IEEE P802.11
Wireless LANs

|  |
| --- |
| TGaz Meeting minutes – July 11-13th, 2017 |
| Date: 2017-07-11 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Roy Want | Google | 1600 Amphitheatre Parkway, Mountain View, CA 94043 USA | 650-691-3600 | roywant@google.com |

Abstract

Minutes for the TGaz meeting beginning on July 11th, 2017.

**IEEE 802.11 Task Group AZ**

**July11th-13th, 2017**

1. **TGaz: Session #1 on 11th July 2017**
	1. Called to order by TGaz Chair, Jonathan Segev (Intel Corporation), and Secretary, Roy Want (Google), at 01.30 PM UTC + 2hrs.
	2. Agenda Doc. IEEE 802.11-17/0836r0
	3. Review Patent Policy and logistics
		1. Chair reminded all to record their attendance
		2. Chair reviewed the IEEE-SA Patency Policy, additional guidelines about IEEE-SA meeting and logistics
		3. Chair called for any potentially essential patent, no one stepped up.
		4. Reviewed the participation as individual professional policy slide and asked if any clarification needed – no request made.
		5. Recorded participation requirement
			1. Headcount: ~29 present
	4. Review Agenda
		1. Called for any additional submissions for the week.
		2. Reviewed and modified the agenda
		3. Chair called for any additional feedback and changes to agenda.
	5. **Motion: We approve the agenda for document IEEE 802.11-17/0836r1**
		1. Approved by unanimous consent.
	6. Approve previous meeting minutes
		1. May Minutes (Roy Want) 11-17-0842r0
			1. **Motion: Move to approve document 11-17-842r0 as TGaz meeting minutes for the May meeting.**
			2. Mover: Assaf Kasher, Seconder: Qingha Li
			3. Discussion of the motion: None
			4. **Vote**: Y: 16, N: 0, A: 0; **Motion passes**
	7. Allan Zhu (Huawei) presented edits to document 11-16-424r5
		1. Title: **Proposed 802.11az Functional Requirements**
		2. Based on 11-17-778r1 a change was made to the FRD, adding revision R28.
		3. The document has been uploaded to mentor.
		4. Discussion: None.
		5. **Motion: Move to adopt document 11-16-424r6 TGaz Working Draft Functional Requirement Document.**
		6. Mover: Allan Zhu, Seconder: Roy Want
		7. **Vote**: Y: 17, N: 0, A: 1; **Motion passes**
		8. Request to rename FRD 11-16-424r7 of FRD which was uploaded in error by Ofer Bar Shalom. The document will be renumbered as a new DCN with just comments for consideration by Ofer Bar Shalon and added to submissions list.
	8. Ganesh Venkastesan (Intel) presented document 11-17-918r0 on behalf of Ofer Bar Shalon
		1. Title: **FRD Requirements for Scalable Location**
		2. Discussion: None
		3. **Strawpoll: We support the addition of the functional requirements outlined in slides #5 & #6 to the FRD under section “scalability” (2.1.3).**
		4. Discussion: None
		5. **Vote**: Y: 20, N: 0, A: 0; supports a motion.
		6. **Motion: Move to adopt the set of functional requirements listed in slides 6 and the terminology in slide 5 of submission 11-17-918r0 and instruct the FRD editor to include it in the TGaz FRD under the sub-section Scalability (2.1.3) for the 802.11az protocol.**
		7. Mover: Ganesh Venkatesan, Seconder: Qinghua Li
		8. **Vote**: Y:17, N: 0, A: 0; **Motion passes**
	9. SK Yong (Apple) presented submission 11-17-952r0
		1. Title: **Comments on 802.11az Functional Requirements Document**
		2. Summary: The document includes four comments prepared by Qi Wang (Apple). 1 & 2) update Type A and B attack definitions to specify whether it applies to 5GHz or 60GHz 3) add another attacker type with smaller response time for ad/ay devices 4) Consider other types of threats (2 presentations on this topic are scheduled).
		3. Discussion: some speculation on what the attack time capabilities should be for 60GHz (perhaps 70ns – but will be resolved later).
	10. Roy Want (Google) presented submission 11-17-955r0.
		1. Title: **Comments on 802.11az Functional Requirements Document**
		2. Summary: Purpose of the comments are to identify the type of likely attacks and validate the resulting protocol is capable of securing against them.
		3. C: in general, supportive of the effort, would like to see experts submit a set of attacks the protocol is capable of fending off.
		4. C: Believe this is a good thing, the group can later evaluate if the existing proposal possibly support these attacks.
		5. C: This practice is a good one and follows the IETF practice of having a section dealing with the set of attacks the protocol protects against for each IETF RFC.
		6. C: a threat model should categorize and group attacks which are similar.
		7. C: please correct submission document header (change to author of comments).
		8. C: is the expectation for each considered solution to exhaustively meet all these requirements?
		9. R: The FRD is an assessment tool for the complete solution / amendment.
		10. Will collect suggestions and propose text for the FRD draft in a later session.
	11. Ganesh Venkatesan (Intel) presented 11-17-1086r1 comments from ARC Document
		1. Title: **IEEE 802.1AS REV D5.0 Review Comments**
		2. Comments on: **IEEE 802.1AS REV project includes use of IEEE 802.11-2016 Fine Timing Measurement as an additional 802.11 protocol to generate timestamps that 802.1AS would use for clock synchronization**
		3. C: We wouldn’t want to have a renegotitiate the FTM frame continuously
		4. R. The FTM Negotiation is done first, then the Master sends messages to the Slaves forever. Typically, FTM frames sent from master to slave at a rate of 8 per second. Multiple bursts might help. Best not to have to wait for new trigger for frames to be sent. Hence an FTM Frames ‘forever’ bit suggested.
		5. Ganesh invites discussion at 4pm. RevMC 802.11-2016 FTM ARC & 802.1as
		6. Question: What is the best method to keep backward compatibility?
	12. Recess at 3.26pm.
2. **TGaz: Session #2 on 12th July 2017**
	1. Called to order by TGaz Chair, Jonathan Segev (Intel Corporation), and Secretary, Roy Want (Google), at 01.30 PM UTC + 2hrs.
	2. Agenda Document 11-17-0836r3
	3. Review Patent Policy and logistics
		1. Chair reminded all to record their attendance
		2. Chair reviewed the IEEE-SA Patency Policy, additional guidelines about IEEE-SA meeting and logistics
		3. Chair called for any potentially essential patent, no one stepped up.
		4. Reviewed the participation as individual professional policy slide and asked if any clarification needed – no request made.
		5. Recorded participation requirement
			1. Headcount: ~24 present
	4. Reviewed and modified the agenda
	5. Chair called for any additional feedback and changes to agenda (no objection)
	6. Ganesh Venkatesan (Intel) presented document 11-17-1127r1
		1. Title: **Comments on FRD**
		2. Summary: Resolving FRD TBD on worst case range error. Proposal no worse than 11mc (below 4m).
		3. C. Nothing in the spec that performs at a particular level
		4. C. What is the upper bound error?
		5. R. (4m) +/- 2m
		6. C. PAR for 11az states should perform better than 11mc.
		7. C. Please point out the specific text in the spec that references this.
		8. R. Not in spec, but in document 11-16-0134r3
		9. C. Requirements require some of the conditions (LOS, env. conditions etc).
		10. R. Better to reference the exact doc reference
		11. Will work on this offline and bring a proposal back to the group.
	7. Roy Want (Google) Presented document 11-17-0955r2
		1. Title: **Comments on FRD** (Security and Privacy Section)
		2. Summary: 955r2 R38 (OPT1) contains proposed text to classify attacks in scope for the PHY and MAC layers. Its based-on feedback from some TGaz members, but it was not possible to talk to everybody who had concerns, so recommend deferring to session #3.
	8. Roy Want (Google) presented document 11-17-1118r3
		1. Title: **Relay Treat Model for TGaz**
		2. Summary: Presentation describes a relay attack, applications that need to be immune to it, and a solution that achieves range integrity without encryption keys or signed messages. This is achieved by using a cloud service to valid the range measurement derived at both ends of an FTM exchange.
		3. Discussion
			1. C: ACK is a legacy control frame, changes are best addressed by the new protocols and not touch on the time critical ACK message.
			2. C: ACK is time critical message, not sure there is sufficient time to generate a random number.
			3. R. Random numbers can be pre-calculated
			4. Q: how is the t1, t4 protected from manipulation?
			5. R: the t1 and t4 are not required to be transmitted over the air in this proposal, but is transmitted over a secured link at the application level.
			6. C: how long is A and B?
			7. R: preferably as long as possible, but may be re-using the MAC address TA field (48-bits) not used today in the ACK.
			8. Q: what happens if no out band secured link exist?
			9. R: the ranging still works; the proof of range does not exist in that case.
			10. C: does that means the privacy of the client is infringed due to the client location keep being sent to a server on a cloud?
			11. R: it is a matter of user choice, today a mobile phone OS will give a user choice if location will be reported to a cloud service.
		4. Discussion of Straw Poll
		5. C. Text revised in discussion to above text by group adding type A adversaries.
		6. C: It provides some assurance on a MAC level attack but a PHY level attack might still be able to provide wrong sense of distance.
		7. C: would like to remover the upper layer out of band communication part, because then it directs towards a specific technique.
		8. C: does that still applies to associated STAs as well?
		9. R: It could, but then STAs will likely have shared keys
		10. **Straw poll:** **11az protocol shall support a mode where range integrity can be obtained without authentication and encryption protecting against type A adversaries.**
		11. **Vote**: Y: 16, N: 0, A: 7; **supports a motion**.
		12. Out of time for a motion now (see session #3, for conclusion)
	9. Qinghua Li (Intel) presented document 11-17-0795r1.
		1. Title: **PHY-Level Security Protection**
		2. Summary: MAC protection is insufficient for preventing Type B spoofing, and PHY protection is needed. Type B spoofing can be detected by using CSD unknown to spoofer. However, Type B spoofing can be suppressed by using randomized sounding signal. Sounding sequences, whose PAPRs are comparable to 11ax LTF, can be easily generated.
		3. Discussion: none
	10. Mingguang Xu (Apple) presented document 11-17-1122r0
		1. Title: **CP-Replay Threat Model for 11az**
		2. Summary: CP of an OFDM symbol or any other repetition of signals in the waveform for channel measurement is subject to attack. This presentation demonstrates fake paths can be created accurately by an attacker even in the case of random waveforms used for channel measurement. Solution TBD.
		3. No Discussion (out of time).
	11. Recess at 3.30pm.
3. **TGaz: Session #3 on 12th July 2017**
	1. Called to order by TGaz Chair, Jonathan Segev (Intel Corporation), and Secretary Roy Want (Google) 04.00 PM UTC + 2hrs.
	2. Review Patent Policy and logistics
		1. Chair reminded all to record their attendance
		2. Chair reviewed the IEEE-SA Patency Policy, additional guidelines about IEEE-SA meeting and logistics
		3. Chair called for any potentially essential patent, no one stepped up.
		4. Recorded Participation requirement (nobody objected)
		5. Agenda document 11-17-0836r5 – r6 in progress.
		6. Attendance ~25
	3. Thomas Handte (Sony) presented document 11-17-0958r0
		1. Title: Proposed Changes to FRD
		2. **Motion: Move to adopt the following modified text to section 2.1.2 of the Functional Requirement Document and instruct the FRD editor to include it in the TGaz FRD under the sub-section 60 GHz Bands (2.1.2) for the 802.11az protocol.

		R14 TGaz: The 802.11az amendment shall support at least one mode of operation that enables AOA/AOD measurement in the 60GHz band with an accuracy of 5deg, @90%.[Ref-6]

		R16 TGaz: The 802.11az amendment shall support at least one mode of operation that provides location using both range and angle measurements of a single link. [Ref-6]**
		3. Mover: Thomas Handte, Seconder: Christian Berger
		4. **Vote**: Y: 16, N: 0, A: 0; **Motion passes**
	4. Qingua Li (Intel) presented document 11-17-1111r0
		1. Title: **Measurement Report Feedback in 11az**
		2. Summary: TGaz have discussed the negotiation and channel measurement mechanisms, but no agreement has yet been formed. This submission reviews the design considerations of different technical approaches for the location measurement reporting (LMR).
		3. Discussion: None.
	5. Christian Berger (Marvell) presented document 11-17-1120r1.
		1. Title: **VHT Sounding Feedback**
		2. Summary: ToA should be mandatory. All 11az STAs should be able to provide some sort of ToA. Low cost STAs can advertise a CSI feedback capability to increase accuracy when acting as responder. High performance APs will offer ToA feedback after SIFS as a responder by setting MinToaReady and MaxToaAvailable to 0.
		3. Discussion.
		4. C. Is there any limit on SIFT + X? Perhaps it should be limited?
		5. R. Perhaps there is a need if processing takes longer than a slot time
		6. C. One solution is to transmit an NDP while processing to maintain the channel, or send feedback not ready.
		7. R. Proposal is that APs provide a min and max, which gives a general solution.
		Discussion of straw poll.
		8. C. Why exclude CSI? May not need ToA.
		9. R. Just trying to establish a baseline.
		10. C. slide 7: Limit applies to the session only or longer ?
		11. R. Each connection could tune the values, but is it intended to be long term?
		12. C. It could take longer for some stations compared to others. So perhaps it should be established per connection.
		13. C. Proposal does not state how limits are communicated.
		14. C. The proposal is intended for low-performance stations – so aren’t you increasing the burden on them? Shouldn’t you limit it for certain classes of device?
		15. R. There might be stations that don’t want to process CSI, so ToA limits are used.
		16. C. You are substituting CSI with ToA.
		17. **Straw Poll #1: We support to make ToA feedback in LMR mandatory: whereby the ToA feedback should be ready by MinToaReady (MinToaReady = 0 means ready after SIFS in same Tx OP), and stored until MaxToaAvailable**
		18. **Vote**: Y: 6, N: 0, A: 16
		19. **Straw Poll #2: We support to make ToA feedback in LMR conditionally mandatory (if not supporting CSI feedback):** **whereby the ToA feedback should be ready by MinToaReady (MinToaReady = 0 means ready after SIFS in same Tx OP), and stored until MaxToaAvailable**
		20. Discussion: None
		21. **Vote**: Y:6, N:0, A: 15
	6. Roy Want (Google) follow-up motion for 11-17-1118r3 presented earlier in Session #2.
		1. **Move to adopt the functional requirement depicted below, and instruct the FRD editor to include it in the FRD under section 2.1.6, in a subsection dealing with ranging integrity without cryptography, and give editorial license.
		“11az protocol shall support a mode where range integrity can be obtained without authentication and encryption protecting against type A adversaries.”**
		2. Mover: Roy Want, Seconder: SK Yong
		3. **Vote**: Y: 10, N: 0, A: 2; **Motion Passes**
	7. Vladica Sark (IHP) presented document 11-17-0981r0
		1. Title: **Efficient Positioning Method using Beacon Frames**
		2. Summary: Passive scaleable positioning achieved by measuring TDoA of beacons containing ToA & DoD of beacons from all nearby APs. Beacons must not be synced, and must listen to neighboring APs. More APs results in greater precision.
		3. C. How would current systems deal with the higher bandwidth requirements?
		4. C. No current radios are capable of listening on multiple channels simultaneously
		5. C. System must use unique ID/Hash of packets to identify specific beacon frames.
		6. **Straw Poll**: **Should the APs and STAs support listening on multiple channels simultaneously in order to enable passive positioning. of STAs**.
		7. **Vote:** Y: 1, N: 0: A: 16
	8. Remaining speakers on agenda are not available.
	9. Session adjouned at 5.45pm.
4. **TGaz: Session #4 on 13th July 2017**
	1. Called to order by TGaz Chair, Jonathan Segev (Intel Corporation), and Secretary, Roy Want (Google), at 04.00 PM UTC + 2hrs.
	2. Agenda Doc. IEEE 802.11-17/0836r3
	3. Review Patent Policy and logistics
		1. Chair reminded all to record their attendance
		2. Chair reviewed the IEEE-SA Patency Policy, additional guidelines about IEEE-SA meeting and logistics
		3. Chair called for any potentially essential patent (no one stepped up).
		4. Reviewed the participation as individual professional policy slide and asked if any clarification needed – no request made.
		5. Recorded Participation requirement
			1. Headcount: ~24 present
	4. Reviewed and modified the agenda
	5. Chair called for any additional feedback and changes to agenda
	6. C. Move the FRD status before the TG (changed)
	7. No objections to amended agenda.
	8. Chittabrata Ghosh (Intel) presented document 11-17-1128r0
		1. Title: **Target Wake Time for MU Measurement Scheduling**
		2. Summary: Introduces the Target-Wake-Time (TWT) element as defined in 802.11ax. Proposes the use of the TWT element for MU NDP measurement, and in the definition of the ranging start time, interval, and measurement duration. In addition, proposes differentiation of the TWT element to be used for MU NDP over that in 802.11ax, using a ranging subfield in the control field for signaling.
		3. C. Its TWT an optional or mandatory feature
		4. R. Individual = Mandatory, Broadcast = Optional
		5. R. Not preposing a separate TWT negotiation
		6. C. How are the TWT values used?
		7. R. At this time we are just introducing the scheduling elements for ranging.
		8. C. How are TWT fields updated when network conditions change?
		9. R. The AP performs group rescheduling.
		10. **Straw Poll:** **Do you agree that the periodic MU measurements among HEz non-AP STAs an HEz Aps shall be based on Individual Target-Wake-Time (TWT).**
		11. **Vote:** Y: 11, N: 0, A: 10
		12. Discussion of the motion
		13. C. Are there any alternate scheduling mechanisms available
		14. R. One mechanism and mandatory is part of 11ax.
		15. C. If AP negotiated with all STA, does it not mean it can Poll other stations
		16. R. Yes it can poll other STAs.
		17. **Motion**

**Move to:**

* **Adopt the set of spec framework requirements listed in slide #5 of submissions 11-17-1128r0**
* **Instruct the SFD editor to include it in the TGaz SFD under the sub-section 3.2 (protocol description) and give the editor editorial license.**
	+ 1. Mover: Chitto Ghosh, Seconder: Christian Berger
		2. **Motion:**

**Table motion till Sep. meeting.**

* + 1. Mover: Chao Chun Wang, Seconder: SK Yong.
		2. Discussion of the motion: none.
		3. **Vote:** Y: 7, N:3, A:6; **Motion Fails.**
		4. **Motion**

**Move to:**

* **Adopt the set of spec framework requirements listed in slide #5 of submissions 11-17-1128r0**
* **Instruct the SFD editor to include it in the TGaz SFD under the sub-section 3.2 (protocol description) and give the editor editorial license.**
	+ 1. Mover: Chitto Ghosh, Seconder: Christian Berger
		2. **Vote**: Y: 6, N: 4, A: 6; **Motion Fails**
	1. Roy Want (Google) follow-up on ‘comments on the proposed FRD’, Security & Privacy section, document 11-17-0955r3.
		1. Based on considerable discussion with various members of TGaz, we have two alternate options for R38 of the FRD (presented and uploaded in 955r3). However, there is no clear way to move forward to select the option of record. We can have more discussion in the TGaz planning (final) slot of this session.
	2. Chao Chun Wang (MediaTek) presented document 11-17-462r5
		1. Title: **Overview of Spec Framework Document draft**
		2. Motion: Move to adopt document 11-17-0462r5 as TGaz SFD working draft.
		3. Mover: Chao Chun Wang, Seconder: Rob Sun
		4. Discussion: none.
		5. **Vote:** Y: 12, N: 0, A: 1; **Motion passes**.
	3. Chao Chun Wang (MediaTek) presented document 17-11-1113r0
		1. Title: **Resource Negotiation for Unassociated STAs in SU Request and Response in MU Operation**
		2. Summary: The contribution focus on the whether 11az shall support unassociated STAs send request in SU mode and AP returns responses in MU mode
		3. Discussion: none.
		4. **StrawPoll**: Do you support to include a mode in 11az SFD to support multiple STAs to send FTM request in SU mode (SU PPDU), and the AP sends an FTM response in an SU PPDU addressed to multiple STAs.
		5. C. Text revised in discussion to above by group.
		6. In favor of StrawPoll: Y: 9, N: 0: A: 7
		7. **Motion:**

**Move to:**

* **Adopt the following text to the spec framework requirements.**
* **Instruct the SFD editor to include it in the TGaz SFD under the sub-section 3.2 (protocol description) and give the editor editorial license.**

**“To include a mode in 11az protocol to support multiple STAs sending FTM Request in SU mode (SU PPDU) and the AP sends FTM Response in a SU PPDU to address multiple STAs”**

* + 1. Mover: Chao Chun Wang, Seconder: Nehru Bhandara.
		2. Discussion: none.
		3. **Vote:** Y: 9, N: 0, A: 5. **Motion Passes**
	1. Jonathan Segev (Intel) presents agenda slides on FRD Maturity options
		1. Summary: At the May meeting we decided to freeze the FRD in 45 days. We need to resolve differences highlighted by discussion during the TGaz July meeting sessions. Here we consider the options.
		2. **Options:**
		3. **OPT-1:** **Freeze FRD for further comments and resolve the existing comments till the end of next IEEE FtF meeting, the final FRD is the last version at that meeting.**
		4. **OPT-2:** **Freeze FRD Now**.
		5. Discussion of options:
		6. C. Moving with the concensus; keep the FRD open until next meeting.
		7. C. How many comments are there to resolve?
		8. R. 11 resolved 2 outstanding.
		9. C. Process: Freeze FRD as is, bring back the comments in the next phase (SFD).
		10. C. Its import to address the security attacks. The CP-Replay attack needs more time to discuss, and for TGaz to consider solutions.
		11. C. Delay comment discussion to the SFD, and support the FRD freeze now.
		12. C. Could it be partially frozen (no more comments). Then resolve the current FRD comments in next session.
		13. R. This will push the timelines of the project forward.
		14. C. Too much importance on the FRD doc. In favour of an FRD freeze.
		15. C. Why do we need to freeze the FRD – does not affect development. Why does this affect the timeline. It should only affect the engineering solutions.
		16. C. An extended timeline is not acceptable for industry. Freezing the FRD is IEEE standard procedure.
		17. C. Talked to all sides, can understand their point of view. A way forward is to compromise. Freeze comments, but keep FRD open to resolve existing comments until Sep. meeting (echoing previous comment).
		18. C. In favor of compromise solution.
		19. C. Can we vote at a later telecom?
		20. R. There are no motions during regular TG telecons.
		21. C. The FRD is really a guide for what the group will specify in the SFD. It sounds like some members are reading more into it than necessary. We should Freeze and move on.
		22. **Vote:** Option #1: 13, Option #2: 3; **Majority prefers Option #1.**
		23. **Motion: We agree to Freeze the FRD for further comments and resolve the existing comments until the end of next IEEE FtF meeting, the final FRD is the last version at that meeting.**
		24. Mover: Harry Bims, Seconder: SK Yong.
		25. **Vote:** Y: 13, N: 2, A: 3; **Motion passes.**
	2. Jonathan Segev (Intel) presents TGaz Timelines slides from 11-17-0836r7.
		1. Adjustments based on new events: no July FRD freeze, timelines show roughly 6 months delay
		2. Timeline projects this is now a 2022 project.
		3. Goals for September 2017 meeting.
			1. Continue SFD development
			2. Resolve remaining FRD comments
			3. Consider technical proposals
		4. **Motion - Approval of Sep. meeting Goals:**

**We commit for the Sep. meeting goals as the TG Plan Of Record.**

* + 1. Mover: Rob Sun, Seconder: Assaf Kasher
		2. **Vote:** Y: 16, N: 0, A: 0; **Motion passes**
	1. Telecon scheduled for Aug 30th 11am ET. No additional calls requested.
	2. Call for AOB – none identified.
	3. Adjourned at 6.03 pm.

**References:**

1. <https://mentor.ieee.org/802.11/dcn/17/11-17-0836-07-00az-tgaz-july-meeting-agenda.pptx>
2. <https://mentor.ieee.org/802.11/dcn/17/11-17-0842-01-00az-meeting-minutes-may-2017-session.docx>
3. <https://mentor.ieee.org/802.11/dcn/17/11-17-0778-01-00az-scalable-location.pptx>
4. <https://mentor.ieee.org/802.11/dcn/16/11-16-0424-06-00az-proposed-802-11az-functional-requirements.docx>
5. <https://mentor.ieee.org/802.11/dcn/17/11-17-0952-00-00az-comments-on-802-11az-functional-requirement-document.docx>
6. <https://mentor.ieee.org/802.11/dcn/17/11-17-0955-03-00az-comments-on-802-11az-functional-requirement-document.docx>
7. <https://mentor.ieee.org/802.11/dcn/17/11-17-1086-01-0arc-ieee-802-1as-d5-0-review-comments.pptx>
8. <https://mentor.ieee.org/802.11/dcn/17/11-17-1127-01-00az-comments-on-the-802-11az-functional-requirements.docx>
9. <https://mentor.ieee.org/802.11/dcn/17/11-17-1118-03-00az-relay-threat-model-for-tgaz.pptx>
10. <https://mentor.ieee.org/802.11/dcn/17/11-17-0795-03-00az-phy-level-security-protection.ppt>
11. <https://mentor.ieee.org/802.11/dcn/17/11-17-1122-00-00az-cp-replay-threat-model-for-11az.pptx>
12. <https://mentor.ieee.org/802.11/dcn/17/11-17-0958-01-00az-proposed-changes-to-fr-document.docx>
13. <https://mentor.ieee.org/802.11/dcn/17/11-17-1111-00-00az-measurement-report-feedback-in-11az.pptx>
14. <https://mentor.ieee.org/802.11/dcn/17/11-17-1120-01-00az-vht-sounding-feedback.pptx>
15. <https://mentor.ieee.org/802.11/dcn/17/11-17-0981-01-00az-efficient-positioning-method-using-beacon-frames.pptx>
16. <https://mentor.ieee.org/802.11/dcn/17/11-17-1128-00-00az-target-wake-time-for-measurement-scheduling.pptx>
17. <https://mentor.ieee.org/802.11/dcn/17/11-17-0462-05-00az-11-az-tg-sfd.docx>
18. <https://mentor.ieee.org/802.11/dcn/17/11-17-1126-00-00az-mu-negotiation-for-unassociated-stas-follow-up.pptx>