IEEE P802.11
Wireless LANs

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| Minutes of the July 2019 IEEE 802.11 Coexistence Workshop |
| Date: 2019-07-17 |
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Abstract

This document contains the minutes of the IEEE 802.11 Coexistence workshop held in Vienna, Austria, in July 2019.

# IEEE 802.11 Coexistence Workshop

Location: Meliá Vienna (48.2321600°, 16.4122410°), Donau-City-Straße 7, 1220 Wien, Austria

* 1. At 2019-07-17T13:00+02:00 Andrew Myles (Cisco) calls the IEEE 802.11 Coexistence Workshop to order. A. Myles (Cisco) acts as chair of the workshop’s first session. A. Myles (Cisco) states that Dorothy Stanley (Hewlett Packard Enterprise, HPE, and IEEE 802.11 Working Group Chair) will chair the second and third sessions. A. Myles (Cisco) presents a document that is available from the [IEEE Mentor](https://mentor.ieee.org/) server, see [11-19/1113r9](https://mentor.ieee.org/802.11/dcn/19/11-19-1113-09-coex-coex-workshop-agenda.pptx). A. Myles (Cisco) states that the IEEE 802.11 Coexistence Standing Committee appointed Guido R. Hiertz (Ericsson) as recording secretary of the workshop.
	2. During his presentation, A. Myles (Cisco) reminds attendees to follow all applicable laws including anti-trust and competition laws. Furthermore, he reminds attendees that attendees shall not discuss the interpretation, validity or essentiality of patents. Furthermore, attendees shall not discuss licensing rates, terms or conditions, and they shall not discuss or engage in the fixing of product prices, allocation of customers or division of sales markets. A. Myles (Cisco) reminds attendees to identify themselves when they speak or present.
	3. At 2019-07-17T13:18+02:00 A. Myles (Cisco) welcomes D. Stanley (HPE) and invites her to come to the podium. D. Stanley (HPE) comes to the podium and welcomes attendees of the workshop. D. Stanley (HPE) states that the goal of this workshop is to increase understanding.
	4. At 2019-07-17T13:21+02:00 A. Myles (Cisco) welcomes Balazs Bertenyi (Nokia and Chair of 3GPP RAN). B. Bertenyi (Nokia) comes to the podium and welcomes workshop attendees and thanks them for being here. B. Bertenyi (Nokia) appreciates that so many technical experts come together.

# Session 1: Invited Keynote standardization and regulatory updates

Myles (Cisco) chairs the first session.

* 1. At 2019-07-17T13:22+02:00 Jing Sun (Qualcomm and 3GPP rapporteur of release 16 NR-U Work Item) comes to the podium and presents [Status Report for Rel.16 NR-U](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/NR-U%20channel%20access%20summary%20to%20be%20submitted%20to%20IEEE%20coexistence%20workshop.ppt) by J. Sun (Qualcomm), B. Bertenyi (Nokia), and Havish Koorapaty (Ericsson and 3GPP RAN1 Vice-Chair). At 13:23 H. Koorapaty comes to the podium and presents page 2 of the submission. At 2019-07-17T13:30+02:00 J. Sun (Qualcomm) continues presenting from page 3. At 2019-07-17T13:53+02:00 J. Sun (Qualcomm) ends his presentation. Attendees discuss the presentation:
		1. Brian Hart (Cisco): On slide 2, please explain the identification of regulatory requirements.
		2. Lorenzo Casaccia (Qualcomm): The project USOS was created because there are legal requirements in some areas in which charging is different in licensed and unlicensed bands.
		3. B. Hart (Cisco): On slide 7, I would not categorize Cat. 1 as LBT.
		4. Sorour Falahati (Ericsson): Another node has done the LBT and the transmission is a response.
		5. B. Hart (Cisco): On slide 11, do you have a maximum transmission duration?
		6. J. Sun (Qualcomm): This depends on local regulation.
		7. B. Hart (Cisco): If there is no regulation?
		8. S. Falahati (Ericsson): The duration depends on the priority. It is aligned with what IEEE 802.11 resp. EN 301 893 mandates resp. defines. There is a contention-based mechanism imitating 802.11. We copied what 802.11 does.
		9. B. Hart (Cisco): On slide 12, is this 5 % less than per device or per base station?
		10. J. Sun (Qualcomm): Even in LAA LTE there is a similar discussion. In a typical deployment everything is synchronized, so these DRS transmissions all occur at the same time. We come from a cellular background.
		11. B. Hart (Cisco): Every enterprise deploys its own network. Who knows which synchronization is used, e.g. if no GPS is available?
		12. A. Myles (Cisco): In NR-U, there are many more starting positions compared to LAA. In NR-U, you have starting positions every 35 µs.
		13. J. Sun (Qualcomm): Yes, this is true. These increased number of starting points comes at the cost of increased power consumption.
		14. S. Falahati (Ericsson): DRS have been discussed a lot. I assume a short LBT is a concern. This kind of LBT is for synchronization signals. It is transmitted when the gNB has no data to transmit. Otherwise, the DRS is piggy-backed with data. Then, the related medium access performs a normal, random backoff. Thus, DRS is a special case. I only have that single chance to transmit. If the medium is not idle at the DRS time, the transmission is waived.
	2. At 2019-07-17T14:06+02:00 Osama Aboul-Magd (Huawei and Chair of IEEE Task Group 802.11ax, 802.11 TGax) presents [High Efficiency WLAN (802.11ax) Overview](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/Coexistence-Workshop-802-11ax-Overview.pptx). At 2019-07-17T14:41+02:00 O. Aboul-Magd (Huawei) ends his presentation. Attendees discuss the presentation:
		1. Myles (Cisco): Explains that the previous two presentations were provided more time to review the basics of both technologies. Attendees discuss the previous presentation:
		2. Monisha Ghosh (University of Chicago): Was there any discussion to drop the legacy preamble in 6 GHz?
		3. O. Aboul-Magd (Huawei): There wasn’t much discussion regarding this idea. It’s only for practical reasons. Nobody wants to change their hardware. The preamble is from the last century.
		4. M. Ghosh (University of Chicago): 6 GHz might define asymmetric power regulation in the US. Devices may be allowed different power levels.
		5. Stuart Strickland (Aruba Networks): I want to thank you for the chart that compares 802.11n, 802.11ac, and 802.11ax. I want to note that 802.11ac is used in stadium environments, too.
		6. O. Aboul-Magd (Huawei): Yes, this is true. 802.11ac is used outdoors. The table in my presentation just explains that unlike 802.11ac, 802.11ax provides features that are designed for outdoor usage.
		7. B. Hart (Cisco): Actually, I made a presentation for a possibly optimized preamble in 6 GHz. We realized that the market demand was so urgent that no time was left for designing a new preamble. It seemed to be very desirable to continue operating 20 MHz channels and using the old preamble.
		8. S. Falahati (Ericsson): Has IEEE 802.11 TGax ever studied, analyzed or considered coexistence with other technologies in 6 GHz band?
		9. O. Aboul-Magd (Huawei): No.
	3. At 2019-07-17T14:47+02:00 Alfred Asterjadhi (Qualcomm, Chair of IEEE Task Group 802.11be, 802.11 TGbe) presents [IEEE 802.11 WG: Enhancements for extremely high throughput (EHT) Wi-Fi](https://mentor.ieee.org/802.11/dcn/19/11-19-1210). At 2019-07-17T14:55 +02:00 A. Asterjadhi (Qualcomm) completes his presentation. A discussion follows:
		1. Mathias Bohge (R3 communications GmbH): You are not targeting reliability in your talk. How does IEEE 802.11be address reliability?
		2. A. Asterjadhi (Qualcomm): TSN is a topic for 802.11be now. Redundant transmissions, HARQ and other techniques are evaluated. There is a limit to what we can do here because of license-exempt spectrum. The reduction of latency is also analyzed.
		3. M. Bohge (R3 communications GmbH): Is it a clear design goal to increase reliability?
		4. A. Asterjadhi (Qualcomm): Seen from a worst-case, latency reductions come with reliability improvements.
		5. M. Bohge (R3 communications GmbH): Are you aware of any other 802.11 activity improving reliability?
		6. A. Asterjadhi (Qualcomm): No, I am not aware of.
		7. Jiayin Zhang (Huawei): I am curious about the 320 MHz channel size. Can this be applied to 5 GHz, too?
		8. A. Asterjadhi (Qualcomm): We have not gone to these details. I would believe it could be used in any band that allows it. This could also be interpreted as 160 MHz in 5 GHz and 160 MHz in 6 GHz.
	4. At 2019-07-17T15:02+02:00 David Boldy (Broadcom) presents [ETSI BRAN Update](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/BRAN%2819%29102039r3_Coex_Worskhop_Vienna_2019__ETSI_BRAN.pptx). At 2019-07-17T15:16+02:00 D. Boldy (Broadcom) ends his presentation. Workshop attendees discuss the submission:
		1. S. Falahati (Ericsson): Other technologies can also use the paused COT. When you look at the Harmonized Standard, except for the use of the 802.11a preamble, everything else in terms of usage is technology-neutral.
	5. At 2019-07-17T15:18+02:00 Andrew Gowans (OFCOM UK) presents [A 6 GHz regulatory update](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/802.11%20coex%20workshop%20on%206GHz%20studies%20r1.pptx). At 2019-07-17T15:35+02:00 A. Gowans (OFCOM UK) ends his presentation. Attendees discuss the presentation:
		1. Alexander Golitschek (Lenovo): You are writing about Wi-Fi in 6 GHz?
		2. A. Gowans (OFCOM UK): In general, I mean RLAN. I prepared that presentation for somebody else before. All of this will be registered use.
		3. Timothy Fisher-Jeffes (MediaTek): Do you have an opinion about V2X use cases?
		4. A. Gowans (OFCOM UK): There is a lot of spectrum, maybe there is now an opportunity to segregate and manage the spectrum. You don’t want regulators to get involved. If regulators involve you will equally dislike it.
	6. At 2019-07-17T15:39+02:00 A. Myles (Cisco) declares that the first session ends.

# Session 2: Deployment experience

D. Stanley (HPE) chairs the remaining sessions of the workshop.

* 1. At 2019-07-17T16:03+02:00 D. Stanley (HPE) calls the meeting to order.
	2. At 2019-07-17T16:03+02:00 Stuart Strickland (Aruba Networks) presents [LAA/Wi-Fi coexistence evaluations with commercial hardware](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/2019_07_17_Coexistence_Workshop_HPE.pptx). At 2019-07-17T16:14+02:00 S. Strickland (Aruba Networks) ends his presentation. Workshop attendees discuss his presentation:
		1. Amitav Mukherjee (Charter Communications): In your testing, did you test both technologies using the same TXOP duration?
		2. S. Strickland (Aruba Networks): No, we could not configure both systems. We were unable to find a setting to configure the equipment to achieve the same TXOP.
		3. A. Mukherjee (Charter Communications): Is it fair to say that with two Wi-Fi systems having different TXOPs there would be the same results?
		4. S. Strickland (Aruba Networks): The impact resp. the results would be similar if the TXOPs would be similarly different.
		5. A. Mukherjee (Charter Communications): You did not show the impact of Wi-Fi on LAA LTE?
		6. S. Strickland (Aruba Networks): No, we did not analyze the impact on LAA LTE.
		7. There was no time to take additional questions. However, there were many more attendees that were in line to ask questions. D. Stanley (HPE) kindly asks the audience to take further questions offline.
	3. At 2019-07-17T16:17+02:00 Monisha Ghosh (University of Chicago) presents [Coexistence of LTE-LAA and Wi-Fi: analysis, simulation and experiments](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/2-2-UChicago_Coexistence%20Wkshp.pptx). At 2019-07-17T16:31+02:00 M. Ghosh (University of Chicago) concludes her presentation. Attendees ask questions:
		1. Evgeny Khorov (Institute for Information Transmission Problems, Russian Academy of Sciences, IITP RAS): Did your LAA system use reservation signals?
		2. M. Ghosh (University of Chicago): No. I have to go back and check the exact settings.
		3. There was no time for another question.

# Session 3: Coexistence Topics

* 1. At 2019-07-17T16:32+02:00 Tiago Rodrigues (Wireless Broadband Alliance, WBA) presents [RAN.core convergence/coexistence in action: How the combination of Wi-Fi and cellular complements the 5G experience](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/Coexistence%20Workshop%20%28IEEE%29%20Tiago%20Rodrigues%20WBA%2020190717%20v01F.pptx). At 2019-07-17T16:45+02:00 T. Rodrigues (WBA) concludes his presentation. Workshop attendees discuss the presentation:
		1. Christian Hoymann (Ericsson): These IMT-2020 requirements come with corresponding simulation scenarios. Are these results for corresponding scenarios?
		2. T. Rodrigues (WBA): No, not for these scenarios. I need to check on the exact scenarios. We have to do field trials to confirm these assumptions.
		3. D. Stanley (HPE): I would like to call your attention to simulations done at IEEE 802.11. This analysis is related to a few use cases of IMT-2020.
	2. At 2019-07-17T16:48+02:00 Sorour Falahati (Ericsson) presents [Coexistence in 6 GHz License Exempt Spectrum](https://mentor.ieee.org/802.11/dcn/19/11-19-1083). At 2019-07-17T17:00+02:00 S. Falahati (Ericsson) concludes her presentation. Workshop attendees discuss about the presentation:
		1. Dorin Viorel (CableLabs): On slide 11, what do you mean by weak protection and robustness improvements?
		2. S. Falahati (Ericsson): Wi-Fi implementation use additional sanity checks to improve the reliability of detecting an 802.11 preamble. However, if you take another signal following the 802.11 preamble these checks do not work and the preamble is not recognized. Also, the 802.11 preamble is protected by a single parity bit only. Thus, these additional checks are widely used in deployed 802.11 products.
		3. Since there is not enough time, D. Stanley (HPE) kindly asks attendees to handle further questions during offline discussions.
	3. At 2019-07-17T17:03+02:00 A. Myles (Cisco) presents [LBT should remain the basis of fair and efficient coexistence in 6 GHz spectrum](https://mentor.ieee.org/802.11/dcn/19/11-19-1111). At 2019-07-17T17:15+02:00 A. Myles (Cisco) ends his presentation. Attendees ask questions:
		1. S. Falahati (Ericsson): On slide 7, the only exception is the use of PD/ED for 802.11. The topic of blocking energy has been discussed at large. When equipment gains a COT, it has the right to transmit. The paused COT concept is available to all technologies.
		2. A. Myles (Cisco): I believe your comments highlight that we have lots of things to discuss.
		3. Further questions need to be taken offline since there is no more time.
	4. At 2019-07-17T17:18+02:00 Dorin Viorel (CableLabs) presents [NR-U/Wi-Fi Coexistence in 5/6 GHz bands](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/Coexistence%20Workshop%20presentation%2007012019.pptx). At 2019-07-17T17:28+02:00 D. Viorel (CableLabs) concludes his presentation. Participants discuss the presentation:
		1. David Mazzarese (Huawei): You were in 3GPP, when we could not agree on a fairness criterion. As far as I know this is the same in 802.11. In 802.11ax, there is the coloring. So, Wi-Fi networks operate with different preamble detection thresholds. If you were to define a fairness criterion with equal airtime, it will also be a problem with older 802.11 technologies. We have 90 % commonalities between cellular and Wi-Fi channel access in license-exempt spectra.
		2. D. Viorel (CableLabs): What you say about fairness is reasonable. The discussion without a criterion may be very difficult.
		3. S. Strickland (Aruba Networks): In 802.11, there is a threshold to recognize noise and there is a threshold to recognize information.
		4. D. Viorel (CableLabs): AT&T has a very interesting contribution with more details on a common preamble.
		5. J. Sun (Qualcomm): I cannot see your connection in the slide 10 with the conclusion. Could you please elaborate?
		6. D. Stanley (HPE): Please take this question offline.
		7. B. Bertenyi (Nokia): What happens if some other SDO comes around, or somebody else brings a new technology and ignores the results of a tiger team formed between 802.11 and 3GPP?
		8. D. Viorel (CableLabs): We have to go by what we have. Obviously, we cannot comment on what happens in the future.
		9. Further questions need to be handled offline.
	5. At 2019-07-17T17:34+02:00 Jiayin Zhang (Huawei) presents [Performance evaluation of channel access mechanisms in 6 GHz spectrum](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/Performance%20Evaluation%20of%20Channel%20Access%20Mechanisms%20in%206%20GHz%20Spectrum%20v4.pptx). At 2019-07-17T17:46+02:00 J. Zhang (Huawei) concludes his presentation. Attendees discuss the presentation:
		1. A. Myles (Cisco): The best about simulations is that they show so many things. Actually, Ericsson showed that the use of a preamble improves performance of NR-U. The issue we have here is that we have uncertainty about what is going on. There are many different simulation results. We cannot get to the right answer. We have an ED of −72 dBm and we could have LAA using the preamble. Does that make sense to you?
		2. J. Zhang (Huawei): I am not convinced that a preamble is needed. While we do see a general trend in our simulations there are some cases where the situation is more complicated.
		3. There is no additional time for questions.
	6. At 2019-07-17T17:48+02:00 Sorour Falahati (Ericsson) presents [Coexistence Mechanisms](https://mentor.ieee.org/802.11/dcn/19/11-19-1088). At 2019-07-17T17:58+02:00 S. Falahati (Ericsson) ends her presentation. Workshop participants discuss the presentation:
		1. S. Strickland (Aruba Networks): I found your discussion about spatial reuse very fruitful for discussion. But I believe this works only because of having two thresholds. Would you agree that a common PD in both technologies helps to improve capacity?
		2. S. Falahati (Ericsson): A common preamble sounds very simple, but it is impractical. It requires testing and calibration. Additionally, existing products provide mechanisms to manually set the preamble threshold level.
		3. There is no more time for additional discussion.
	7. At 2019-07-17T18:01+02:00 Imran Latif (Quantenna) presents [Efficient and Fair Medium Sharing Enabled by a Common Preamble](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/coex_Presentation_CP_Quantenna.pdf). At 2019-07-17T18:10+02:00 I. Latif (Quantenna) concludes his presentation. Attendees discuss the presentation:
		1. Klaus Hugl (Nokia): How would your results look if both technologies had implemented an ED threshold of −82 dBm?
		2. I. Latif (Quantenna): The performance would look the same for both technologies.
		3. There is no time for additional questions.
	8. At 2019-07-17T18:11+02:00 Benoit Graves (Orange) presents [On the interest of a common preamble between NR-U and Wi-Fi](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/IEEE%20co-existence%20workshop%20-%20Orange%20views%20-%2017th%20July%202019%20-final.pdf). At 2019-07-17T18:16+02:00 B. Graves (Orange) ends his presentation. Workshop participants engage in a discussion:
		1. D. Mazzarese (Huawei): If you would add another Wi-Fi network you would also see performance degradation because this additional network transmits. Isn’t the first step to use different channels?
		2. B. Graves (Orange): If we use different channels then there is no coexistence issue. If we have to share the same channel, then the preamble must be used.
		3. D. Mazzarese (Huawei): The complaint from your existing network will still be there if you deploy another Wi-Fi network next to it.
		4. B. Graves (Orange): Wi-Fi defers to another Wi-Fi at a lower threshold than non-Wi-Fi devices. There a are number of places where you operate at around −72 dBm. The additional Wi-Fi will better protect the existing Wi-Fi than NR-U.
		5. Alexander Golitschek (Lenovo): I wonder what you expect from tuning. You can only tune your own network. Most of your interference comes from networks not under your control. So, how much do you gain from tuning?
		6. B. Graves (Orange): All we can control is what we do in our own networks. There is no fixed value that works for all locations.
		7. A. Golitschek (Lenovo): If you lower your threshold, it will not affect how others access the channel. Do you agree?
		8. There is no more time for additional questions. Further questions must be handled offline.
	9. At 2019-07-17T18:21+02:00 Sindhu Verma (Broadcom) presents [On a common preamble between Wi-Fi and NR-U](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/coex-workshop-presentation-common-preamble-Broadcom.pptx). At 2019-07-17T18:34+02:00 S. Verma (Broadcom) ends her presentation. Workshop attendees discuss the presentation:
		1. A. Golitschek (Lenovo): I would not necessarily expect that all NR-U devices will be collocated with a Wi-Fi chip. Devices might be serving IoT applications or there are other reasons that equipment does not employ a Wi-Fi chip.
		2. S. Verma (Broadcom): What we had in mind was NR-U handset devices with Wi-Fi. This study is confined to showing coexistence issues.
		3. There is no more time for additional questions. Further questions need to be handled offline.
	10. At 2019-07-17T18:36+02:00 Vyacheslav Loginov (Institute for Information Transmission Problems, Russian Academy of Sciences, IITP RAS) presents [Collision Detection for Fair LAA/Wi-Fi Coexistence](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/wireless_collision_detection.pptx). At 2019-07-17T18:46+02:00 V. Loginov (IITP RAS) concludes his presentation. Workshop participants discuss the presentation:
		1. D. Mazzarese (Huawei): We have never specified a reservation signal in 3GPP.
		2. S. Falahati (Ericsson): When you assume that there is always a reservation signal then this is misleading.
		3. V. Loginov (IITP RAS): I understand that reservations signals are not specified but are common practice. I am from academia and I am interested in research.
		4. Shubhodeep Adhikari (Broadcom): 3GPP’s choice of LBE for LAA LTE instead of Frame Based Equipment was not to make it more friendly to Wi-Fi. The decision was to avoid that LAA LTE was killed by a neighboring Wi-Fi. It is commonly accepted that reservation signals are used. There is only one book on NR and it describes the use of reservation signals in many cases.
		5. V. Loginov (IITP RAS): Thank you.
		6. There is no time for additional discussions.
	11. At 2019-07-17T18:52+02:00 Ralf Bendlin (AT&T) presents [Common Preamble Design in the 6 GHz Band - Merits and Challenges](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/att_coex_ws_final.pdf). At 2019-07-17T19:05+02:00 R. Bendlin (AT&T) completes his presentation. There is no time for questions.
	12. At 2019-07-17T19:06+02:00 D. Stanley (HPE) declares that the second part of the workshop ended.

# Panel discussion on Common Preamble

* 1. At 2019-07-17T20:00+02:00 D. Stanley (HPE) calls the meeting to order and invites Monisha Ghosh (University of Chicago), Sorour Falahati (Ericsson), Imran Latif (Quantenna), Benoit Graves (Orange), Sindhu Verma (Broadcom), Vyacheslav Loginov (Institute for Information Transmission Problems, Russian Academy of Sciences, IITP RAS), and Ralf Bendlin (AT&T) to the podium for a panel discussion.
		1. D. Stanley (HPE): Is there anything you learned from other presentations?
			1. S. Falahati (Ericsson): It was very interesting to see the different perspectives on this issue.
			2. I. Latif (Quantenna): In the end, if we want to find a solution, everyone needs to sacrifice. Something in the middle. Something that will be best in the long term for all technologies.
			3. B. Graves (Orange): If we do nothing, we will have a problem. If we don’t define it in standards, we’ll have an issue in real life.
		2. Questions coming from the audience and responses by the panel members:
			1. A. Myles (Cisco): The results showed a wide variety of proposals. Some say we should do energy detection only, some say something in the middle. How, do we resolve this diversity of the proposals?
			2. M. Ghosh (University of Chicago): I am not surprised because every use case is based on different assumptions. The systems are extremely complicated. How do we prove any proposal that comes forward? It’s difficult to implement everything for testing. Common test cases also have to have a common platform.
			3. B. Graves (Orange): Some sources assume ideal network topologies. Devices are regularly placed, APs and devices. And then there are sources with statistics from networks. It’s a reality that there are power levels below defined thresholds. Wi-Fi is there for years and there is room to learn from the deployments.
			4. R. Bendlin (AT&T): Diversity doesn’t mean that there is something wrong. System level simulation is all about extraction of results. Diversity doesn’t mean some do it right and some do it wrong.
			5. S. Verma (Broadcom): I agree there is diversity. There are conclusions made by realistic deployments. There needs to be an effort to perform simulations based on realistic assumptions. There has to be a lot of efforts so that assumptions align.
			6. C. Hoymann (Ericsson): We saw two types of setups and that is where different results come from. We had results from one AP and one basestation and there were realistic scenarios with many base stations and APs analyzed in a system level simulation. These are two different things. I don’t think if we don’t do anything there will be chaos and anarchy. So far, the world is still turning. Wi-Fi still works, LAA works. Everybody is happy. What I have learned about collaboration is that 802.11ax is done. So where should we do something together, what are we talking about? IEEE 802.11be?
			7. B. Hart (Cisco): Some talk about an ED threshold of −82 dBm. In 802.11n days, some vendors said that they were deferring more often than desirable. How would you resolve that?
			8. S. Verma (Broadcom): In my opinion, operating ED at −82 dBm is not feasible. There are papers that show this.
			9. M. Ghosh (University of Chicago): Our assumption is that you detect something, some kind of a signal, and not just gaussian noise.
			10. S. Falahati (Ericsson): Our understanding is that the PD threshold is adjusted in practice. The whole point is the difference between the PD and the ED value. The proposals are all about the 802.11a preamble but this is not a reliable signal. Without 802.11 data following the preamble deployed devices do not always respect the preamble.
			11. S. Verma (Broadcom): PD can be raised as high as ED. But ED can be lowered down to PD only.
			12. I. Latif (Quantenna): All 802.11 devices are certified. If other technologies send the preamble do devices behave properly? These devices should defer for the time indicated through the preamble’s L-SIG field. Devices will treat non-802.11 transmissions like any other 802.11 node in the network.
	2. At 2019-07-17T20:17+02:00 D. Stanley (HPE) ends the panel discussion.
	3. At 2019-07-17T20:19+02:00 Andrew Myles (Cisco) presents [The use of no LBT for DRS is not justified by history](https://mentor.ieee.org/802.11/dcn/19/11-19-1112). At 2019-07-17T20:25+02:00 A. Myles (Cisco) end his presentation. There is no time for discussion.
	4. At 2019-07-17T20:25+02:00 David Mazzarese (Huawei) presents [LBT for short control messages](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/LBT%20for%20short%20control%20messages%20v4.pptx). At 2019-07-17T20:36+02:00 D. Mazzarese (Huawei) concludes his presentation. There is no time for discussion.
	5. At 2019-07-17T20:36+02:00 Sindhu Verma (Broadcom) presents [On standalone transmissions with short-LBT](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/coex-workshop-presentation-short-LBT-Broadcom.pptx). At 2019-07-17T20:45+02:00 S. Verma (Broadcom) concludes her presentation. There is no time for discussion.

# Panel discussion on short/no LBT

* 1. At 2019-07-17T20:46+02:00 D. Stanley (HPE) invites Sindhu Verma (Broadcom), David Mazzarese (Huawei), and Andrew Myles (Cisco) to the podium for a panel discussion.
		1. S. Falahati (Ericsson): Wi-Fi uses Cat. 2 with channel aggregation. Thus, reducing SCS would impact Wi-Fi. An exception for LAA would not help with 802.11. Also, TC BRAN initially intended removing FBE from EN 301 893. But then, it was realized that various technical solutions by several vendors rely on FBE. Thus, there are severe consequences when easily removing aspects from a Harmonized Standard. At TC BRAN, we had reports that some Wi-Fi products use up to 5 % SCS under some circumstances.
		2. S. Verma (Broadcom): I would like to disagree with your comment. In the current debate, we consider Cat. 2 for starting a COT. Cat. 2 for continuing or within the COT is out of consideration. What has been justified for LAA may not be possible for NR-U. LAA is a controlled system whereas NR-U may be distributed. It’s also an option to limit the use of Cat. 2 medium access in NR-U.
		3. A. Myles (Cisco): It’s always dangerous to change regulation afterwards. I agree with that. But we have done it in the past. We have reduced SCS from 10 % to 5 %. That’s why we have a proposal to grandfather LAA. I like to agree with Sindhu and David. In case of David, he showed that there was not much difference. Sindhu showed there was a danger to Wi-Fi. Since there is not much difference, it is a great case, to reduce in NR-U so that Wi-Fi is protected. The nice thing about Cat. 4 is that it is aligned with the philosophy in unlicensed spectrum of LBT and exponential backoff. It is a problem of a technology to impose a synchronous system on an asynchronous spectrum.
		4. D. Mazzarese (Huawei): We have not seen the issue that Broadcom discovered. We did not see more than 10 % degradation for the 5th percentile, we ran extra simulations in recent days and could not confirm Broadcom’s results. We should put into perspective that NR-U supports many deployments. Also, standalone operation can be synchronized. Your own network may be synchronized to a neighbor. I don’t think we will see a lot of unsynchronized transmissions. Furthermore, disagree with the assumption Cat. 1 access leads to 100 % collision. NR-U is designed to operate as single-frequency network with frequency reuse 1.
		5. S. Verma (Broadcom): The example that I provided has been for two devices starting to sense at the same time. I mean they use the same resources. Whether it still can be decoded was not part of my assessment. I want to comment on coordinated NR-U. We do understand that there is a need for devices that need Cat. 2 for their transmissions. This may be limited in LAA, but that limit may not be easy to achieve in NR-U. I am not saying there will be chaos, however, we need to understand the need to put a cap.
		6. K. Hugl (Nokia): We are talking about unlicensed spectrum, it’s free to everyone. It’s not prohibited to use a synchronous system.
		7. A. Myles (Cisco): If that synchronous structure of LAA or NR-U affects others, then it is a problem.
		8. K. Hugl (Nokia): Should we also remove the Cat. 2 LBT now, because it hits the secondary carrier? This is the regulatory consequence if we just remove things.
		9. A. Myles (Cisco): In practice it was technology neutral, the technology neutrality term has been widely misused. Go and look up what it means.
		10. J. Sun (Qualcomm): What if there is a primary channel of another network on the bonded, secondary channel?
		11. S. Verma (Broadcom): Cat. 2 is only acceptable with channel bonding. Cat. 4 is justified and it is on the bonded channel. The channels are not separated. The primary channels need to be aligned for this to work.
	2. At 2019-07-17T21:00+02:00 D. Stanley (HPE) ends the panel discussion.
	3. At 2019-07-17T21:01+02:00 James Wang (MediaTek) presents [Coexistence simulation and analysis](https://mentor.ieee.org/802.11/dcn/19/11-19-1230). At 2019-07-17T21:17+02:00 J. Wang (MediaTek) concludes his presentation. Attendees discuss the presentation:
		1. S. Strickland (Aruba Networks): What do you want as take-away message? Are you suggesting that the priority marking is broken or that having everything in one category is an issue?
		2. J. Wang (MediaTek): First, we want to share our observation with everyone. It can easily affect how the system works. You can abuse them, it can be detrimental. We are worried that some technology could come in that abuses it.
		3. A. Myles (Cisco): There is no such a thing as an ETSI device. The conclusion that I draw from this is that 802.11 should modify its EDCA default parameters. I am not drawing the conclusion from this that there is something wrong with EN 301 893.
	4. At 2019-07-17T21:21+02:00 Jerome Arokkiam (Connect Centre, Trinity College Dublin) presents [An experimental Evaluation of Coexistence Challenges of Wi-Fi and LTE in the unlicensed band](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/2019_07_01_CoEx2019_presentation_Jerome_final.pptx). At 2019-07-17T21:27+02:00 J. Arokkiam (Trinity College Dublin) ends his presentation. A discussion of the presentation follows:
		1. C. Hoymann (Ericsson): You have taken release 8 LTE and you put this in coexistence with Wi-Fi with at 2.4 GHz?
		2. J. Arokkiam (Trinity College Dublin): Yes, that is correct.
		3. C. Hoymann: This has nothing to do with LAA. There is no single LAA feature in release 8. You could have taken a TV tower and it would have also wiped out Wi-Fi. This has nothing to do with this workshop. I don’t understand why this submission was accepted.
		4. Marco Papaleo (Qualcomm): What is the meaning of low and high power? What is the level you used?
		5. J. Arokkiam (Trinity College Dublin): You are looking at a hidden node scenario. Then it doesn’t matter if it is LAA LTE or LTE.
	5. At 2019-07-17T21:31+02:00 Leigh Chinitz (Octoscope) presents [A testbed architecture for 6 GHz Wi-Fi/NR-U Coexistence Testing](http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/Coexistence-Presentation-octoScope.pptx). At 2019-07-17T21:38+02:00 L. Chinitz (Octoscope) concludes his presentation. There are no questions.

# Closure of the workshop

* 1. D. Stanley (HPE) shares final remarks with the audience.
		1. D. Stanley (HPE): I would like to thank Monisha. One thing is to detect a signal and the other thing is to detect noise. Where are we going from here? What might be the avenues to go forward? The discussion will continue in ETSI TC BRAN. What other conversations do we add? In IEEE 802.11, we have the coexistence standing committee. There is an emphasis on a common preamble. Ralf provided an avenue how this could be done. Continued liaisons are another path forward. I will commit to talk to Havish and Balazs to continue discussion. We need to find ways to build on what we learned here.
		2. Paul Nikolich (IEEE 802 Executive Committee chair): I want to congratulate Andrew for bringing this together. Thank you, Dorothy, for your leadership. Are these kinds of events helpful? We need feedback on this. Personally, I believe these events have a potential for lot of effects. Should we do this more often than once in four years?
		3. H. Koorapaty (Ericsson): It was good to get together. It is good to understand the decisions that were taken. You see why each side is thinking as they are. We have discussed these issues before, and more fora to discuss these issues are not useful without fresh thinking. Let’s take the common preamble. I learned from this workshop that implementation aspects are hard to change. We need to be very realistic. Otherwise, we’ll bang our heads against the same wall. It is possible to go lower with ED. Why does the ED threshold need to be so much greater than the PD? Keeping everything else on the 802.11 side and adjusting the thresholds could be a simple approach. On the 802.11 side, it would be good to consider reducing the difference between ED and PD. For 3GPP products, it would be good to think about threshold adaptation. Things work in reality because full-buffer is not realistic. Full buffer is a zero-sum game. In reality, win-win solutions are possible.
		4. D. Stanley (HPE): I have a final anecdote: Albert Einstein was asked how to solve a problem if he had only 1 h. He replied, he would spend 55 min thinking about the problem and 5 min on defining the solution.
	2. At 2019-07-17T21:50+02:00 D. Stanley (HPE) declares the workshop to be dismissed.

# List of Attendees (as of 11-19/1216-06)

**First name Surname Affiliation**

Alistair Abington Ofcom

Shubhodeep Adhikari Broadcom

Ian Appleton Samsung

Jerome Arokkiam OSRAM GmbH

Alfred Asterjadhi Qualcomm

Abid Athankutty Samsung Cambridge Solution Centre

Matthieu Avrillon Luceor

Robert Baeten Qorvo

Stephane Baron Canon Research Center France

Ralf Bendlin AT&T Labs

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George Calcev Futurewei Technologies

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Laurent Cariou Intel

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Dana Ciochina Sony Europe

Carlos Cordeiro Intel Corporation

Subir Das Perspecta Labs

Rolf De Vegt Qualcomm

Thomas Derham Broadcom

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Peter Ecclesine Cisco Systems

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Yonggang Fang ZTE (TX)

Syed Farrukh Apple

Timothy Fisher-Jeffes Mediatek

Detlef Fuehrer Hewlett Packard Enterprise

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Tim Godfrey EPRI

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Alexander Golitschek Lenovo

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Andrew Gowans OFCOM

Benoit Graves Orange

Michael Grigat Deutsche Telekom

Thomas Handte SONY Europe

Tim Harrington Pro-ID

Brian Hart Cisco Systems

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Evgeny Khorov IITP RAS

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Igor Kim ETRI

Jeongki Kim LG Electronics

Akira Kishida NTT

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Wolfgang Krammer Federal Ministry for Transport, Innovation and Technology

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Masahito Mori Sony Europe B.V.

Alaa Mourad BMW Group

William Mueller Broadcom Inc.

Amitav Mukherjee Charter Communications

Andrew Myles Cisco

Ayman Naguib Apple Inc

Paul Nikolich IEEE 802 LMSC

Youngseok Oh SK Telecom

Jinhyung Oh Electronics and Telecommunications Research Institute (ETRI)

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Josh Redmore CableLabs

Tiago Rodrigues Wireless Broadband Alliance (WBA)

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Rui Yang InterDigital, Inc.

Xun Yang Beijing Huawei Digital Technologies Co. Ltd

James Yee MediaTek

Gordon Young BlackBerry UK Limited

Jiayin Zhang Huawei Technologies

Yan Zhang Marvell Semiconductor

# References:

1. Coexistence workshop website, <http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/workshop.htm>
2. Coexistence workshop agenda, <http://grouper.ieee.org/groups/802/11/Workshops/2019-July-Coex/2019-07-Coex-agenda-2.htm>
3. List of registered workhop attendees, as of Jul. 29th, 2019, <https://mentor.ieee.org/802.11/dcn/19/11-19-1216-06>