 15 | 0 | 0 | 2 | 3(2) | 0 |
| May 2015 | 6 | 4(2) | 1 | 0 | 2(1) | 0 | 1(1) | 0 |
| March 2015 | 4 | 3 | 3 | 0 | 1 | 0 | 3(1) | 0 |
| Total | 148(1) | 68(2) | 66 | 5 | 14(4) | 18(3) | 17(4) | 3 |

## P802.11ax specification development

P802.11ax specification development (Phase 3) is currently underway.

The initial draft specification was adopted in March 2016, see <https://mentor.ieee.org/802.11/dcn/16/11-16-0024-01-00ax-proposed-draft-specification.docx> .

# The technical matter in the complaint

## Background

The coexistence topic is a difficult one technically; solutions are not easy to come by and calculated analyses and simulations offer contrasting results.

## Alternative technical solutions

The proposals that were considered generally fall into one of the following categories of solution:

1. Coloring. The concept of Coloring was introduced in IEEE 802.11ah, and consists of adding a new identifier, a bit field in the preamble, if you will, a color, to a BSS. The color value is then used to distinguish between overlapping BSSs operating in the same channel. When a STA detects the bitfield, it knows that the frame originated in the same (or different) BSS.
2. Dynamic Sensitivity Control (DSC) as initially proposed and subsequently modified in Graham Smith’s (the complainant) proposals.
3. DSC with TPC, as described in 11-15-1069.

Each of the proposals has advantages and disadvantages. We were told that the current text in the 11ax draft allows the AP to set CCA threshold in devices, and thus implement Graham Smith’s proposal, DSC.

### Proposed Solutions – Coloring

Coloring appears to be an additional mechanism for spatial re-use, separate from DSC/TPC variants.

### Proposed Solution - DSC

Input from members on issues with DSC:

* CCA is essential for Wi-Fi operation; if one STA transmits the others need to defer. DSC alone is not ideal for dense environments.
* DSC as proposed does not distinguish between inter-BSS and intra-BSS. Raising the CCA would not be fair to legacy STAs. A contribution from Sony illustrated this issue. If CCA is raised, then TX power needs to be backed off as well. Modifying both CCA and TX power in tandem provide a better solution. There were technical issues with the Complainant’s proposal and that’s likely why he did not receive support in straw polls and votes.
* Also wanted to distinguish between OBSS and intra-BSS – adopt BSS color from 11ah.
* The complainant’s proposal limits the flexibility for a chipset vendor to implement features to address dense environments.
* The medium throughput gets better with DSC, but the performance of disadvantaged clients gets worse.
* Although there are technical issues with the Complainant’s proposal, it doesn’t prevent him from proposing his scheme under the current framework that was accepted by 802.11ax. The topic is still under discussion in the Task Group.

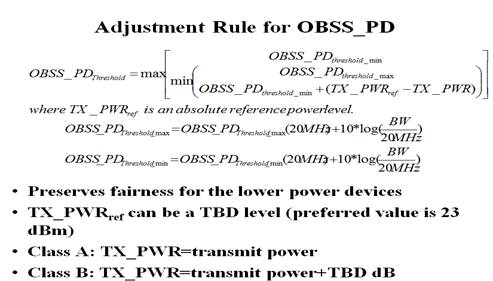
### Proposed Solution – DSC and TPC

Input from one member is below; this input indicates that discussion underway on the 11ax solution includes DSC as a subset:

“I looked into the history of the “proportional rule” for spatial reuse. The concept is pretty simple: a STA’s CCA threshold is set according to its transmit power. High transmit power  interferes over a wide area  needs sensitive CCA. Conversely, low transmit power  interferes over a smaller area  needs less sensitive CCA threshold. The CCA threshold is proportional (or inversely proportional if you like) to the transmit power.

The concept is present in LTE-LAA and ETSI BRAN (ETSI EN 301 893). LTE-U follows ETSI BRAN so its present there as well.

In the SFD, the proportional rule is captured in the formula:



Where OBSS\_PD is the “packet detect threshold for OBSS traffic”

Graham Smith’s dynamic sensitivity control (DSC) proposal was to have the AP set the CCA threshold in associated STAs.

If I had to guess as to why the proportional rule is more popular the Graham Smith’s proposal, I would say

1.       It is present in the other standards cited above

2.       It takes account of transmit power of the device and thus the amount of interference caused while Graham Smith’s does not

Ongoing discussion around the proportional rule is to have the have the AP set the parameters in the above formula. This is partly because it is hard to reach agreement on fixed parameters and partly because there are no fixed values that are optimal in all scenarios. If we do that then Graham Smith’s proposal would be a subset of this mechanism: by choosing certain values for the parameters the AP would essentially set the CCA threshold in the devices.”

## Status of Specification Framework Document (SFD) work

### Work on the SFD has completed

The 11ax task group has stopped work on the SFD (the last revision was 15/0132r17 <https://mentor.ieee.org/802.11/dcn/15/11-15-0132-17-00ax-spec-framework.docx> ) as of the close of the May 2016 session. Going forward, adding detail to the spatial reuse features or any new spatial reuse features will be adopted with text directly modifying the draft amendment.

### SFD presentations that resulted in statements related to spatial reuse

Below are the presentations that resulted in SFD statements being added to the SFD (section “5.1 Features for operation in dense environments”) and the sessions in which the statements were added.

An observation from the member who provided the list was that “*based on the author list in the presentations, it is safe to assume that the ones listed as “+ many others” had their origin in the DensiFi SIG.”* The “+many author documents” are highlighted in grey below.

**September 2015**

[132] 15/1063r1 11ax Channel access procedure Chao-Chun Wang (MediaTek) + many others

[137] 15/1069r3 Adaptive CCA and TPC James Wang (MediaTek) + many others

[133] 15/1109r1 OBSS NAV and PD Threshold Rule for Spatial Reuse Rossi Jun Luo (Huawei) + many others

[136] 15/1104r4 TXOP Considerations for Spatial Reuse Reza Hedayat (Newracom) + 4 others affiliated with Newracom[[1]](#footnote-1)

[135] 15/1138r1 To DSC or not to DSC Filip Mestanov[[2]](#footnote-2) (Ericsson)

**November 2015**

[138] 15/1348r0 Multiple NAVs for Spatial Reuse Evgeny Khorov (IITP) + 3 others (IITP and Quantenna[[3]](#footnote-3))

**March 2016**

16/0414r1 Adjustment Rules for Adaptive CCA and TPC James Wang (MediaTek) + many others

**May 2016**

[139] 16/0640r3 BSS Color Collision Geonjung Ko (WILUS) + 4 others affiliated with WILUS

[134] 16/0647r0 Consideration of Spatial Reuse for Trigger Frame Po-Kai Huang (Intel) + many others

### Spatial re-use related SFD text

The text in Section 5.1 is copied below. The highlighted text resulting from documents that originated in the DensiFi SIG.

*This section describes features that improve overlapping BSS (OBSS) operation in dense environments. This includes features such as deferral rules and CCA levels.*

*The STA determines whether the detected frame is an inter-BSS or an intra-BSS frame by using BSS color or MAC address in the MAC header. If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receive sensitivity level*

*NOTE–Maybe extra rules need to be added to ensure that all 11ax STAs can make the decision in a consistent manner.*

*[MAC Motion 34, September 17, 2015, see [132]]*

*A STA should regard an Inter-BSS PPDU with a valid PHY header and that has a receive power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload. The OBSS PD level is greater than the minimum receive sensitivity level.*

*[SR Motion 1, September 17, 2015, see [133]]*

*If the SR field in the HE-SIG-A of the HE SU PPDU or HE extended range SU PPDU is set to a TBD value, the medium condition for the STA shall indicate BUSY for the duration of the HE SU PPDU or HE extended range SU PPDU. Note that the TBD value of the SR field in the HE-SIG-A of the HE SU PPDU or HE extended range SU PPDU can be set when trigger frame is carried in the HE SU PPDU or HE extended range SU PPDU or under other TBD conditions.*

*[May 2016, see [134]]*

*If the SR field in the HE-SIG-A of the HE MU PPDU is set to a TBD value, the spatial reuse transmission in the HE MU PPDU is limited to within the duration of the HE MU PPDU. Note that the TBD value of the SR field in the HE-SIG-A of the HE MU PPDU can be set when trigger frame is carried in the HE MU PPDU or under other TBD conditions.*

*[May 2016, see [134]]*

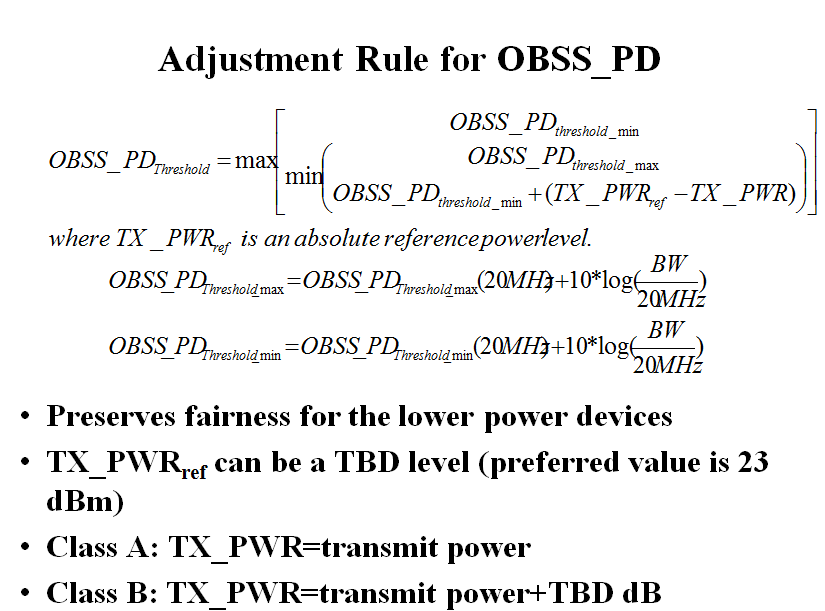
*The amendment shall include one or more mechanisms to improve spatial reuse by allowing adjustments to one or more of the CCA-ED, 802.11 Signal Detect CCA, OBSS\_PD or TXPWR threshold values. The constraints on selecting threshold values are TBD.*

*[SR Motion 2, September 17, 2015, see [135]]*

*The specification to consider a procedure that may revise the NAV depending on TBD conditions at the recipient of the ongoing OBSS frame.*

*[SR Motion 3, September 17, 2015, see [136]]*

*An 11ax STA regards a valid OBSS PPDU as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload if the RXPWR of the received PPDU is below the OBSS\_PD threshold and TBD conditions are met, noting that the OBSS\_PD threshold is accompanied by a TXPWR value following adjustment rules:*



*[SR Motion 4, September 17, 2015, see [137], modified with SR Motion 7, March 2016, see 16/414r0]*

*An HE STA should have a mechanism to remember and distinguish NAVs set by intra-BSS frame and OBSS frame. A CF-end frame that comes from intra-BSS should not reset NAV that was set by a frame from OBSS. To determine which BSS is the origin of a frame, the HE STA may use BSS color.*

*[SR Motion 5, November 2015, see [138]]*

*When a STA, that receives an HE PPDU with the same BSS Color as the BSS Color announced by its associated AP, identified from MAC header fields that the frame is an inter-BSS frame, the STA shall treat the frame as an inter-BSS frame after the FCS has been verified, unless the frame is identified as TDLS frame. [May 2016, see [139]]*

### Additional input

The bulk of the text related to spectrum reuse in the SFD, and the most substantive additions came from SIG originated documents.

Additional input from Graham Smith regarding the process:

* The adopted proposal, DSC with TPC was brought in for voting with no additional presentations and minimal technical justification.
* Graham Smith indicated that he wrote to several members to propose collaboration and received no responses. He has tried to reach out to SIG members to attempt to collaborate with them. He tried to work with a number of companies; the work started with a few companies but suddenly stopped.
* The 11ax group is not behaving “normally” where “normally” is defined as including substantive technical discussion and debate on documents and proposals.

Additional input from other interviewees:

* Believed that Graham Smith needed to be more flexible with feedback and collaborate better.
* All 100+ authors were aware of the proposal (11-15-1069r3) and reviewed the documents; a subset of the co-authors contributed more to the proposals.
* Graham Smith is disadvantaged by not being a member in the SIG.
* The straw poll on the Complainant’s DSC proposal failed in May 2015 because the solution was deficient in a few scenarios. An alternative proposal was discussed outside of the meeting but was not ready for presentation in a contribution. More work had to be done to make the solution be universally applicable.

## Observations and current status

After 2 years of discussion and debate, the text currently adopted into the pre-1.0 draft of P802.11ax allows DSC as proposed by Graham Smith. Work is continuing, obviously, on this.

# Attendance and voting member data

## Introduction

Roll call or recorded votes/straw polls were not held in 11ax for the duration described in the complaint. The first recorded vote was held in July 2016; see <https://mentor.ieee.org/802.11/dcn/16/11-16-0967-00-00ax-tgax-july-2016-san-diego-meeting-minutes.docx> section 12.2, page 17 and Appendix A. Thus recorded vote data is not available for the votes and straw polls called out in the dominance complaint and related investigation.

In the absence of the detailed vote data, we have looked at available IMAT (attendance tool) data and 802.11 voter data to obtain insight into the voting strength of DensiFi SIG member companies. Please see the sections below.

## IMAT data for September 2015: 11-15-1069r3 motion

IMAT data show the number of attendees who claim attendance in a particular meeting timeslot, along with attendee affiliation. Note that there is a known issue with IMAT data, in that the IMAT recorded attendance often exceeds the number of people in the room. See the <https://mentor.ieee.org/802-ec/dcn/16/ec-16-0005-01-00EC-attendance-requirements.pptx> slides which provide data from September 2015, showing IMAT recorded data (180 people) versus counts of people in the room (150) for the September 2015 Thursday PM1 TGax session.

The September 2015 Thursday PM1 session is when the motion to approve incorporating the SFD text in 11-15-1069r3 was held. IMAT data of the number of attendees per affiliated company for the Thursday PM1 session is shown in the chart below. Assuming that the DensiFi SIG members are the companies listed on the 11-15-1069r3 submission (as indicated by several interviewees), then there were 105 attendees present affiliated with the SIG. Assuming 150 total people (as counted) this is 105/150 or 70% of those present. Assuming a total of 186 (IMAT recorded attendance); this is 105/186 or 56% of those present. The vote result was 35-5-36, motion passed. (Voting member data is discussed in the next section.)



## 802.11 voting member data

Below is data based on the lists of voters and nearly voters for several 802.11 sessions based on the voter spreadsheets prepared ahead of the meeting to be used (if needed) for recorded votes for three sessions: March 2015, November 2015 and September 2016. The calculation for estimated number of SIG members is based on the authorship of documents during the sessions indicated (as indicated by several interviewees).

The estimated number of SIG voters and potential voters and their percentage of total 802.11 voters are: March 2015 (156/421, or 37%), November 2015 (209/444 or 47%) and September 2016 (247/400 or 61%). This data shows the growth of (estimated) 802.11 voters who are SIG-member affiliated over time.

The “Total listed” row indicates the total number of voters affiliated with all of the listed companies that appear to be active in the 802.11ax TG. The estimated number of SIG voters and potential voters as a percentage of the “Total listed” number is: March 2015 (156/269, or 58%), November 2015 (208/298, or 70%) and September 2016 (247/279, or 88%).

|  |  |  |  |
| --- | --- | --- | --- |
| Company affilation | Mar-15 | Nov-15 | Sep-16 |
| Mediatek USA | 0 | 0 | 0 |
| Mediatek | 11 | 14 | 10 |
| Qualcomm | 21 | 39 | 39 |
| Intel | 19 | 21 | 22 |
| Broadcom | 14 | 18 | 16 |
| Huawei | 34 | 34 | 47 |
| Marvell | 18 | 14 | 17 |
| Apple | 7 | 6 | 7 |
| LG Electronics | 12 | 16 | 14 |
| Orange | 4 | 0 | 1 |
| ZTE | 5 | 8 | 8 |
| Cisco Systems | 7 | 7 | 8 |
| Samsung | 12 | 11 | 6 |
| NTT | 6 | 6 | 6 |
| NTT Docomo | 5 | 5 | 2 |
| Sony Corporation | 7 | 10 | 11 |
| Newracom | 24 | 27 | 21 |
| Quantenna | 1 | 3 | 2 |
| Toshiba | 11 | 17 | 10 |
| Nokia | 7 | 8 | 5 |
| ETRI | 18 | 9 | 5 |
| Ericsson | 8 | 9 | 7 |
| CATR | 2 | 1 | 0 |
| Interdigital | 11 | 9 | 7 |
| WILUS Institute | 2 | 3 | 4 |
| SK Telecom | 0 | 0 | 0 |
| HPE/Aruba | 3 | 3 | 4 |
| Total SIG (est) | 156 | 209 | 247 |
| Total listed | 269 | 298 | 279 |
| Total Voters | 351 | 321 | 389 |
| Total Voters & nearly voters | 421 | 444 | 400 |

## IMAT data for March 2016: 11-16-0024r1 motion

The March 2016 Thursday AM2 session is when the motion to approve incorporating the initial P802.11ax D0.01 text in <https://mentor.ieee.org/802.11/dcn/16/11-16-0024-01-00ax-proposed-draft-specification.docx> was held. IMAT data of the number of attendees per affiliated company for the Thursday AM2 session is shown in the table below. Assuming that the DensiFi SIG members are the companies listed on the 11-16-0024r1 submission (as indicated by several interviewees), then there were 88 attendees present with a SIG-member affiliation. Assuming a total of 144 (IMAT recorded attendance); this is 88/144 or 61% of those present. The vote result was 75-0-5, motion passed (see [https://mentor.ieee.org/802.11/dcn/16/11-16-0415-00-00ax-tgax-march-2016-macau-meeting-minutes.docx section 5.1](https://mentor.ieee.org/802.11/dcn/16/11-16-0415-00-00ax-tgax-march-2016-macau-meeting-minutes.docx%20section%205.1) page 13).

## 

# IEEE standards development context

The IEEE and IEEE 802 standards development process follows the five basic principles of Openness, Due process, Balance, Right of Appeal and Consensus. Dominance is also defined.

## Rules related to dominance

Dominance is defined and addressed in the following policy and procedure documents: see <https://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf>, section 5.2.1.3:



and [http](file:///C:\Users\dstanley\Documents\Investigation\http)[://ieee802.org/PNP/approved/IEEE\_802\_WG\_PandP\_v19.pdf](http://ieee802.org/PNP/approved/IEEE_802_WG_PandP_v19.pdf) section 3.4.1, list item x





## Rules related to openness

Openness is defined and addressed in the following policy and procedure documents: see <https://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf> section 5.2.1.4:



The topic of SIG existence and operation was discussed in the IEEE 802. EC workshop held in January 2016. From <http://ieee802.org/minutes/2016_01/2016-01-22-minutes-v1.pdf>, at page 8, last bullet item:

“If a SIGs rules and membership are open, then it is likely OK. If it meets in secret and votes as a block, then it is likely not OK.”

This was a statement by an EC member, was not further discussed in the January SIG workshop, and has not been formally adopted as an EC position.

# Conclusion regarding the specific complaint

The final paragraph of Graham Smith’s complaint is copied below:

*“I am convinced that I have been subjected to deliberate exclusion, that my presentations have not been taken on merit, and I believe that a block of members have deliberately agreed among themselves to exclude my idea. Similar proposals, with much less analysis or description and with higher levels of complication and introduced about 18 months after DSC was first described in detail, pass with big margins.  I therefore can only conclude that this is due to the companies working together in the SIG in TGax which has exercised its influence by reason of superior leverage, strength, and representation to the exclusion of fair and equitable consideration of other viewpoints, and in particular, mine.”*

**Investigative team observations and conclusion:**

As stated earlier, spatial re-use is a very complex and technically difficult topic, and no particular author/co-author should expect his or her proposal to be adopted without comment, change or significant debate. We observe that significant discussion related to Graham Smith’s DSC proposal(s) occurred during TGax meetings. We believe that significant discussion on spatial reuse topics, and potential solutions including DSC occurred within the DensiFi SIG meetings, which Graham Smith did not and could not participate in. We agree that the SIG proposals were voted in with less discussion/rationale in the 802.11ax TG than Graham Smith’s proposal.

The currently understood spatial re-use solution does (with selected parameter settings) include DSC; however DSC is not called out or highlighted as a solution. Did SIG members deliberately agree among themselves to exclude Graham Smith’s idea? Initially, this is likely. Graham Smith’s experience follows the pattern described by others:

* The SIG members are against the proposal: *A lot of discussion and very low likelihood of proposal passing (straw poll results).*
* The SIG members are for the proposal: minimal discussion and very high likelihood of proposal passing *(11-15-1069r3 passed with little debate*).
* The SIG members are for the proposal but have not finalized internal discussions: *A lot of discussions and low likelihood of proposal passing. Proposal will pass at a later date when the SIG members have decided internally (11-15-1069r3 passed with little debate after discussions in the SIG).*

One interviewed member commented that because some non-SIG-originated entries into the SFD were adopted, dominance did not occur. Possibly; we believe, however, that the adoption of the non-SIG originated entries is necessary but may not be sufficient to declare non-dominance as the non-SIG entries might have been non-threatening, or aligned with already agreed SIG directions.

Graham was unaware of the existence of the DensiFi SIG until September 2015; once he became aware of the SIG, he was unable to participate in discussions and presentations within the SIG related to spectrum reuse, including DSC. The investigation of Graham Smith’s complaint identified a number of additional areas of concern, discussed in the next section.

# Conclusion regarding the DensiFi SIG activity

## Introduction

The following observation made in 2008 (see reference 2) regarding participation in 802.11 standards remains true today:

*“Commercial development of 802 specifications has become big business and attracts large numbers of participants including those from large companies who may fund travel for 12 or more people at any one meeting.*

*In the course of constructing standards it is absolutely necessary that groups of people discuss options, and via voting, express agreement on a technical solution to allow any draft to be completed. Hence cooperation among groups is of immense importance. In some circumstances, identifying dominance can be fairly simple once the facts are known. In other circumstances, distinguishing among healthy competition, cooperation, and collusion can be extremely difficult.”*

And also:

*“…it is clear that many people feel the boundaries between propriety and impropriety are continually being tested.”*

## Behaviours raising concern

Several behaviours and structures identified in this investigation raise concerns:

1. The existence of a large, unpublicized, closed or quasi-closed group developing material for submission to IEEE 802.11ax.
2. The apparent ability of DensiFi SIG members, if voting as a block, to prevent adoption of any other proposal in IEEE 802.11ax consideration.
3. The two-tier voting structure of the SIG. A small number of companies determine the documents submitted to IEEE 802.11ax by the SIG.
4. The rolling admission to DensiFi SIG membership, with membership additions limited to 2 companies per 2-month period, effectively preventing individuals and companies from participating in development of designs and specifications and documents that would be submitted to IEEE 802.11ax. An 802.11ax participant whose employer was not a member of the SIG might not have had the ability to have his/her own views considered during the SIG’s development of its submission. Additionally, the participant had no ability to see drafts of SIG presentations until their submission to 802.11ax.
5. While not explicit, the implicit expectation that a company’s IEEE 802.11ax participants support proposals from the SIG in IEEE 802.11ax. SIG document author lists were added as a matter of course, implying support for the document in IEEE voting without express permission of listed individuals. One member mentioned that a statement existed in the Densifi SIG operating documents to the effect of “supports the work of the SIG”. (It is not clear, however, whether this means “participate in, and thereby support, the SIG” or “vote in favour of any SIG proposal, even if you disagree with it.”)

## Finding related to dominance

From <https://standards.ieee.org/develop/policies/bylaws/sb_bylaws.pdf>, section 5.2.1.3:

*Dominance is normally defined as the exercise of authority, leadership, or influence by reason of superior leverage, strength, or representation to the exclusion of fair and equitable consideration of other viewpoints. Dominance can also be defined as the exercise of authority, leadership, or influence by reason of sufficient leverage, strength, or representation to hinder the progress of the standards development activity. Such dominance is contrary to open and fair participation by all interested parties and is unacceptable.*

The investigating team conclude that dominance has occurred through the mechanism of “*superior leverage, strength or representation*” with the effect of excluding viewpoints of non-SIG participants from “*fair and equitable consideration*” within the 802.11ax Task Group.

This conclusion is based on the combination of the SIG’s

a) limited openness to interested parties,

b) the non-public conduct of the SIG’s proceedings and

c) the number of SIG participants as a percentage of 802.11ax participants.

# Appendix 1: Multi-authored documents

Below is a list of selected multi-authored documents and their authors over time. All referenced documents are publicly available on the Mentor document server.



# Appendix 2 – List of Interview questions

Below is the list of questions used in the interviews. Not all questions were used in every interview, and individualized follow-up questions are not included.

1. Please tell me your name, employer(s), and affiliation(s) in connection with 802.11ax.
2. Is your employer or affiliated company a member of any 11ax related SIG?
   1. If yes, what is the name of the SIG(s)? How many companies are members? Who are they?
   2. Does the SIG have a webpage? Is it available publicly?
   3. Tell me something about the SIG? How often does the SIG meet? Are the meetings in person, some other means, or a combination? How are proposals submitted, considered, and voted on? Does the SIG permit alternative paths (e.g., two ways to implement .11ax, rather than one)? Does the SIG entertain proposals from non-member companies? Where (in terms of progress) does the SIG’s work stand relative to the .11ax group?
   4. If yes, tell me about the voting structure of the SIG(s). Do all members have voting rights, and if not, why not? What are the criteria for gaining voting rights?
   5. What is the leadership structure of the SIG? How is the leadership selected? Does your company have any employees or other representatives in a leadership position? What position?
   6. If yes, what are the criteria for joining the SIG(s)? Do you know whether the SIG(s) has ever denied a company membership? If so, for what is your understanding of the reason?
   7. If yes, what is the IPR policy of the SIG(s)? Are you aware of the IPR of any other 802.11ax SIG that your company has not joined?
   8. If yes, does the SIG(s) make recommendations on how you should vote in IEEE 802.11? Does your employer make recommendations of how to vote in either the SIG or IEEE 802.11? What are the consequences if you decline the recommendation?
   9. Has your company ever applied for membership in an 11ax SIG that your company did not join? What happened? Was your company denied membership? If so, what was the reason given? Or did your company decline to join? If so, then why?
   10. If your company has joined more than one SIG, why?
3. Questions regarding the specific complaint
   1. Are you familiar with the complaint in 11-16-784?
   2. Are you familiar with the topic in 11-15-1069r3?
   3. What were the technical matters at issue? Technical advantages of the proposal in 1069r3 compared to DSC?
4. Is there anything else you’d like to share with us about the complaint topic?

**References:**

1. <http://ieee802.org/minutes/2016_01/2016-01-22-minutes-v1.pdf> Note Page 8, last bullet item, “If a SIGs rules and membership are open, then it is likely OK. If it meets in secret and votes as a block, then it is likely not OK.”
2. 2008 dominance investigation report, see <http://grouper.ieee.org/groups/802/secmail/pdf7HnhutvAB2.pdf> .

1. Note Newracom began appearing as a co-author affiliation on multi-authored documents in March, 2016, see Section 11. [↑](#footnote-ref-1)
2. This is the document referenced in paragraph 8 of the complaint text as allowing DSC, see section 3.8. [↑](#footnote-ref-2)
3. Note Quantenna began appearing as a co-author affiliation on multi-authored documents in March, 2016, see Section 11. [↑](#footnote-ref-3)