IEEE P802.11
Wireless LANs

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| IEEE 802.11 TGbqTeleconference Minutes April 2025 |
| Date: 2025-04-29 |
| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Jonghoe Koo | Samsung Electronics |  |  | jh89.koo@samsung.com |

Abstract

This document contains the IEEE 802.11 TGbq minutes for the teleconferences on April, 2025.

Revision history:

R0: initial version with the draft minutes for teleconference on 1 April 2025

R1: added the draft minutes for the teleconference on 8 April 2025

R2: added the draft minutes for the teleconference on 15 April 2025

R3: added the draft minutes for the teleconference on 22 April 2025

R4: added the attendance list for the teleconference on 22 April 2025, with some editorial revisions

R5: some editorial revisions

Abbreviations:

Q Question

A Answer

C Comment

# Tuesday, April 1 2025, 09:30am - 11:00am (EDT)

TGbq Chari: Edward Au (Huawei)

TGbq Vice-Chair: Rui Cao (NXP)

TGbq Vice-Chair: Abhishek Patil (Qualcomm)

TGbq Vice-Chair: Sang Kim (LG Electronics)

TGbq secretary: Jonghoe Koo (Samsung Electronics)

TGbq Editor: Cheng Chen (Intel)

**Opening formalities**

1. The IEEE 802.11 TGbq meeting was called to order at 09:30 EDT by the Chair.
2. Vice-chair Sang Kim introduced himself and sceratary Jonghoe Koo introduced himself.
3. Chair reminded the meeting registration.
4. Chair presented the TGbq meeting agenda [IEEE 802.11-25/0514r0](https://mentor.ieee.org/802.11/dcn/25/11-25-0514-00-00bq-april-2025-teleconference-agenda.xlsx) and reviewed the agenda items.
5. Chair reviewed the meeting agenda and the agenda was approved by unanimous consent.

**[Administrative items]**

1. Chair presented TGbq supplementary materials [IEEE 802.11-25/0191r0](https://mentor.ieee.org/802.11/dcn/25/11-25-0191-00-00bq-tgbq-supplementary-materials-for-meetings.pptx) slides.
2. Chair reviewed IEEE 802 required notices (emphasizing to ensure to announce name and affiliation at the first time to speak, anti-trust compliance, IEEE 802 WG rules and policies, etc.), IEEE SA meeting guidelines, IEEE Codes of Ethics and Conduct, IEEE individual process, and IEEE-SA standards activities with the fair and equitable consideration.
3. Chair reminded all to record their attendance in IMAT and other meeting reminders.

**Contributions**

**Presentation of** [**IEEE 11-25/0363r0**](https://mentor.ieee.org/802.11/dcn/25/11-25-0363-00-00bq-channelization-in-immw.pptx)**, Channelization in IMMW (Yapu Li (OPPO))**

1. Yapu presented the contribution [IEEE 11-25/0363r0](https://mentor.ieee.org/802.11/dcn/25/11-25-0363-00-00bq-channelization-in-immw.pptx).
2. Q: The proposal, non-overlapped and non-aggregated channelization, is to define a new one rather than using the legacy channelization. How does the non-overlapping channelization make the IMMW signalling easier and what is the benefit of doing this?
3. A: We can reuse EHT or UHR PHY design where there are no overlapped channels except for 320 MHz channels. For 20, 40, 80, and 160 MHz, we have non-overlapped and non-aggregated channels. We can reuse this design for IMMW.
4. Q: Assuming that we consider the overlapped channelization, do we still consider the channel numbering that you proposed even to the non-overlapped channelization?
5. A: I think we can reuse the channel number. We may also need to define a preamble for IMMW 320 MHz
6. Q: Any thought about the scaling factor?
7. A: It needs further study since the scaling factor should be considered together with phase noise.

**Presentation of** [**IEEE 11-25/0365r0**](https://mentor.ieee.org/802.11/dcn/25/11-25-0365-00-00bq-ppdu-format-for-immw.pptx)**, PPDU Format for IMMW (Eunsung Park (LG Electronics))**

1. Eunsung presented the contribution [IEEE 11-25/0365r0](https://mentor.ieee.org/802.11/dcn/25/11-25-0365-00-00bq-ppdu-format-for-immw.pptx).
2. Q: In Slide 3, do you think we have to expand STF period, which incurs more processing time. AGC consumes one or several microseconds.
3. A: It is also one of the approaches to increase the length of the STF, though we need further discussion and investigation. It depends on a beamforming capability. If we use a directional antenna, in this case we may consider shorter than the omnidirectional case.
4. Q: In slide 4, you proposed a non-HT style. However, DCM and DUP mode have already been defined in sub 7 GHz. What is the benefit of the non-HT mode compared with the DUP mode and DCM? Furthermore, there are duplicate parts in EHT preamble. What is the benefit of introducing a different structure?
5. A: If there is no STF2 and LTF2, we have an advantage in terms of overhead. We can use this when the packet size is small.
6. Q: In slide 3, both two options are solely new designs. However, we have discussed to reuse EHT/UHR PPDUs for basic PPDU format.
7. A: We also consider reusing them. However, we may need longer STF or slightly modify them for IMMW.
8. Q: In slide3, do you think that 11a like PPDU can be applied to MIMO?
9. A: We can use 7 GHz to exchange side information. Though we use option 1 (11a like PPDU) for MIMO, it does not provide good efficiency so we may need to restrict other option for MIMO case.
10. C: Unified PPDU format is preferred.
11. Q: Do you consider a duplicate preamble structure for wider bandwidth case?
12. A: For both cases, STF, LTF, and SIG parts can be duplicate in the wider bandwidth where data part can be further optimized.
13. Q: In slide 6, you proposed a duplicate tone plan for the smallest bandwidth and proposed to allow separate PHYs to process each frequency sub-block. Is it aligned with ‘upclocking’ that we have discussed? Tone plans for 512-FFT and 1024-FFT are not duplicate with each other.
14. A: The intention was to use 80 MHz bandwidth case for the smallest bandwidth. However, we can determine the smallest bandwidth later based on the discussion.
15. Q: Is it the intention of your proposal that a tone plan for 512-FFT and another tone plan for 1024-FFT in wider bandwidth mode are duplicate?
16. A: If we assume to use 80 MHz as the smallest bandwidth, then we can use a duplicate tone plan as described in this proposal.
17. Q: For the data portion, a whole bandwidth is processed. Then what does it mean to process each frequency sub-block with separate PHYs?
18. A: We need further discussion later.
19. Q: Regarding the SIG, do you want to enable IMMW-SIG in addition to U-SIG? Alternatively, do you want to define a completely new design?
20. A: We need further discussion later. We think about L-SIG, too.
21. C: My preference is to remove L-SIG and, instead, to use a unified U-SIG for easier feature extension.
22. Q: We do not need L-SIG in my opinion. It is enough to define a new SIG format, e.g., U-SIG + xx-SIG.
23. A: I agree that we do not have to consider the backward compatibility.

**Closing formalities**

1. Chair announced that two MAC contributions are scheduled for presentation next week.
2. Chair called for PHY contributions.

**Adjourn**

1. The chair announced that the call was adjourned at 10:26am EDT.

**List of Attendees**

TGbq 04/01/2025 Li, Haozheng TP-Link System Inc.

TGbq 04/01/2025 Zhou, Lei H3C Technologies Co., Limited

TGbq 04/01/2025 Li, Weiyi Spreadtrum Communication USA, Inc

TGbq 04/01/2025 Lee, Hong Won LG ELECTRONICS

TGbq 04/01/2025 Dong, Xiandong Xiaomi Communications Co., Ltd.

TGbq 04/01/2025 Luo, Chaoming Beijing OPPO telecommunications corp., ltd.

TGbq 04/01/2025 Wang, Zisheng ZTE Corporation

TGbq 04/01/2025 Sambasivan, Sam AT&T

TGbq 04/01/2025 Sadiq, Bilal Samsung Research America

TGbq 04/01/2025 Rosdahl, Jon Qualcomm Technologies, Inc.

TGbq 04/01/2025 Quan, Yingqiao Spreadtrum

TGbq 04/01/2025 Patwardhan, Gaurav Hewlett Packard Enterprise

TGbq 04/01/2025 Schelstraete, Sigurd MaxLinear

TGbq 04/01/2025 Patil, Abhishek Qualcomm Incorporated

TGbq 04/01/2025 Singh, Aditi Charter Communications

TGbq 04/01/2025 Park, Eunsung LG ELECTRONICS

TGbq 04/01/2025 Nayak, Peshal Samsung Research America

TGbq 04/01/2025 SUH, JUNG HOON Huawei Technologies Co., Ltd

TGbq 04/01/2025 McCann, Stephen Huawei Technologies Co., Ltd

TGbq 04/01/2025 Lin, Wei Xiaomi Communications Co., Ltd.

TGbq 04/01/2025 Li, Yapu Guangdong OPPO Mobile Telecommunications Corp....

TGbq 04/01/2025 Sun, Bo Sanechips

TGbq 04/01/2025 Li, Yanchun Huawei Technologies Co., Ltd

TGbq 04/01/2025 Koo, Jonghoe SAMSUNG ELECTRONICS

TGbq 04/01/2025 Zhong, Ke Ruijie Networks Co.,Ltd.

TGbq 04/01/2025 Choi, Jinsoo LG ELECTRONICS

TGbq 04/01/2025 Hussein, Abdalla Huawei Technologies Co., Ltd

TGbq 04/01/2025 Kim, Sang Gook LG ELECTRONICS

TGbq 04/01/2025 Gao, Ning Guangdong OPPO Mobile Telecommunications Corp....

TGbq 04/01/2025 Cha, Dongju LG ELECTRONICS

TGbq 04/01/2025 Hasabelnaby, Mahmoud Huawei Technologies Canada; Huawei Technologie...

TGbq 04/01/2025 Choi, JinHo SAMSUNG ELECTRONICS

TGbq 04/01/2025 Yano, Kazuto Advanced Telecommunications Research Institute...

TGbq 04/01/2025 Chen, Cheng Intel

TGbq 04/01/2025 Chen, Junbin TP-Link Systems Inc.

TGbq 04/01/2025 Kain, Carl Noblis, Inc.; USDoT

TGbq 04/01/2025 Chen, Wei-Han MediaTek Inc.

TGbq 04/01/2025 Cho, Hangyu LG ELECTRONICS

TGbq 04/01/2025 HUANG, CHIHAN MediaTek Inc.

TGbq 04/01/2025 CHENG, yajun Xiaomi Communications Co., Ltd.

TGbq 04/01/2025 Xiao, Tong Xiaomi Communications Co., Ltd.

TGbq 04/01/2025 Byeon, Seongho SAMSUNG ELECTRONICS

TGbq 04/01/2025 Au, Kwok Shum Huawei Technologies Co., Ltd

TGbq 04/01/2025 Chen, Xu Xiaomi Communications Co., Ltd.

TGbq 04/01/2025 Wei, Dong Guangdong OPPO Mobile Telecommunications Corp....

TGbq 04/01/2025 Xin, Yan Huawei Technologies Co., Ltd

TGbq 04/01/2025 Fan, Shuang Sanechips Technology Co., Ltd.

TGbq 04/01/2025 feng, Shuling MediaTek Inc.

TGbq 04/01/2025 Wee, Gaius Panasonic Holdings Corporation

TGbq 04/01/2025 Klein, Arik Huawei Technologies Co., Ltd

TGbq 04/01/2025 Kim, Youhan Qualcomm Technologies, Inc.

TGbq 04/01/2025 Zheng, Xiayu NXP Semiconductors

TGbq 04/01/2025 Deshmukh, Mrugen Ofinno

TGbq 04/01/2025 Fletcher, Paul Samsung Cambridge Solution Center

TGbq 04/01/2025 Cui, Yaoshen TP-Link Systems Inc.

TGbq 04/01/2025 Chou, Tzu-Hsuan Qualcomm Incorporated

TGbq 04/01/2025 Yamada, Ryota SHARP CORPORATION

TGbq 04/01/2025 Zhang, Jiayi Ofinno

# Tuesday, April 8 2025, 09:30am - 11:00am (EDT)

TGbq Chari: Edward Au (Huawei)

TGbq Vice-Chair: Rui Cao (NXP)

TGbq Vice-Chair: Abhishek Patil (Qualcomm)

TGbq Vice-Chair: Sang Kim (LG Electronics)

TGbq secretary: Jonghoe Koo (Samsung Electronics)

TGbq Editor: Cheng Chen (Intel)

**Opening formalities**

1. The IEEE 802.11 TGbq meeting was called to order at 09:30 EDT by the Chair.
2. Chair introduced the TGbq leadership members.
3. Chair reminded the meeting registration.
4. Chair presented the TGbq meeting agenda [IEEE 802.11-25/0514r3](https://mentor.ieee.org/802.11/dcn/25/11-25-0514-03-00bq-april-2025-teleconference-agenda.xlsx) and reviewed the agenda items.
5. Chair reviewed the meeting agenda and the agenda was unanimously approved.

**[Administrative items]**

1. Chair presented TGbq supplementary materials [IEEE 802.11-25/0191r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0191-01-00bq-tgbq-supplementary-materials-for-meetings.pptx) slides.
2. Chair reviewed IEEE 802 required notices (emphasizing to ensure to announce name and affiliation at the first time to speak, anti-trust compliance, IEEE 802 WG rules and policies, etc.), IEEE SA meeting guidelines, IEEE Codes of Ethics and Conduct, IEEE individual process, and IEEE-SA standards activities with the fair and equitable consideration.
3. Chair reminded all to record their attendance in IMAT and other meeting reminders.

**Contributions**

**Presentation of** [**IEEE 11-25/0300r1**](https://mentor.ieee.org/802.11/dcn/25/11-25-0300-01-00bq-reachability-of-mmwave-link-follow-up.pptx)**, Reachability of mmWave Link- Follow Up (Insik Jung, LG Electronics)**

1. Insik presented the contribution [IEEE 11-25/0300r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0300-01-00bq-reachability-of-mmwave-link-follow-up.pptx).
2. Q: In case of 11ay, it is assumed that STA has an omnidirectional antenna and AP has a directional antenna. On the other hands, the assumption in this contribution is both STA and AP have directional antennas, resulting in longer reachability estimation than 11ay case.
3. A: Yes, we need to find out the best beam for the IMMW. Further check is required that Rx device uses an omnidirectional in case of 11ay.
4. Q: For the 11ay case, the TX is directional and the Rx is omnidirectional, so the Rx simply needs to receive and then find the best beam. The proposal seems to be more complex than 11ay.
5. A: Agreed.
6. Q: Do the AP and STA agree on the time when the beam training procedure is performed on mmWave link and does the AP expect the time when the STA responds with feedback on a sub-7GHz link? What is the timeout used by the AP to determine that it has not received feedback from the STA?
7. A: The AP allocates a service period for STAs. There might be a failure for the STA to respond with feedback when mmWave link is busy.
8. Q: In the beam training procedure, is it one AP to one STA, or one AP to multiple STAs simultaneously?
9. A: Both are possible.
10. Q: Is the assumption in Slide 8 for the one-to-one case? If the beam training time is common to multiple STAs, then there will be a collision between responses from multiple STAs. However, if it is scheduled as a dedicated manner, the AP must have prior information about those multiple STAs that are scheduled.
11. A: In Slide 8, for the case where STA(s) in dedicated, in order to distinguish the case that STA cannot respond due to busy channel/OBSS interference and the case of unreachability, the AP sends a channel status, i.e., ‘medium Busy’ status in a response frame to STAs.
12. Q: Do both STA and AP perform sector sweep?
13. A: Yes, we need further discussion.
14. Q: In the association request, there is information about how many links the STA wants to setup. In the PAR, single-user case is in our scope, i.e., one AP to one STA case. In Slide 8, how the AP know which sector the STA respond? If the AP does not know which sector to use, how can it receive feedback from the STA?
15. A: Yes, we need further discussion.
16. Q: The STA decides whether to associate an AP or not. Do we need to consider that the STA determines its reachability to an AP on mmWave link rather than the AP decides the reachability of STAs as proposed in this contribution?
17. A: Since the AP schedules the IMMW transmission, the AP would be better to decide the reachability. In addition, only the AP measures the RSSI.
18. Q: However, does a STA decide whether to associate an AP? It’s interesting point to see the reachability from the AP’s point of view.
19. A: Let’s have more discussion offline.
20. Q: Is the assumption that sub-7GHz link is always stable? Shouldn’t we consider the case where the mmWave link is reachable but sub-7GHz is not due to multi-path effect? I’ve seen this a lot in the test environments.
21. A: If sub-7GHz is not stable, STA has not associated with that AP, so this is not case that we are considering.
22. Q: In practice, reachability estimation will likely be performed during the initial stage of determining whether to add a link or associate with an AP, not during the time when the connection is stable. Reachability estimation by this proposal may be considered as an optional operation.
23. A: Let’s have more discussion offline.

**Presentation of** [**IEEE 11-25/0433r2**](https://mentor.ieee.org/802.11/dcn/25/11-25-0433-02-00bq-channel-access-for-immw.pptx)**, Channel Access for IMMW (Dongju Cha, LG Electronics)**

1. Dongju presented the contribution [IEEE 11-25/0433r2](https://mentor.ieee.org/802.11/dcn/25/11-25-0433-02-00bq-channel-access-for-immw.pptx).
2. Q: How does the STA with directional antenna operate the EDCA mechanism? Let’s have an offline discussion.
3. Q: I have a question on EDCA operation in the non-dedicated SP. If the dedicated SP is an individual TWT and the AP schedules non-overlapped TWT SPs as described in Slide 7, we may run into a scalability issue, and hence it may be difficult to support multiple mmWave STAs at the same time.
4. A: Individual TWT can be used to support periodic traffic, but we can still use methods, e.g., Broadcast TWT or SP shared to multiple STAs, other than a dedicated SP for aperiodic traffic.
5. Q: Since TGbq designs non-standalone mmWave solution so that assistance can be provided through sub-7GHz link, e.g., triggering by sub-7GHz, it seems that mmWave can be sufficiently supported by dedicated SP. What is the motivation for introducing non-dedicated SP? It also seems that using non-dedicated SP would not be beneficial from a power-saving perspective.
6. A: Since the discussion in TGbq is in its early stage, we intent to keep all possible options for discussion.

**Closing formalities**

1. Chair encouraged follow-up discussions on today’s presentations to be conducted either individually or through the email reflector.
2. Chair called for one more contribution for the next call and asked the participants to consider a best practice in uploading their contributions one day before the presentation.

**Adjourn**

1. Chair announced that the call was adjourned at 10:43am EDT.

**List of Attendees**

|  |  |  |  |
| --- | --- | --- | --- |
| TGbq | 04/08/2025 | Au, Kwok Shum | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbq | 04/08/2025 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbq | 04/08/2025 | Cha, Dongju | LG ELECTRONICS |
| TGbq | 04/08/2025 | Chen, Cheng | Intel Corporation |
| TGbq | 04/08/2025 | Chen, Junbin | TP-Link Systems Inc. |
| TGbq | 04/08/2025 | Chen, Wei-Han | MediaTek Inc. |
| TGbq | 04/08/2025 | Chen, Xu | Xiaomi Communications Co., Ltd. |
| TGbq | 04/08/2025 | CHENG, yajun | Xiaomi Communications Co., Ltd. |
| TGbq | 04/08/2025 | Cho, Hangyu | LG ELECTRONICS |
| TGbq | 04/08/2025 | Choi, JinHo | SAMSUNG ELECTRONICS |
| TGbq | 04/08/2025 | Choi, Jinsoo | LG ELECTRONICS |
| TGbq | 04/08/2025 | Deshmukh, Mrugen | Ofinno |
| TGbq | 04/08/2025 | Di Taranto, Rocco | Ericsson AB |
| TGbq | 04/08/2025 | Erkucuk, Serhat | Ofinno |
| TGbq | 04/08/2025 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbq | 04/08/2025 | feng, Shuling | Mediatek Inc |
| TGbq | 04/08/2025 | Fletcher, Paul | Samsung Cambridge Solution Centre |
| TGbq | 04/08/2025 | Gao, Ning | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbq | 04/08/2025 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbq | 04/08/2025 | Gupta, Binita | Cisco Systems, Inc. |
| TGbq | 04/08/2025 | HUANG, CHIHAN | MediaTek Inc. |
| TGbq | 04/08/2025 | Jang, Insun | LG ELECTRONICS |
| TGbq | 04/08/2025 | Kain, Carl | Noblis, Inc.; USDoT |
| TGbq | 04/08/2025 | Kim, Jeongki | Ofinno |
| TGbq | 04/08/2025 | Koo, Jonghoe | SAMSUNG ELECTRONICS |
| TGbq | 04/08/2025 | Li, Haozheng | TP-Link System  Inc |
| TGbq | 04/08/2025 | Li, Weiyi | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbq | 04/08/2025 | Li, Xin | Huawei Technologies Co., Ltd |
| TGbq | 04/08/2025 | Lin, Wei | Xiaomi Communications Co., Ltd. |
| TGbq | 04/08/2025 | LIU, QINGLAI | Panasonic Holdings Corporation |
| TGbq | 04/08/2025 | Motozuka, Hiroyuki | Panasonic Holdings Corporation |
| TGbq | 04/08/2025 | Nayak, Peshal | Samsung Research America |
| TGbq | 04/08/2025 | Pan, Ju Yan | Huawei Technologies Co., Ltd |
| TGbq | 04/08/2025 | Park, Eunsung | LG ELECTRONICS |
| TGbq | 04/08/2025 | Patil, Abhishek | Qualcomm Incorporated |
| TGbq | 04/08/2025 | Perez, Javier | Ofinno |
| TGbq | 04/08/2025 | Pettersson, Charlie | Ericsson AB |
| TGbq | 04/08/2025 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbq | 04/08/2025 | Sadiq, Bilal | Samsung Electronics Co., Ltd. |
| TGbq | 04/08/2025 | Schelstraete, Sigurd | MaxLinear |
| TGbq | 04/08/2025 | Singh, Aditi | Charter Communications |
| TGbq | 04/08/2025 | Wang, Zisheng | ZTE Corporation |
| TGbq | 04/08/2025 | Wee, Gaius | Panasonic Holdings Corporation |
| TGbq | 04/08/2025 | Wei, Dong | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbq | 04/08/2025 | Wilhelmsson, Leif | Ericsson AB |
| TGbq | 04/08/2025 | Xiao, Tong | Xiaomi Communications Co., Ltd. |
| TGbq | 04/08/2025 | Yamada, Ryota | SHARP CORPORATION |
| TGbq | 04/08/2025 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbq | 04/08/2025 | Zhang, Jiayi | Ofinno |
| TGbq | 04/08/2025 | Zheng, Xiayu | NXP Semiconductors |
| TGbq | 04/08/2025 | Zhou, Lei | H3C Technologies Co., Limited |

# Tuesday, April 15 2025, 09:30am - 11:00am (EDT)

TGbq Chari: Edward Au (Huawei)

TGbq Vice-Chair: Rui Cao (NXP)

TGbq Vice-Chair: Abhishek Patil (Qualcomm)

TGbq Vice-Chair: Sang Kim (LG Electronics)

TGbq secretary: Jonghoe Koo (Samsung Electronics)

TGbq Editor: Cheng Chen (Intel)

**Opening formalities**

1. The IEEE 802.11 TGbq meeting was called to order at 09:30 EDT by the Chair.
2. Chair introduced the TGbq leadership members.
3. Chair reminded the meeting registration.
4. Chair presented the TGbq meeting agenda [IEEE 802.11-25/0514r4](https://mentor.ieee.org/802.11/dcn/25/11-25-0514-04-00bq-april-2025-teleconference-agenda.xlsx) and reviewed the agenda items.
5. Chair reviewed the meeting agenda and the agenda was unanimously approved.

**[Administrative items]**

1. Chair presented TGbq supplementary materials [IEEE 802.11-25/0191r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0191-01-00bq-tgbq-supplementary-materials-for-meetings.pptx) slides.
2. Chair reviewed IEEE 802 required notices (emphasizing to ensure to announce name and affiliation at the first time to speak, anti-trust compliance, IEEE 802 WG rules and policies, etc.), IEEE SA meeting guidelines, IEEE Codes of Ethics and Conduct, IEEE individual process, and IEEE-SA standards activities with the fair and equitable consideration.
3. Chair reminded all to record their attendance in IMAT and other meeting reminders.

**Contributions**

**Presentation of** [**IEEE 11-25/0628r1**](https://mentor.ieee.org/802.11/dcn/25/11-25-0628-01-00bq-a-mode-of-operation-where-nsa-mmwave-link-is-used-in-dl-only-direction.pptx)**, A Mode of Operation Where NSA mmWave link is used in DL-only Direction (Bilal Sadiq, Samsung Electronics)**

1. Bilal presented the contribution [IEEE 11-25/0628r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0628-01-00bq-a-mode-of-operation-where-nsa-mmwave-link-is-used-in-dl-only-direction.pptx).
2. Q: In 11ay, one of main use cases was an interactive application for AR/VR in a short distance. How to support this application with the proposed DL-only mode?
3. A: My proposal is not to have only this DL-only mode. This is one of operational modes. If uplink is not available or a STA is outside of uplink coverage, this DL-only mode can be enabled and used. This is optional mode to cover the case where uplink is temporarily available.
4. Q: What about a product without Tx chain as described in one of examples in your slide?
5. A: There are two scenarios where DL-only mode is used. One is for the case where uplink is temporarily disabled. As a by-product, it will also enable DL-only mode at the devices that do not implement Tx capability. For certain applications, both Tx and Rx capabilities are clearly necessary. This proposal is not limited to devices that only have Rx capability.
6. Q: What is the initiating condition to start with DL-only mode? Is it an application or coverage?
7. A: Both are possible. Even within uplink coverage, scenarios such as device starts overheating, battery status, or an application which does not require uplink can serve as one of conditions for DL-only mode operation.
8. Q: In slide 9, TV is mentioned as a DL-heavy appliance. However, a smart TV requires some interactive operations. In addition, TVs have a larger area to accommodate antennas and they are located at the fixed positions. Therefore, TVs may encounter fewer issues than you considered.
9. A: Agreed. Depending on the price, or type of TV, there may be TVs that may only require RX implementation.
10. Q: For the handheld case in Slide 7, DL reception will be also obstructed by hand blocking. DL transmission may also have reduced coverage for a certain QoS. Since the performance degradation can occur not only in UL but also in DL, the coverage unbalance between UL and DL may not be severe as expected.
11. A: Assume that both DL and UL are line-of-sight but side-lobe of UL beam illuminates nearby humans or some reflector. It is difficult to distinguish whether the signal reflected back by a human is from the side-lobe or the main-lobe. Radar-like operation is used to simply check for the presence of a human nearby in order to reduce Tx power to meet the MPE limit.
12. Q: It requires clarification on the first bullet point in Slide 15.
13. A: We always have sub-7 GHz link. We should use sub-7 GHz link when the IMMW link quality is not good.
14. Q: First, there are more than just cross-link BA to consider when using DL-only mode, such as control frame exchange like RTS/CTS which require immediate responses. Secondly, there is no immediate interaction between the AP and STA in DL-only mode. Therefore, performance degradation may occur due to delayed feedback.
15. A: It is understood that all cross-link control and management proposals will have some delay in responses but they are still deemed useful. BA feedback delays are also present in LTE case, and additional delays occur when some processing is performed in conjunction with the upper layer. So feedback will slower than SIFS delay, but it is still good for many applications.
16. Q: Wi-Fi is entirely contention-based, which differs from other scheduled-based technologies. Therefore, it is more vulnerable to delayed feedback.
17. A: By offloading a small amount of uplink traffic to other links, we can achieve better utilization of the IMMW link by maximally utilizing it for DL traffic. If small amount of BA traffic on Sub-7 GHz is suffering congestion delays, the level of congestion will be extremely severe unless we offload some traffic to the mmWave link. This is a scenario where DL-only mode can make a big impact by reducing channel utilization on sub-7GHz link.
18. Q: The sounding and BA transmission protocols would need to be modified when using DL-only mode. In slide 6, the equation should be double-checked, particularly for antenna array gain component.
19. A: Array gains of AP and STA are the same in DL and UL directions. The difference is only in Tx power because AP has more PAs.
20. Q: Is this optional operation mode applicable to AP?
21. A: Whether this operation mode is mandatory/optional and its applicability to the AP are second-level discussions.
22. Q: There are also many additional implementations required on the AP side to support DL-only STAs. Is this DL-only mode a static capability, or is it a dynamic operational mode that can be changed over time?
23. A: It’s dynamic. This mode can be used for mobile device as a supplementary for downlink in case of uplink unavailability. But once dynamic is supported, as by-product, we can also support devices that statically operate in DL-only mode.
24. Q: In the existing specifications, cross-link BA is only marked for successful receptions. Are you intending to apply this rule as is, or are you also considering marking failures? A value of 0 indicates ambiguity while a value of 1 represents a clear success.
25. A: Define it from AP’s point of view. When the value is 0 and the condition for cross-link feedback is met, the AP can assume that the STA failed to decode, and as a result, the AP can perform a retransmission without worrying that the retransmission is redundant.
26. Q: When does the AP determine that a failure has occurred, and how long should it wait before making that decision? There are many factors to affect the delay of the BA such as sub-7GHz congestion, channel access delay, internal processing delays inside the STA, and more. It is difficult for the AP to distinguish the reasons why it may not receive an ack and difficult to precisely determine what to retransmit. In case of mobility, timely beam re-selection and beam alignment over the sub-7GHz link are challenging in DL-only mode. When a DL failure occurs on the IMMW link, how can the AP or STA distinguish whether the issue requires beam management or if the beam is functioning normally but the failure is caused by other reasons?
27. A: The mentioned considerations are referred to as “when the conditions met” in the slide, and it is indeed important to clearly define the condition. For example, if there is sufficient time gap between MSDU transmitted on mmWave and BAR or BA transmitted on sub-7GHz link, then AP can assume BA received in the mmWave link contains cross-link feedback for the mmWave MSDU.
28. Q: In-device processing delay can be considered for cross-link BA operation by having the STA inform the AP during association. However, sub-7GHz channel access delay is unpredictable due to OBSSs.
29. A: The time gap can be a function of device capability. Interpretation of BA does not depend on channel access delay. For example, if AP sends a BAR on sub-7GHz link, based on the time gap information, AP can determine which mmWave MSDUs shall be reported in BA. Regarding the second question on cross-link beam management delay, there are several other contributions on this topic too. When beam coherence time is few tens of milliseconds or longer, then cross-link delay is small and not a problem.
30. Q: If there is no issue with the IMMW link but the sub-7GHz link is problematic to transmit a cross-link BA, how should be MCS be adjusted?
31. A: Link adaptation can work on BAs as usual.

**Presentation of** [**IEEE 11-25/0628r1**](https://mentor.ieee.org/802.11/dcn/25/11-25-0628-01-00bq-a-mode-of-operation-where-nsa-mmwave-link-is-used-in-dl-only-direction.pptx)**, Anchor Link for ML Operation with mmWave Link (Peshal Nayak, Samsung Electronics)**

1. The presentation of [IEEE 11-25/0628r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0628-01-00bq-a-mode-of-operation-where-nsa-mmwave-link-is-used-in-dl-only-direction.pptx) was deferred.

**Closing formalities**

1. Chair called for presentations for May Interim meeting.
2. Chair reminded all to record their attendance in IMAT.

**Adjourn**

1. The chair announced that the call was adjourned at 10:49am EDT.

**List of Attendees**

|  |  |  |  |
| --- | --- | --- | --- |
| TGbq | 04/15/2025 | Au, Kwok Shum | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | Byeon, Seongho | SAMSUNG ELECTRONICS |
| TGbq | 04/15/2025 | Chen, Cheng | Intel Corporation |
| TGbq | 04/15/2025 | Chen, Junbin | TP-Link Systems Inc. |
| TGbq | 04/15/2025 | Chen, Wei-Han | MediaTek Inc. |
| TGbq | 04/15/2025 | Chen, Xu | Xiaomi Communications Co., Ltd. |
| TGbq | 04/15/2025 | Chen, You-Wei | Mediatek Inc |
| TGbq | 04/15/2025 | CHENG, yajun | Xiaomi Communications Co., Ltd. |
| TGbq | 04/15/2025 | Cho, Hangyu | LG ELECTRONICS |
| TGbq | 04/15/2025 | Choi, JinHo | SAMSUNG ELECTRONICS |
| TGbq | 04/15/2025 | Choi, Jinsoo | LG ELECTRONICS |
| TGbq | 04/15/2025 | Chou, Tzu-Hsuan | Qualcomm Incorporated |
| TGbq | 04/15/2025 | Deshmukh, Mrugen | Ofinno |
| TGbq | 04/15/2025 | Doostnejad, Roya | Ofinno |
| TGbq | 04/15/2025 | Erkucuk, Serhat | Ofinno |
| TGbq | 04/15/2025 | Fan, Shuang | Sanechips Technology Co., Ltd. |
| TGbq | 04/15/2025 | feng, Shuling | Mediatek Inc |
| TGbq | 04/15/2025 | Gu, Xiangxin | Spreadtrum Communications (Shanghai) Co., Ltd. |
| TGbq | 04/15/2025 | Hasabelnaby, Mahmoud | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | HUANG, CHIHAN | MediaTek Inc. |
| TGbq | 04/15/2025 | Hussein, Abdalla | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | Jang, Insun | LG ELECTRONICS |
| TGbq | 04/15/2025 | Kain, Carl | Noblis, Inc.; USDoT |
| TGbq | 04/15/2025 | Kim, Jeongki | Ofinno |
| TGbq | 04/15/2025 | Koo, Jonghoe | SAMSUNG ELECTRONICS |
| TGbq | 04/15/2025 | Lee, Hong Won | LG ELECTRONICS |
| TGbq | 04/15/2025 | Li, Haozheng | TP-Link System Inc. |
| TGbq | 04/15/2025 | Li, Weiyi | Spreadtrum Communication USA, Inc |
| TGbq | 04/15/2025 | Li, Xin | Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | Lin, Wei | Xiaomi Communications Co., Ltd. |
| TGbq | 04/15/2025 | LIU, QINGLAI | Panasonic Holdings Corporation |
| TGbq | 04/15/2025 | Motozuka, Hiroyuki | Panasonic Holdings Corporation |
| TGbq | 04/15/2025 | Nayak, Peshal | Samsung Research America |
| TGbq | 04/15/2025 | Pan, Ju Yan | Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | Patil, Abhishek | Qualcomm Incorporated |
| TGbq | 04/15/2025 | Patwardhan, Gaurav | Hewlett Packard Enterprise |
| TGbq | 04/15/2025 | Perez, Javier | Ofinno |
| TGbq | 04/15/2025 | Pettersson, Charlie | Ericsson AB |
| TGbq | 04/15/2025 | Qi, Yue | SAMSUNG ELECTRONICS; Samsung Electronics Co., Ltd. |
| TGbq | 04/15/2025 | Quan, Yingqiao | Spreadtrum Communications (Shanghai) Co., Ltd.; Unisoc (Shanghai) Technologies Co., Ltd. |
| TGbq | 04/15/2025 | Sadiq, Bilal | Samsung Electronics Co., Ltd. |
| TGbq | 04/15/2025 | Shafin, Rubayet | Samsung Electronics |
| TGbq | 04/15/2025 | Silverman, Matt | Cisco Systems, Inc. |
| TGbq | 04/15/2025 | Sun, Bo | Sanechips Technology Co., Ltd. |
| TGbq | 04/15/2025 | Wang, Zisheng | ZTE Corporation |
| TGbq | 04/15/2025 | Wee, Gaius | Panasonic Holdings Corporation |
| TGbq | 04/15/2025 | Wei, Dong | Guangdong OPPO Mobile Telecommunications Corp.,Ltd |
| TGbq | 04/15/2025 | Xiao, Tong | Xiaomi Communications Co., Ltd. |
| TGbq | 04/15/2025 | Xin, Yan | Huawei Technologies Canada; Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | Yamada, Ryota | SHARP CORPORATION |
| TGbq | 04/15/2025 | Yano, Kazuto | Advanced Telecommunications Research Institute International (ATR) |
| TGbq | 04/15/2025 | Zhang, Jiayi | Ofinno |
| TGbq | 04/15/2025 | Zhang, Maolin | Huawei Technologies Co., Ltd |
| TGbq | 04/15/2025 | Zhou, Lei | H3C Technologies Co., Limited |
| TGbq | 04/15/2025 | Zhou, Renlong | Sanechips Technology Co., Ltd. |

# Tuesday, April 22 2025, 09:30am - 11:00am (EDT)

TGbq Chari: Edward Au (Huawei)

TGbq Vice-Chair: Rui Cao (NXP)

TGbq Vice-Chair: Abhishek Patil (Qualcomm)

TGbq Vice-Chair: Sang Kim (LG Electronics)

TGbq Secretary: Jonghoe Koo (Samsung Electronics)

TGbq Editor: Cheng Chen (Intel)

**Opening formalities**

1. The IEEE 802.11 TGbq meeting was called to order at 09:30 EDT by the Chair.
2. Chair introduced the TGbq leadership members.
3. Chair reminded the meeting registration.
4. Chair presented the TGbq meeting agenda [IEEE 802.11-25/0514r5](https://mentor.ieee.org/802.11/dcn/25/11-25-0514-05-00bq-april-2025-teleconference-agenda.xlsx) and reviewed the agenda items.
5. Chair reviewed the meeting agenda and the agenda was unanimously approved.

**[Administrative items]**

1. Chair presented TGbq supplementary materials [IEEE 802.11-25/0191r1](https://mentor.ieee.org/802.11/dcn/25/11-25-0191-01-00bq-tgbq-supplementary-materials-for-meetings.pptx) slides.
2. Chair reviewed IEEE 802 required notices (emphasizing to ensure to announce name and affiliation at the first time to speak, anti-trust compliance, IEEE 802 WG rules and policies, etc.), IEEE SA meeting guidelines, IEEE Codes of Ethics and Conduct, IEEE individual process, and IEEE-SA standards activities with the fair and equitable consideration.
3. Chair reminded all to record their attendance in IMAT and other meeting reminders.

**Contributions**

**Presentation of** [**IEEE 11-25/0431r0**](https://mentor.ieee.org/802.11/dcn/25/11-25-0431-00-00bq-mlo-based-scheduling-for-immw.pptx)**, MLO-based Scheduling for IMMW (Insun Jang, LG Electronics)**

1. Q: In Slide 5, what is the intention of referring the schedule-based approach within a beacon interval as same as 11ad/11ay? How is it related to IMMW link defined in TGbq?
2. A: It is just a reference.
3. Q: Do you have any intention to take periodic operations that are repeated at regular intervals, such as beacon interval?
4. A: We do not have to align with this schedule defined in 11ad/11ay.
5. Q: For beam training, periodic beam training may not be necessary for non-AP STAs that are in a steady-state, i.e., for non-AP STAs that do not have mobility.
6. A: We may need to discuss how the AP can determine the mobility of non-AP STAs. Meanwhile, the periodic BFT is not always on and it may be enabled and disabled by the AP based on the status of the non-AP STA.
7. Q: Could you elaborate more on broadcasting schedules?
8. A: The AP broadcasts schedules towards all the sectors so that all of non-AP STAs can participate to the schedules. This broadcast is similar to beacon transmission in 11ay case. The non-AP STAs check their best beams and transmit feedbacks via a sub-7GHz link.
9. Q: If the AP broadcasts something in different directions, it results in significant overhead and becomes inefficient. While this approach is useful for stand-alone mmWave systems, as seen in 11ad/11ay, we utilize MLO with sub-7GHz links to assist with discovery and establish the mmWave link for TGbq. We do not need this kind of blind broadcast beamforming. Instead, a dedicated beamforming in the mmWave link is enough in case that we have a basic connection in a sub-7GHz link.
10. A: I think this operation depends on the environment such as the number of STAs. If there are many STAs, broadcasting is useful. Let’s have further discussion on the necessity and how to balance between broadcast schedules and individually assigned schedules for beam training.
11. Q: There is a case for broadcast beam sweep if there are many STAs, as one broadcast can serve multiple STAs. We should design beam training from a client’s perspective. Therefore, every client should perceive the beam sweep as being performed on demand and specific to a client. It should have the flexibility to use a single beam sweep for multiple STAs. The question is related to TSF. Since the mmWave link is not a standalone, a problem may happen due to a clock drift. To address this, we need a very precise sub-microsecond-level clock running on every link. If we do not have that precision, we may need to provide TSF.
12. A: We may have further discussion.

**Presentation of** [**IEEE 11-25/0632r1**](https://mentor.ieee.org/802.11/dcn/25/11-25-0632-01-00bq-anchor-link-for-ml-operation-with-mmwave-link.pptx)**, Anchor Link for ML Operation with mmWave Link (Peshal Nayak, Samsung Electronics)**

1. Q: Generally aligned with the proposal of beacon on mmWave link. It needs to be very lightweight. Can you elaborate more on the key concept of BSSID replacement?
2. A: Instead of repeatedly advertising full 48-bit of BSSID, APs can advertise only a portion of it. If APs advertise a portion of the BSSID, there could be a risk of collision because the same value might be used by multiple APs for their BSSID portions. To avoid this, one approach is to advertise a few sets of bits and apply a time-based rotation pattern. In other words, the STA can determine which portion of the original 48 bits is being advertised based on the rotation pattern.
3. Q: In slides 9 and 10, can you elaborate more on a Non-AP MLD specific information?
4. A: Some part will come from broadcast overhead by offloading to sub-7GHz links and there will be other types of overhead. Two categories. One is something that needs to be broadcasted and there is no way to tackle it besides broadcasting. The Second is something non-AP MLD specific. There is no need to broadcast this type of information.
5. Q: Is this specific information broadcasted on sub-7GHz links not mmWave link?
6. A: Yes, it’s all offloaded on a sub-7GHz link.
7. Q: In Slide 7, is this periodic broadcasting a sector-level broadcasting?
8. A: In the mmWave link, we will have to periodically sweep sectors for beacons.
9. Q: In Slide 8, what does ‘STA side acquires the Receive beam’ mean? Is this ‘AP Receive beam’ or ‘STA Receive beam’?
10. A: It’s the ‘STA Receive beam’. If the STA wants, it can also perform beam training.
11. Q: For ‘Transmit beam index’ information, you set 6 bits for beam index. Do you mean that the minimum number of sectors would be 64?
12. A: In case of 11ad/11ay, a beam sector covers quite a huge range of direction. The beam index does not correspond to a sector and beams can overlap. It depends on the number of beams. 6 bits are enough but we need up to 10 bits to represents more beams if a system wants to have more fine-grained beams.
13. Q: Is the transmit beam index is equivalent to the AWV (Antenna Weight Vector) in 11ad/11ay?
14. A: We can decide details in the next step.
15. Q: In slide 14, what does it mean ‘at least one anchor link should be maintained during link deletion?
16. A: In here, it’s about deleting one of sub-7GHz links. If we want to use the mmWave link, it should make sure that there is at least one anchor link for having the mmWave link to operate.
17. Q: If the anchor link suffers from congestion while the AP can obtain TXOP in one of the other links and the AP only relies on the anchor link to transmit information of mmWave to STAs, it takes long time due to congestion and hence this is not a timely manner.
18. A: Channel access on a sub-7GHz link is probabilistic. It depends on the type of operation or the information to offload to the sub-7GHz link. Choosing the anchor link is an implementation issue. If there is time-critical information, we need to consider how to handle it and apply that mechanism to the anchor link. Our goal is to minimize the amount of information offloaded to sub-7GHz links by selecting only a subset of links. If we choose the anchor link properly, the device can perform other operations more efficiently without overloading the other links.
19. C: It doesn’t have to be only one anchor link. There is an option to have multiple anchor links as shown in Slide 12, i.e., ‘Option 3: multiple non-AP MLD specific anchor links’.
20. C: I said that any link could be operated as an anchor link.
21. Q: Does the AP provide information about the mmWave link via a sub-7GHz link in an unsolicited manner? Or does the non-AP STA poll to the AP to transmit information about the mmWave link?
22. A: It depends on information to be delivered. For the initial setup, the multi-link element, which contains information indicating which link is the anchor link, can be delivered. After a configuration change, some updates can be delivered. That is the one design option. There are multiple design options available.
23. Q: If there is no anchor link, the AP broadcasts information on all the links. In addition, any STA can poll the AP and retrieve information on any available link. I am not sure how we can fully utilize the benefits of MLO with the anchor link. Either the AP or non-AP STA can quickly access channel on any link and retrieve the information, rather than being constrained to the anchor link. What would be the benefit of having an anchor link? For example, when the anchor link is congested, it may not be able to get the information via the anchor link in a timely manner.
24. A: If there is an issue regarding the transmission of time-critical information not being completed on time, it applies equally to all sub-7GHz links. Without an anchor link, the design does not give flexibility of controlling offloading overhead.
25. C: This is not a new problem but one that commonly occurs in MLO.

**Closing formalities**

1. Chair called for presentations for 2025 May Interim meeting, where the operational procedure and the estimated timeline will be finalized.
2. Chair encouraged all to discuss the documents and share their preferences through the email reflector to ensure out best consensus is reached in May.
3. Chair reminded all to record their attendance in IMAT through the corrected link.

**Adjourn**

1. The chair announced that the call was adjourned at 10:51am EDT.

**List of Attendees**

|  |  |  |  |
| --- | --- | --- | --- |
| TGbq   |    04/22/2025   |     Erkucuk, Serhat |                                             Ofinno |
| TGbq   |    04/22/2025   |        Chen, Junbin |                               TP-Link Systems Inc. |
| TGbq   |    04/22/2025   |      Dong, Xiandong |                    Xiaomi Communications Co., Ltd. |
| TGbq   |    04/22/2025   |    Deshmukh, Mrugen |                                             Ofinno |
| TGbq   |    04/22/2025   |        Choi, Jinsoo |                                     LG ELECTRONICS |
| TGbq   |    04/22/2025   |         Choi, JinHo |                                SAMSUNG ELECTRONICS |
| TGbq   |    04/22/2025   |        CHENG, yajun |                    Xiaomi Communications Co., Ltd. |
| TGbq   |    04/22/2025   |       Au, Kwok Shum |                       Huawei Technologies Co., Ltd |
| TGbq   |    04/22/2025   |       Chen, You-Wei |                                      MediaTek Inc. |
| TGbq   |    04/22/2025   |            Chen, Xu |                    Xiaomi Communications Co., Ltd. |
| TGbq   |    04/22/2025   |       Chen, Wei-Han |                                      MediaTek Inc. |
| TGbq   |    04/22/2025   |      Byeon, Seongho |                                SAMSUNG ELECTRONICS |
| TGbq   |    04/22/2025   |    Doostnejad, Roya |                                             ofinno |
| TGbq   |    04/22/2025   |         Fan, Shuang |                     Sanechips Technology Co., Ltd. |
| TGbq   |    04/22/2025   |           Wei, Dong |  Guangdong OPPO Mobile Telecommunications Corp.... |
| TGbq   |    04/22/2025   |      Fletcher, Paul |                  Samsung Cambridge Solution Center |
| TGbq   |    04/22/2025   |     McCann, Stephen |                       Huawei Technologies Co., Ltd |
| TGbq   |    04/22/2025   |  Motozuka, Hiroyuki |                     Panasonic Holdings Corporation |
| TGbq   |    04/22/2025   |         Pan, Ju Yan |                       Huawei Technologies Co., Ltd |
| TGbq   |    04/22/2025   |       Zhou, Renlong |                     Sanechips Technology Co., Ltd. |
| TGbq   |    04/22/2025   |           Zhou, Lei |                  New H3C Technologies Co., Limited |
| TGbq   |    04/22/2025   |       Park, Eunsung |                                     LG ELECTRONICS |
| TGbq   |    04/22/2025   |     Patil, Abhishek |                              Qualcomm Incorporated |
| TGbq   |    04/22/2025   |       Perez, Javier |                                             Ofinno |
| TGbq   |    04/22/2025   |           Zhong, Ke |                           Ruijie Networks Co.,Ltd. |
| TGbq   |    04/22/2025   |        Zheng, Xiayu |                                 NXP Semiconductors |
| TGbq   |    04/22/2025   |        Zhang, Jiayi |                                             Ofinno |
| TGbq   |    04/22/2025   |      Quan, Yingqiao |                                         Spreadtrum |
| TGbq   |    04/22/2025   |        Yano, Kazuto |  Advanced Telecommunications Research Institute... |
| TGbq   |    04/22/2025   |       Yamada, Ryota |                                  SHARP CORPORATION |
| TGbq   |    04/22/2025   |      Ratnam, Vishnu |                                SAMSUNG ELECTRONICS |
| TGbq   |    04/22/2025   |        Sadiq, Bilal |                                SAMSUNG ELECTRONICS |
| TGbq   |    04/22/2025   |     Silverman, Matt |                                Cisco Systems, Inc. |
| TGbq   |    04/22/2025   |            Xin, Yan |  Huawei Technologies Canada; Huawei Technologie... |
| TGbq   |    04/22/2025   |        Singh, Aditi |                             Charter Communications |
| TGbq   |    04/22/2025   |   Wilhelmsson, Leif |                                        Ericsson AB |
| TGbq   |    04/22/2025   |       Wang, Zisheng |                                    ZTE Corporation |
| TGbq   |    04/22/2025   |        LIU, QINGLAI |                     Panasonic Holdings Corporation |
| TGbq   |    04/22/2025   |       feng, Shuling |                                       Mediatek Inc |
| TGbq   |    04/22/2025   |           Li, Weiyi |                  Spreadtrum Communication USA, Inc |
| TGbq   |    04/22/2025   |       Lee, Hong Won |                                     LG ELECTRONICS |
| TGbq   |    04/22/2025   | Hasabelnaby, Mahmoud |  Huawei Technologies Canada; Huawei Technologie... |
| TGbq   |    04/22/2025   |       HUANG, CHIHAN |                                      MediaTek Inc. |
| TGbq   |    04/22/2025   |    Hussein, Abdalla |  Huawei Technologies Canada; Huawei Technologie... |
| TGbq   |    04/22/2025   |        Li, Haozheng |                                TP-Link System Inc. |
| TGbq   |    04/22/2025   |       Jeon, Eunsung |                                SAMSUNG ELECTRONICS |
| TGbq   |    04/22/2025   |          Kain, Carl |                                Noblis, Inc.; USDoT |
| TGbq   |    04/22/2025   |         Jang, Insun |                                     LG ELECTRONICS |
| TGbq   |    04/22/2025   |        Kim, Jeongki |                                             Ofinno |
| TGbq   |    04/22/2025   |      Kim, Sang Gook |                                     LG ELECTRONICS |
| TGbq   |    04/22/2025   |         Klein, Arik |                       Huawei Technologies Co., Ltd |
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