IEEE P802.11
Wireless LANs

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| IEEE 802.11 NG60 SGMarch 2015 Berlin Meeting Minutes |
| Date: 2015-3-13 |
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Abstract

NG60 SG meeting minutes from the IEEE 802.11 Berlin session, March 8-13, 2015.

**IEEE 802.11 Next Generation 60 GHz (NG60) Study Group**

**March 2015 Berlin Meeting**

**March 8-13, 2015**

**Monday, March 9, 2015, PM1 Session (13:30-15:30)**

1. The meeting called to order at 13:30 by Edward Au (Marvell Semiconductor), the chairperson of the NG60 SG. Introduced himself and secretary Jeorge Hurtarte (Teradyne)
2. Agenda Doc. IEEE 802.11-15/0217r4
3. The chair reviewed the IEEE-SA Patency Policy, Logistics, and Reminders on Study Group Rules
	1. Chair asked if anyone has any questions about the IEEE-SA patent policy, logistics or reminders. No questions.
	2. Chair reminded all to record their attendance.
4. The chair reviewed the SG meeting time slots and agenda items for the week (see slides 8-14 of the agenda)
	1. Chair indicated that the key focus for the week is on the resolution of any comments on PAR or CSD.
	2. Chair asked if there are any objections for the week’s agenda. No objections.
		1. Question on the expected timeline. Will review as part of the agenda.
5. Review of Submissions
	1. Five presentations identified for review for Monday PM 1 and an additional six for Thursday AM 2
	2. Chair asked if there are more submissions. No more submissions noted.
6. Reviewed the Summary from the January 2015 IEEE 802.11 NG60 SG meeting.
7. Motion to approve the January 2015 Atlanta Interim Meeting Minutes
	1. Move: Carlos Cordeiro (Intel)
	2. Second: Yan Xin (Huawei)
	3. Motion to approve:
		1. Yes: 43
		2. No: 0
		3. Abstain: 0
		4. Motion passed. Approved.
8. Chairman reviewed the Study Group Timeline (slide 17 of the agenda).
	1. Chairman answered previous question on NG60 SG timeline
	2. Chairman asked if any further questions. No further questions.
9. Presentations
	1. Presentation by HanGyu Cho (LG Electronics), 8K UHD Wireless Transfer Usage Model for NG 60, Doc. IEEE 11-15/0345r0. Key points reviewed:
		1. High-resolution display and service evolution
			1. 8K UHD display and services are nearly in market
		2. Wired solution for high-resolution display
			1. Wired interface solutions are ready to support 8K UHD (HDMI 2.1, DisplayPort 1.3, super MHL)
		3. NG 60 as a wireless solution for 8K UHD
			1. Replacement of wired interface, wireless transfer from fixed/mobile devices for 8K UHD
		4. How much data rate is required for 8K UHD resolution? 28.51 Gbps, slide 6
		5. How to achieve the data rate required for 8K UHD in NG60? See slide 7.
		6. Usage model: 8K UHD wireless transfer at smart home. See slide 8.
		7. Floor opened for discussion.
			1. Discussion on data compression requirements
			2. Discussion on QoS parameters, PHY vs MAC specifications consistency, channel bonding.
			3. Discussion on non-compression needed for gaming applications due to very low latency requirements.
			4. Discussion on tradeoff between adding compression versus increasing the data rate.
	2. Presentation by Alexander Eitan (Qualcomm), SC 64APSK for 802.11ay, Doc. IEEE 802.11-15/0339r0. Key points reviewed:
		1. Addition of 64 constellation to SC modulation to increase the bit rate of links that support only single channel SC (w or w/o channel bonding)
		2. Demonstrating the technical feasibility of achieving this goal
		3. Presenting simulation results
		4. Conclusions:
			1. Suggesting to add 64APSK to the SC modulation, with existing LDPC rates, as part of the 11ay
			2. Benefits: 50% throughput increase and increased spectral efficiency
			3. Getting more confident that 64APSK SC is feasible
		5. Floor opened for discussion:
			1. Discussion on simulation results
			2. Discussion on PAPR measurement set up, phase noise, RMS vs. dB reporting for PAPR
			3. Discussion on aggregation and continuous modes simulations with PA.
			4. Discussion on phase noise sensitivity of 64QAM vs. 64APSK
			5. Discussion on how many bits of precision used.
	3. Presentation by Alireza Tarighat (Broadcom), A Framework for MIMO Operation over mmWave Links, Doc. IEEE 802.11-15/0334r1. Key points reviewed:
		1. mmWave MIMO for NG60
		2. Possible MIMO scenarios
			1. SVD multiplexing
			2. Multi-array beam forming
			3. Spatial aggregation
			4. Multi-array diversity
		3. Impact of phase noise on SVD multiplexing
		4. Conclusions
			1. All four “multi-radio” scenarios can be implemented using a common PHY standard framework.
		5. Floor opened for discussion.
			1. Discussion on slide 11
	4. Presentation by Alireza Tarighat (Broadcom), Framework for NG60 Channel Bonding, Doc. IEEE 802.11-15/0335r2. Key points reviewed:
		1. Channel bonding options in NG60
			1. Channel bonding vs. channel aggregation concepts
		2. Implementation variations
		3. Key comparison metrics
		4. Summary
			1. Proposing to consider 2.2x/2x contiguous mode
			2. Proposing enabling 2x carrier aggregation mode in NG60
			3. 2x carrier aggregation enables noncontiguous channel bonding.
			4. 2x carrier aggregation can enable both SC and OFDM modes (no change to OFDM parameters or FFT size).
		5. Floor opened for discussion.
			1. Discussion on channel access implications for carrier aggregation mode, some confusion on the use of the term “aggregation” which needs to be clarified.
			2. Discussion on slide 5, channel bonding implementations.
	5. Presentation by Alexander Maltsev (Intel), MU-MIMO schemes for NG60, Doc. IEEE 802.11-15/0356r0. Key points reviewed:
		1. Point-to-multipoint use cases in NG60
		2. MU-MIMO mode implementation
		3. DL MU-MIMO performance evaluation
		4. Evaluation assumptions and parameters
		5. Simulation results and discussion
		6. Summary/ Next steps
			1. MU-MIMO schemes based on the MAA may be recommended for NG60
			2. MAA-based mmWave AP demonstrates acceptable performance (10-20%) degradation in comparison with FAA-based
		7. No time remaining for questions, so will allocate time for open discussion on Thursday AM2
10. Meeting recessed at 15:31 and will resume on Tuesday PM3

**Tuesday, March 10, 2015, PM3 Session (19:30-21:30)**

1. The meeting called to order at 19:30 by Edward Au (Marvell Semiconductor), the chairperson of the NG60 SG. Introduced himself and secretary Jeorge Hurtarte (Teradyne)
2. Agenda Doc. IEEE 802.11-15/0217r4
3. The chair reviewed the IEEE-SA Patency Policy, Logistics, and Reminders on Study Group Rules
	1. Chair asked if anyone has any questions about the IEEE-SA patent policy, logistics or reminders.
	2. Chair reminded all to record their attendance.
	3. Chair reminded that if anyone has any further presentation submissions they should upload them as soon as possible.
	4. Chair asked if anyone has any questions. No questions.
4. Key focus for this time slot was on the resolution of all comments on the PAR and CSD
	1. Reviewed Doc. IEEE 802.11-15/0271r0, Comments on TGay PAR and CSD, Edward Au (Marvell Semiconductor) and Carlos Cordeiro (Intel).
		1. Question by Jon Rosdahl (CSR) was asked if a comment from IEEE 802.22 was received. Chair answered that the comment came after the deadline of 18:30
		2. Discussion on comments from Paul Nikolich on PAR clause 5.2.b regarding both power efficiency and co-existence.
		3. Discussion on comments from IEEE 802.15 on PAR clause 7.1 regarding similarities and differences between IEEE 802.11ay and both IEEE 802.15.3c and IEEE 802.15.3e.
		4. Discussion on IEEE comments from IEEE 802.3 on CSD clauses 1.2.3, 1.2.4 a) and 1.2.4 b)
		5. Discussion on comments from Annette Reilly (NesCom member) on PAR clauses 2.1 and 5.5
		6. Discussion on what the title of the amendment should be.
		7. Discussion on comments from Osama Aboul-Magd (NesCom member) on PAR clauses 2.1, 5.2.b, and 7.1
		8. Discussion on comments from Andrew Myles (NesCom member) on PAR clause 2.1
		9. Discussion on comments from IEEE 802.15 on PAR clause 7.1 regarding similarities and differences between IEEE 802.11ay and IEEE 802.15.3e.
5. Meeting recessed at 21:32 and will resume on Wednesday AM 1

**Wednesday, March 11, 2015, AM1 Session (08:00-10:00)**

1. The meeting called to order at 08:01 by Edward Au (Marvell Semiconductor), the chairperson of the NG60 SG. Introduced himself and secretary Jeorge Hurtarte (Teradyne)
2. Agenda Doc. IEEE 802.11-15/0217r6
3. The chair reviewed the IEEE-SA Patency Policy, Logistics, and Reminders on Study Group Rules
	1. Chair asked if anyone has any questions about the IEEE-SA patent policy, logistics or reminders.
	2. Chair reminded all to record their attendance.
	3. Chair reminded that if anyone has any further presentation submissions they should upload them as soon as possible.
	4. Chair asked if anyone has any questions. No questions.
4. Continued discussion on the resolution of all comments on the PAR and CSD with updated responses from previous session.
	1. Reviewed Doc. IEEE 802.11-15/0271r2, Comments on TGay PAR and CSD, Edward Au (Marvell Semiconductor) and Carlos Cordeiro (Intel).
		1. Chair noted that the PAR/CSD comment/answer presentation was reformatted to show the comment and the response on the same chart. Then the chair proceeded to review each comment one at a time to ensure audience in agreement and solicit comments or questions.
			1. Discussion on the title of the amendment on the word “enhanced throughput.”
			2. Discussion on PAR clause 7.1 and the mention to “20 Gbps.”
5. Presentation by Carlos Cordeiro on doc. IEEE 802.11-14/1151r7, 802.11 NG60 SG Proposed PAR
	1. Carlos Cordeiro reviewed all edits resulting from preceding the comments and responses discussions
		1. A few edits were made into the PAR and a new revision r8 was produced.
		2. Opened the floor for additional questions or comments. No questions or comments.
6. Presentation by Carlos Cordeiro, Intel, on doc. IEEE 802.11-14/1152r8, IEEE 802.11 NG60 SG Proposed CSD
	1. Carlos Cordeiro reviewed all edits resulting from preceding the comments and responses discussions
		1. Opened the floor for questions or comments. No questions or comments.
7. Chair asked if there are any further questions regarding the revised PAR or CSD.
8. Chair presented the Motion #11 to approve the revised doc.: IEEE 802.11-14/1151r8, 802.11 NG60 SG Proposed PAR
	1. Move: Carlos Cordeiro (Intel)
	2. Second: Yan Xin (Huawei)
	3. Chair asked if there are any concerns or questions about the motion
		1. Adrian Stephens (Intel Corporation) asked to remove and amend the note “for WG 802 preview”, which is seconded by Jon Rosdahl (CSR).
			1. No objections
	4. Motion to approve:
		1. Yes: 37
		2. No: 0
		3. Abstain: 0
		4. Motion passed. Approved.
9. Chair presented the Motion #12, CSD, to approve the revised doc. IEEE 802.11-14/1152r8, 802.11 NG60 SG Proposed CSD
	1. Move: Carlos Cordeiro (Intel)
	2. Second: Yan Xin (Huawei)
	3. Chair asked if there any concerns or questions about the motion
	4. Motion to approve:
		1. Yes: 37
		2. No: 0
		3. Abstain: 0
		4. Motion passed. Approved.
10. Resumed Presentations
	1. Presentation by Camillo Gentile (NIST), NIST Millimeter-wave Channel Sounders, doc. IEEE 802.11-14/342r0. Key points reviewed:
		1. 60 GHz channel sounder characteristics
		2. Electronically switched antenna array receiver, low and high resolution
		3. Electronically switched antenna array transmitter
		4. Transmitter / receiver radio-frequency sections
		5. Antenna characteristics
		6. Measurable channel properties
		7. Existing 83 GHz channel sounder
		8. Floor opened for discussion.
			1. Discussion on wider bandwidth characterization beyond 1GHz, possibly up to 3 GHz, but ideally up to 4 GHz or even 6 GHz.
			2. Discussion on MIMO characterization methodology
			3. Discussion on whether or not can up-convert to different center frequencies
			4. Discussion on slide 6, antenna beam width and resolving for all multipath components.
			5. Discussion on the accuracy for the location, including angular accuracy, results data plots, space requirements for Wi-Fi applications compared to the presentation space requirements.
			6. Discussion on recording the spatial angle of arrival
11. Chair asked if any presenters scheduled for the next session are ready to present next at this session.
	1. No further presentations for this session
12. Meeting recessed at 09:37 and will resume on Thursday AM 2

**Thursday, March 12, 2015, AM2 Session (10:30-12:30)**

1. The meeting called to order at 10:30 by Edward Au (Marvell Semiconductor), the chairperson of the NG60 SG. Introduced himself and secretary Jeorge Hurtarte (Teradyne)
2. Agenda Doc. IEEE 802.11-15/0217r8, slides 28 and 29
3. The chair reviewed the IEEE-SA Patency Policy, Logistics, and Reminders on Study Group Rules
	* 1. Chair asked if anyone has any questions about the IEEE-SA patent policy, logistics or reminders.
		2. Chair reminded all to record their attendance.
		3. Chair reminded that if anyone has any revisions to their presentations they should upload them as soon as possible to the NG60 website
		4. Chair asked if anyone has any questions or concerns. No questions.
4. Resumed Presentations
	1. Chair asked if anybody has any questions on Alexander Maltsev’s (Intel) presentation (MU-MIMO schemes for NG60, Doc. IEEE 802.11-15/0356r0) from Monday PM 1 as there was no time then for questions then. No questions.
	2. Presentation by Robert Muller (Ilmenau University of Technology), Channel Sounding for NG60, doc. IEEE 802.11-14/329r0. Key points reviewed:
		1. Motivation
		2. Measurement scenarios and requirements
		3. Ultra-wideband dual-polarized indoor 3D measurement
		4. Challenges for ultra-wideband dual-polarized 60 GHz indoor 3D measurement
		5. Channel modeling Issues
		6. Conclusions
		7. Floor opened for discussion.
			1. Discussion on slide 4 regarding “bandwidth” or “beam width”, and some discussion on slides 8, 12 and 17.
			2. Discussion on room model accuracy for “ray tracing”
			3. Discussion on slide 17 on delay parameter
	3. Presentation by Cagatay Capar (Ericcson), Long range indoor channel measurements for the 60 GHz band, doc. IEEE 802.11-14/296r0. Key points reviewed:
		1. New channel models needed to support the wide range of use cases envisioned for NG60.
		2. Importance of channel measurements to help with channel modeling efforts.
		3. Presenting some results from a channel measurement campaign carried out within the METIS project.
		4. Presenting long range indoor office signal strength measurements in the 60 GHz band for both line-of-sight and non-line-of-sight
		5. Presenting measurements of loss due to blockages
		6. Floor opened for discussion
			1. Discussion on slide 6, 7, the measurement layout and results
			2. Discussion on the measurement results dependency on materials in the environment and whether or not that should be included in the models.
			3. Discussion on slide 5, clarifying what the bandwidth is.
			4. Discussion on slide 7 regarding the building layout corner losses
			5. Discussion on slide 8, Recursive Berg model fitting
			6. Discussion on slide 11, human body shadowing measurement techniques.
	4. Presentation by Alexander Eitan (Qualcomm), SC LOS/NLOS Channel Measurements, Doc. IEEE 802.11-15/0340r1. Key point reviewed:
		1. LOS/NLOS channel measurements in cubical environment at different STA and AP positions.
		2. Floor opened for discussion
			1. Discussion on slide 6 regarding the results plot discontinuities and meaning of the blue and green lines and which device in the picture is the STA and AP.
			2. Discussion on details of the beam forming array: 16x2 (16 horizontal and 2 vertical), all on.
			3. Discussion on slide 17 on MMSE EQ degradation expected to be 3-11 dB for LOS channels
			4. Discussion on the architecture of the antenna array and polarization, guard interval.
	5. Presentation by Presentation by Dmitry Cherniavsky (SiBEAM), Shared MIMO Architecture for 802.11ay, Doc. IEEE 802.11-15/0431r1. Key point reviewed:
		1. A shared MIMO architecture for IEEE 802.11ay.
		2. Proposal for an additional architecture for multi-stream operation of IEEE 802.11ay link.
		3. Opened the floor for discussion.
			1. Discussion on what channel model used for the simulations
			2. Discussion on whether or not standards support is needed for the proposed shared MIMO architecture for multi-stream operation.
			3. Discussion on independent or non-overlapping streams
			4. Discussion on feedback for the different architectures and the need for a more methodical approach to decide which architecture(s) to support.
			5. Discussion on whether the antenna architecture has separate arrays for the transmit or receive or a homogeneous array.
	6. Presentation by Presentation by Rob Sun (Huawei), NG 60 Use Cases, Doc. IEEE 802.11-15/0328r4. Key point reviewed:
		1. Usage Model 1: Ultra short range (USR) communications
		2. Usage Model 2: 8K UHD wireless transfer at smart home
		3. Usage Model 3: Augmented reality and virtual reality
		4. Usage Model 4: Data center NG60 inter-rack connectivity
		5. Usage Model 5: Video/mass-data distribution/video on demand system
		6. Usage Model 6: Mobile offloading and multi-band operation (MBO)
		7. Usage Model 7: Mobile fronthauling
		8. Usage Model 8: Wireless backhauling with single hop
		9. Usage Model 9: Wireless backhauling with multi-hop
		10. Floor opened for discussions
			1. Discussion on the multi-hop usage model 9
			2. Discussion on usage model 6 and its relationship to LAA
			3. Discussion on IEEE 802.15e having a similar usage model 1.
			4. Discussion on the wide distance range of applications of the various usage models, and thus concerned expressed in losing focus for NG60.
		11. Discussion on the proposed Straw Poll of slide 24:
			1. “Do you agree that the use cases described in document 11-15/328r4 represent a sufficient set of use cases for the NG60 SG and future TG?”
				1. In Favor 30
				2. No: 1
				3. Need More Information: 10
5. Chair discussed Motion # 13 on Study Group Extension
	1. Moved: Carlos Cordeiro (Intel)
	2. Second Rob Sun (Huawei)
	3. Yes: 37
	4. No: 0
	5. Abstain: 0
	6. Motion passed. Approved.
6. Chair reviewed conference call schedule and goals for the May 2015 meeting.
7. The Berlin NG60 SG meetings adjourned for the week at 12:32.