IN THE UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

G+ COMMUNICATIONS, LLC, Plaintiff, v. SAMSUNG ELECTRONICS CO., LTD., and SAMSUNG ELECTRONICS AMERICA, INC., Defendants.	Civil Action No. 2:22-CV-78 **JURY TRIAL DEMANDED**

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1.	*Group*, MERRIAM-WEBSTER.COM, https://www.merriamwebster.com/dictionary/group (last visited Feb. 3, 2023)
2.	Certified Translation of PCTCN2016-082087
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I. INTRODUCTION

Defendants Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. ("Samsung"), respectfully submits this Opening Claim Construction and ask the Court to adopt its constructions for the reasons set forth below.

II. DISPUTED CLAIM TERMS

A. U.S. Patent No. 8,761,776

1. "offset-based reselection principle" (claims 1-3)

Samsung's Proposed Construction	G+'s Proposed Construction
"Rs=Qmeas,s+Qhysts, Rn=Qmeas,n−Qoffset, wherein s stands for a serving cell, n stands for a neighbouring cell, Qmeas,s stands for a measured level of a serving cell, Qmeas,n stands for a measured level of a neighbouring cell, Qhysts stands for the hysteresis of a serving cell, and Qoffset stands for a level offset of a neighbouring cell. After the calculation is completed, the terminal will rank all R values. The one ranked first is the best cell, the terminal will select the best cell when performing reselection."	"using Qoffset as a variable for reselection"

The claims of the '776 patent require, among other limitations, the use of an "offset-based cell reselection principle." '776 patent at 7:15-16. This phrase is not a term of art that a person of ordinary skill in the art ("POSITA")[1] would readily recognize, and the claims themselves provide no additional context that would help a POSITA understand the term's meaning. Min Decl., ¶¶59-60. The specification does, however, provide ***an express definition*** in the background of the invention for a known "method to perform intra-frequency cell reselection"—namely Samsung's proffered construction—and makes clear that this reselection method is "called an offset-based cell reselection method." '776 patent at 1:47-64; *see also Vitronics Corp. v. Conceptronic, Inc.*,

[1] POSITA definitions for all patents-in-suit are provided in declarations supporting Samsung's claim construction proposals. *See* Min Decl. (Dkt. 98-3), ¶20 ('776 patent), ¶21 ('130 patent); Bims Decl. (Dkt. 98-2), ¶22 ('430 patent); Wicker Decl. (Dkt. 98-4), ¶34 ('881 and '443 patent).

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90 F.3d 1576, 1582 (Fed.Cir.1996) ("The specification acts as a dictionary when it expressly defines terms used in the claims or when it defines terms by implication."). The patent goes on to refer to this same definition in describing the purported invention, noting that the "the offset-based cell reselection principle ***has been described in details in the background***[2] of the present invention, so it will not be described here again." *See* '776 patent at 4:64-67, 6:35-38. Thus, a POSITA would understand that the recited "offset-based cell reselection method" refers to the definition provided in the specification as stated in Samsung's construction. Min Decl., ¶64.

G+ argues that there is no "clear indication that the applicants intended to disclaim all other offset-based cell reselection methods." Dkt. 98 at 2. But G+ and its expert provide no examples of alternative methodologies for performing "offset-based cell reselection," supporting the conclusion that a POSITA would not understand the meaning of this term and would have to rely on disclosures in the specification. *See generally id*. at 2-3; Akl Decl. (Dkt. 98-1), ¶¶38-42.

2. "same-priority cells" (claims 1-3)

Samsung's Proposed Construction	G+'s Proposed Construction
"cells assigned a same cell priority"	Plain and Ordinary meaning

The '776 patent teaches the consideration of two different types of priority in cell reselection: 1) the priority of the frequencies the cells operate on; and 2) the priority of the cells themselves. *See* '776 patent at 3:5-12; Min Decl., ¶¶51-52. The intrinsic record casts the latter as a central consideration to the purported invention, and focuses on setting certain cells to a "same priority" even if the group of cells operate across multiple frequencies. Min Decl., ¶53. Claim 1, for example, recites "***setting the cells*** on multiple frequencies with the second priority as ***same-priority cells***" and subsequently "selecting a cell as a reselected cell by the terminal from among

[2] Unless otherwise noted, emphasis added to original.

the same-priority cells." '776 patent at 6:65-7:3. *See also id.* at 4:18-26; Fig. 1. In fact, during prosecution, applicants specifically distinguished the purported invention from prior art reselection techniques that relied solely on frequency priority without consideration of cell priority. *See* Dkt. 98-5 at GCOM000891 (distinguishing a prior art Huawei reference that performed reselection based on "the frequency of the cell, rather than the priority of the cell."). Samsung's proposal simply clarifies what the intrinsic record requires; namely that to practice the reselection technique of the claimed invention, cells themselves must be assigned a priority in addition to established priorities associated with the frequencies on which the cells operate. Min Decl., ¶¶54-56.

G+ objects to Samsung's proposal on the basis that it "could cause jury confusion" and that "nothing in the claim language or specification … requires any 'assignment' of cells to 'a same cell priority.'" Dkt. 98 at 3. To the contrary, as noted above, the patent repeatedly teaches "setting" cells to a same priority. As the term "assigning" is synonymous with "setting," Samsung's construction is fully consistent with the intrinsic record, and thus can cause no more confusion to a jury than the language used by applicants in describing their purported invention.

G+ further questions whether there is any distinction between "cell priority" and "frequency priority" and attempts to conflate the two concepts. Dkt. 98 at 4. The file history dispels any question in this regard, however, given that the applicant clarified that "the priority of the frequency of the cell and the priority of the cell are distinct concepts" when attempting to distinguish the aforementioned Huawei reference. Dkt. 98-5 at GCOM000891.

Lastly, G+ asserts that the applicants' arguments made during prosecution do not disavow the claim scope. Dkt. 98 at 5-6. However, the applicants' statements reflect a clear and unmistakable disavowal in their attempt to distinguish prior art, where cell reselection was done on the basis of frequency priority alone, and without using the cell priority.

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> Further, as discussed above, ***Huawei's disclosure of "equal priority" relates to the priority of the frequency of the cell, rather than the priority of the cell***. Huawei discloses that "the UE may search and rank all cells of equal or lower priority layer. *Huawei*, page 9/12. ***However, the priority of the frequency of the cell and the priority of cell are distinct concepts.*** Huawei does not disclose or suggest searching and ranking based on the priority of the cell. In other words, Huawei does not disclose or suggest which cells are considered by the UE as cells of equal priority prior to ranking.

Dkt. 98-5 at GCOM000891.[3] *See Speedtrack, Inc. v. Amazon*, 998 F.3d 1373, 1377-81 (Fed. Cir. 2021) (holding that applicant's arguments in the prosecution history distinguishing prior art amounted to "a clear and unmistakable disavowal" that surrendered claim scope).

3. "wherein the priority of the same-priority cells is equal to the absolute priority of corresponding frequencies" (claims 1-3)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite.	Not Indefinite. Plain and Ordinary meaning

This term is indefinite because a POSITA would not be able to ascertain the scope of this term with reasonable certainty. *See, e.g., Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014). A POSITA reading the claims and specification would not understand how the priority of a cell relates to priority of the frequency, which are two distinct concepts. Min Decl., ¶68. The claims refer to two distinct concepts: (1) cell priority and (2) frequency priority. As noted above, during prosecution the applicants made clear that "the priority of the frequency of the cell and the priority of the cell are ***distinct*** concepts." Dkt. 98-5 at GCOM000891. The term at issue, however,

[3] G+ attempts to obfuscate this express record by stating that the disavowal was made in the context of explaining that the prior art failed to disclose "which cells are considered by the UE as cells of equal priority," and as such it does not somehow qualify as a disavowal. Dkt. 98 at 5-6. This argument is nonsensical, as the very reason the prior art did not read on the claims according to the applicants was because it disclosed the priority of the frequency (*i.e.*, "equal priority"), and not priority of the cell, which are "distinct concepts."

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mixes these two distinct concepts by requiring a comparison of the priority of the cells (*i.e.*, cell priority) with the absolute priority of the frequencies (*i.e.*, frequency priority). The specification simply mirrors the claims and does not explain how those concepts could work together. *See, e.g.* '776 patent at 3:20-21, 3:43-44; 4:59-60, 6:29-30.

G+ argues that the concept of distinct cell priority that is separate from the frequency priority does not exist, and that "both the priority of the "same-priority cells" and the "absolute priority of corresponding frequencies" relate to the priority of frequencies among the cells," completely ignoring applicant's statements during prosecution. Dkt. 98 at 6-7. Further, G+ points to the 3GPP standard 38.304, referring to the "cellReselectionPriority" definition. This citation does not, however, resolve the ambiguity in the claim, because this definition does not explain how the absolute priority of a frequency relates to the concept of cell priority. Min Decl., ¶70.

Lastly, because the patent describes a "priority-based reselection method" in the background as a prior art reselection process that the present invention purports to be an improvement over, a POSITA would not understand that the "priority of the same-priority cells" is the absolute priority of the corresponding frequency. Min Decl., ¶71. Thus, a POSITA would understand that a cell priority could not be set to a frequency priority.

4. "first reselection module, used to select cells on multiple frequencies, other than the serving frequency, with a second priority according to a priority-based reselection principle when a terminal performs cell reselection" (claims 2-3)

Samsung's Proposed Construction	**G+'s Proposed Construction**
Indefinite. §112(6) governs this claim element. **Function:** "selecting cells on multiple frequencies, other than the serving frequency, with a second priority according to a priority-based reselection principle when a terminal performs cell reselection" **Corresponding structure:** none.	Not Indefinite. Governed by 35 U.S.C. §112(6). **Function:** selects cells on frequencies with higher priority based on the priority of frequencies. **Structure:** a processor or part of an integrated processor within the terminal operating executable code and comprises a combination of hardware and / or software, and equivalents thereof.

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Claims 2 and 3 recite a "first reselection module." The parties agree that this term is governed by 35 U.S.C. § 112, ¶ 6 and agree on the claimed function.[4] The parties, however, disagree that the specification discloses sufficient structure for performing the claimed function.

In a means-plus-function claim in which the disclosed structure is a general purpose computer or processor, "if a recited function requires special programming, then the specification must disclose the algorithm that the computer performs to accomplish that function." *Qualcomm Inc. v. Intel Corp.*, 6 F.4th 1256, 1266 (Fed. Cir. 2021). Here, other than broadly describing that a terminal performs the cell reselection method, '776 patent at 3:1-4, the specification does not mention any structure that performs the recited function, including any specific circuitry, processor or otherwise. Thus, a POSITA would have found that the specification does not describe or even suggest any piece of hardware or software that selects cells on multiple frequencies according to a priority-based reselection principle. Min Decl., ¶79. As such, G+ cannot and does not contend that the specification discloses any special purpose structure for performing the recited function.

Further, the specification's disclosure of the first and second reselection modules as possibly "integrated" does not connote structure for the "reselection module." Min Decl., ¶79. Simply using the term "integrated" does not automatically connote a processor, much less special purpose hardware or software that excuses the specification from having to disclose special programming. The mere presence of "modifiers" and "prefixes" by itself does not connote definiteness for a "first reselection module." *See, e.g., Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1351 (Fed. Cir. 2015) ("While [it] is correct that the presence of modifiers can change the

[4] Although G+ previously contested the claimed function, it now conceded to and agreed with Samsung's proposal. Dkt. 98 at 8 n.3.

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meaning of 'module,' the presence of these particular terms does not provide any structural significance to the term 'module' in this case."); *Intell. Ventures II LLC v. BITCO Gen. Ins. Corp.*, No. 6:15-cv-59, 2016 WL 125594, at *26-24 (E.D. Tex. Jan. 11, 2016) ("In context of the specification, the 'encryption/decryption module' is merely a black box that could be anything" as is thus subject to § 112, ¶ 6, and "indefinite for failure to disclosure structure corresponding to the function 'to randomly generate a device key seed Sd according to a time interval between two specific operations on the storage device.'").

The '776 specification fails to provide an algorithm for performing the recited function. G+ cites to the examples in the '776 patent at 5:7-60 as algorithms provided by the '776 patent. But as discussed above, a POSITA would not understand these disclosures to be algorithms because they do not describe how priority-based reselection actually occurs. Min Decl., ¶80. At best these disclosures correspond with two of the three possible situations for the recited function. For instance, the cited portion explains how the first reselection module selects cells when either "cells on multiple frequencies with the second priority that is higher than the first priority" (Example 1), '776 patent at 5:7-31, or when "cells on multiple frequencies with the second priority that is lower than the first priority" (Example 2). '776 patent at 5:34-60. The specification does not address the situation in which "a serving cell, and cells on the serving frequency and on one or more frequencies having the same priority with the serving frequency." The only discussion of this situation merely parrots the claim language. '776 patent at 3:17-18, 4:40-42. G+ makes no attempt to provide any citation to the specification for this last situation, and neither does Dr. Akl. *See e.g.*, Akl Decl., ¶¶52-58.

5. "second reselection module, used to select a cell as a reselected cell from among the same-priority cells based on a best-cell reselection principle" (claims 2-3)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite. §112(6) governs this claim element. **Function:** "selecting a cell as a reselected cell from among the same priority cells based on a best-cell reselection principle" **Corresponding structure:** none.	Not Indefinite. Governed by 35 U.S.C. §112(6). **Function:** selects a cell as a reselected cell from among the same-priority cells based on a best-cell reselection principle. **Structure:** a processor or part of an integrated processor within the terminal operating executable code and comprises a combination of hardware and / or software, and equivalents thereof.

Claims 2 and 3 recite a "second reselection module." The parties agree that this term is governed by 35 U.S.C. § 112, ¶ 6 and agree on the claimed function. However, the parties disagree on whether the specification discloses sufficient structure for performing the claimed function.

G+ argues that the best-cell reselection principle "requires only that the ranking R values are calculated using Qoffset." Dkt. 98 at 10. However, the best-cell reselection method disclosed in the '776 patent also requires measuring the radio quality to the candidate cells. '776 patent at 1:60-65 ("reselection among neighbouring cells lies on not only the radio quality of these cells but also on the value of Qoffset"). A POSITA would look to the specification for guidance of that specialized hardware or software, but would find no description of any such hardware or software. Min Decl., ¶88. The specification does not describe a processor, memory, or the like. Nor does it describe any software, much less an algorithm for performing the function. The closest structural description is that of the first and second reselection modules can "also be integrated." '776 patent at 6:7-8. But this description fails to specify what the modules are integrated into, such as hardware or software or a combination thereof. Min Decl., ¶8.

A POSITA would understand that the function of "selecting a cell as a reselected cell from among the same-priority cells based on a best-cell reselection principle" is a specific function and

would require specialized hardware or software. For example, a POSITA would recognize that a best-cell reselection principle requires special programming to measure the signal strength of various cells and compare the measured signal strength based on certain calculations. Furthermore, because best-cell reselection is performed on same-priority cells, a POSITA would recognize that specialized hardware and/or software is needed to identify a single cell from among the same-priority cells for which the best-cell reselection principle is satisfied. Min Decl., ¶89.

G+ argues that by merely stating that a module "may also be integrated" with another undefined module and uses a variable such as Qoffset, that sufficient structure is implied. But this recitation does not convey adequate description for a POSITA to associate the claim with a structure. *See, e.g., Synchronoss, Techs., Inc. v. Dropbox, Inc.*, 987 F.3d 1358 (Fed. Cir. 2021) ("It is not enough that a [MPF] claim term correspond to a very known way of achieving the claimed function; instead the terms must correspond to 'adequate' structure in the specification" to allow a POSITA to associate it as corresponding structure.").

B. U.S. Patent No. 10,448,430

1. "UE group" (claims 1-18)

Samsung's Proposed Construction	G+'s Proposed Construction
"a plurality of UEs configured to jointly perform a single random access"	"a set of one or more UE(s)"

Plain reading of the claims supports Samsung's proposal. Claim 1 recites a UE group containing more than one UEs configured to jointly perform a single random access procedure. '430 patent at cl. 1 ("sending, by a first User Equipment (UE) in *a **UE group***, a preamble … monitoring, by at least **one of the first UE or a second UE in the UE group**, a Random Access Response …."). While it is possible that the second UE may contain the first UE, as "the second UE is all or some UEs in the UE group," the claim language reflects that the second UE, and thus

the group it is part of, contains a plurality of UEs ("all or some ***UEs***").[5] *Id*.

The specification likewise supports Samsung's proposal and tracks with the claim language. "[M]ultiple ***(two or more)*** UEs form a UE group." *Id*. at 13:20-21. The '430 patent seeks to "greatly save[]" resources by engaging in group-based random access where "***a group of UEs*** only needs to occupy a PRACH resource . . . in a random access." *Id*. at 8:52-60; *see also id. at* 11:33-38 (similar), 13:3-8 (similar), 15:34-39 (similar), 29:66-30:8 (similar). Otherwise, the specification mentions the same possibility suggested by the claims – that the second UE in a group may include the first UE, among the plurality of other UEs. *See id.* at 9:36-41 ("The second UE ***may be all or some UEs*** in the ***UE group, i.e., UEs having random access requests***. Therefore, ***the second UE may include the first UE***."); *see also* Bims Decl., ¶¶63-68.

G+'s proposal that a UE group could contain just one UE is inconsistent with the stated purpose of the patent, which involves a group of UEs using a single PRACH resource to perform random access. *See* '430 patent at 15:34-39 ("***A random access in the related art is independently completed by each UE. However, in the present example, a group of UEs only occupies a PRACH resource*** . . . in a random access, so that PRACH resources can be greatly saved."); *Praxair, Inc. v. ATMI, Inc*., 543 F.3d 1306, 1323-24 (Fed. Cir. 2008) ("The claims of the patent must be read in light of the specification's consistent emphasis on [a] fundamental feature of the invention."); *see also* Bims Decl., ¶¶70-73. Indeed, G+'s *Markman* tutorial explains that the '430 patent addresses problems "when the bandwidth is strained when multiple devices are overloading the network" and in LTE, "a large number of resources are needed as UE's are not uniformly

[5] Extrinsic evidence is also unequivocal that a group requires a plurality of members. Ex. 1 (*Group*, MERRIAM-WEBSTER.COM, https://www.merriamwebster.com/dictionary/group (last visited Feb. 3, 2023)); Bims Decl., ¶69.

accessed in large systems." Dkt. No. 96 (G+ Markman Tutorial) at 19, 21; '430 patent at 30:3-8; *see also* Dkt. No. 96 (G+ Markman Tutorial) at 22-23 (relying on an embodiment with multiple UEs in FIG. 1 that teaches a "first UE in a group of ***UEs***" where the "first UE ***and/or a second UE in the group of UEs*** then monitors a Random Access Response").

G+'s only argument referencing the patent specification focuses on the embodiment where "the second UE may include the first UE" and asserts that a UE group may contain just one UE. Dkt. 98 at 12. As explained above, this embodiment only suggests that the second UE may contain, among other UEs, the first UE, and otherwise does not indicate that there could be just one UE in a group. G+ also extends the same argument to the language of claim 1, which is unavailing for the same reason. The specification explains that the first UE is the group leader because "group members report [] to a ***first UE*** (***hereinafter referred to as a group leader***) . . . [which] may be ***representative of the whole group of UEs to initiate a random access.***" '430 patent at 22:19-35.

2. "pre-set UE number" (claims 1-18)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite	Not Indefinite Plain and Ordinary meaning

A POSITA would not understand the scope of this term with reasonable certainty. Claim 1 refers to three possible contents of message 3–"[1] a number of UEs having random access requests in the UE group or [2] a number of UEs contained in the UE group or [3] a pre-set UE number." The first two options expressly refer to a quantity ("a number of UEs . . .") but the language is unclear whether "pre-set UE number" pertains to a quantity (*e.g.*, a pre-set number of UEs in the UE group), an identifier (*e.g.*, a pre-set number specific to a certain UE or the UE group), or something else (*e.g.*, priority, order). *Id.; see also* Bims Decl., ¶¶74-76. Other claim terms referring to identifiers expressly state so, unlike here. '430 patent at cl. 3 (reciting "group

Identifier (ID)"), cl. 13 (reciting "a group ID"), cl. 5 (reciting "Random Access Radio Network Temporary Identity (RA-RNTI)" and "Temporary Cell Radio Network Temporary Identity (TC-RNTI)"). The claims fail to clarify the scope of the term aside from implying "pre-set UE number" is not an identifier. *See* Bims Decl., ¶¶74-80.

The specification provides no clarification about the scope of the term at issue, simply reciting it in the same manner as the claims. '430 patent at 4:41-49, 7:24-27, 7:29-32, 11:20-22, 11:23-27, 27:17-21. While the specification mentions a "UE Identifier" and a "group ID" in various embodiments of group-based random access, it does not tie any of those embodiments to the claimed "pre-set UE number." *Id.* at 2:2-7, 13:20-23, 13:49-50. If anything, the patent suggests that the "pre-set UE number" is not an identifier, as it refers to any identifiers expressly, *see, e.g.*, *id.* at 4:16-23 ("group ID of the UE group," "ID of the first UE," "ID of a preamble"), but is otherwise devoid of any guidance about how to interpret this term. *See* Bims Decl., ¶¶81-84.

Extrinsic evidence suggests that the uncertainty about the meaning of "pre-set UE number" is the result of translation error. Certified translations of the foreign applications underlying the '430 patent reflect that the original language of the term at issue referred to a quantity of UEs, namely "a preset number of UEs." Ex. 2 at cl. 21 (SAM-GC00073496) ("wherein the message 3 includes the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or ***a preset number of UEs***"), Ex. 3 at cl. 21 (SAM-GC00073817) ("wherein the message 3 includes the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or ***a preset number of UEs***").[6] Contradicting the intrinsic and extrinsic record, G+ interprets "pre-set UE number" in the infringement contentions

[6] During prosecution, claim 1 was amended to include the "wherein the message 3 …" clause of claim 21 of the foreign priority application. *See* Ex. 4 at GCOM000978-82.

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as an identifier.[7] *See* Ex. 5 at 29 ("Upon information and belief, the C-RNTI MAC CE field [that signifies an identifier] comprises a pre-set UE number."); *see also* Bims Decl., ¶¶85-86.

G+ argues that Samsung's is "confusing breadth [of the term] with indefiniteness." Dkt. 98 at 12. To the contrary, G+ confuses the nature of the dispute. Here, breadth is not at issue; rather it is that the language at issue can be read to mean different things—quantity, identifier, or something else (*e.g.*, priority, order). *Media Rights Techs., Inc. v. Capital One Fin. Corp.*, 800 F.3d 1366, 1371 (Fed. Cir. 2015) (holding that "a claim is indefinite if its language might mean several different things and no informed and confident choice is available among the contending definitions" (internal quotations marks omitted)).

3. "monitoring unit configured to: monitor a Random Access Response (RAR) corresponding to the preamble and sent by eNB" (claim 18)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite. §112(f) governs this claim element. **Function:** "monitor a Random Access Response (RAR) corresponding to the preamble and sent by the eNB" **Corresponding structure:** none.	Not Indefinite. Governed by 35 U.S.C. §112(6). **Function:** monitor an RAR corresponding to the preamble and sent by the eNB. **Structure:** a processor or part of an integrated processor within the terminal operating executable code and comprises a combination of hardware and / or software, and equivalents thereof.

The parties agree means-plus-function applies and do not materially contest the claimed function but dispute whether the specification discloses sufficient corresponding structure.

The claimed function is unconventional and a POSITA would not know how to implement it without additional guidance. *See* Bims Decl., ¶¶114-117. Group-based monitoring of the RAR (whether performed by one UE on behalf of the entire group, distributed across a plurality of UEs, or even all UEs, in the group) as part of group-based random access is unique to the '430 patent

[7] As discussed above, intrinsic record suggests that the term at issue ***is not*** an identifier.

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such that it requires a specific explanation about how to accomplish it. *Id*., ¶117. The specification merely repeats the function without providing a series of steps for a POSITA to understand how to accomplish it with reasonable certainty. *See* '430 patent at 15:9 ("all UEs monitor an RAR"), 17:36-38 ("all or some intra-group UEs … monitor the RAR"), 22:43-47 ("an eNB learns of that the UE is the group leader, and sends an RAR"), 28:36-40 ("the first UE and/or a second UE in the UE group are/is configured to: monitor an RAR").

The specification fails to provide sufficient corresponding structure for the claimed function. *See* Bims Decl., ¶¶118-121. It lacks structural discussion of the "monitor[ing]" function beyond referencing other "units" within the "monitoring unit," which is insufficient. *See* '430 patent at 6:14-16 ("first descrambling subunit, a first receiving subunit and an allocation subunit"), 6:32-34 ("a determination subunit, a second descrambling subunit and a second receiving subunit"). Though suggesting embodiments may be implemented via computer program in a processor or an integrated circuit, *see id.* at 28:46-29:62, the specification fails to disclose any computer algorithm or an integrated circuit design that could perform the claimed function, and group-based monitoring by one or more UEs. *See* Bims Decl., ¶¶118-121.

G+ cites disclosure that doesn't explain how (or provide an algorithm for how) UEs in the group determine or know to determine whether the monitoring is performed by a UE on behalf of other UEs in the UE group, by a plurality of UEs in the UE group, or by all UEs in the group.[8] The background explains "the UE is unable to know whether other UEs make a random access by using the same resource" and the specification never provides a sufficient algorithm for a POSITA to know with reasonable certainty how to implement the claimed function in group-based random

[8] Dkt. No. 98 at 14-15. The disclosure in the specification G+ argues is an algorithm does not comport with their proposed construction, which is generic and not specific to a certain algorithm.

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access. '430 patent at 1:64-65. Thus, this term is indefinite.

4. "sending unit … configured to: send a preamble to an evolved Node B (eNB) over a time-frequency resource comprising a time domain resource and a frequency domain resource; … and … further configured to: send a message 3 according to a Uplink (UL) grant allocated to the UE, wherein the message 3 comprises a number of UEs having a random access requests in a UE group or a number of UEs contained in the UE group or a preset UE number" (claim 18)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite. §112(f) governs this claim element. **Function:** "send a preamble to an evolved Node B (eNB) over a time frequency resource, comprising a time domain resource and a frequency domain resource; and further send a message 3, comprising a number of UEs having random access requests in a UE group or a number of UEs contained in the UE group or a pre-set UE number, according to a Uplink (UL) grant allocated to the UE" **Corresponding structure**: none.	Not Indefinite. Governed by 35 U.S.C. §112(6). **Function:** send a preamble to an eNB over a time-frequency resource, the time-frequency resource including a time domain resource and a frequency domain resource, and send a message 3 according to a Uplink (UL) grant allocated to the UE, the message 3 comprising a number of UEs having random access requests in a UE group or a number of UEs contained in the UE group or a pre-set UE number. **Structure:** a processor or part of an integrated processor within the terminal operating executable code and comprises a combination of hardware and / or software, and equivalents thereof.

The parties agree means-plus-function applies and do not materially contest the claimed function but dispute whether the specification discloses sufficient corresponding structure.

The claimed function is unconventional and a POSITA would not know how to implement it without additional guidance or instructions. *See* Bims Decl., ¶¶94-100. The claimed function requires the UE to send UE group information to the eNB, which means that before sending a preamble and message 3, a UE performing random access on behalf of the UE group needs to know UE group information. *See* '430 patent at 22:34-35 ("a group leader may be representative of the whole group of UEs to initiate a random access"), 22:41-52 (discussing sending a preamble by a group leader), 22:48-50 (same for message 3). A POSITA would not understand how this could be accomplished without specific guidance, as group-based random access was not defined

in cellular standard specifications. *Id.* at 1:64-65 ("the UE is unable to know whether other UEs make a random access by using the same resource"); *see* Bims Decl., ¶¶94-100.

The specification fails to provide sufficient corresponding structure for the claimed function. *See* Bims Decl., ¶¶101-106. The specification does not provide any structural discussion pertaining to the "sending[ing]" function, and instead resorts to reciting functional descriptions that track with the express language of the claimed function. *See, e.g.*, '430 patent at 6:8 ("send a preamble …"), 6:45 ("send a message 3 …"), 7:20-21, 4:41-44. Further, while the specification suggests that the embodiments may be implemented via computer program in a processor or an integrated circuit, *see id.* at 28:46-29:62, it fails to disclose any computer program algorithm or an integrated circuit design capable of performing the claimed function, much less provide specifics on how such function may be implemented for sending a preamble and message 3 on behalf of a UE group. *See* Bims ¶¶101-106. A POSITA would recognize that sending of a preamble and message 3 at least requires specialized software, which rules out any discussions of a general processor as sufficient, and that the protocol or algorithm should incorporate handling of information about the UE group, which is not provided in the specification. Bims Decl., ¶¶101-106. In some embodiments, the '430 patent vaguely refers to communication via "physical signal signaling or high-layer signaling," but provides no algorithm to guide a POSITA with reasonable certainty. '430 patent at 16:13-22.

G+ cites no algorithm for the unconventional sending in group-based random access because the specification does not provide one. G+ argues the communicating group leader may be pre-set, fixed, or "determined as a UE in the UE group in accordance with a certain rule" and "intra-group UEs may interact mutually by using a short-distance communication manner such as Wireless Fidelity (WIFI) and D2D." *Id.* at 22:12-31. This does not provide any steps as to how

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the UEs, moving in and out of cells, would know to form a group and communicate or would know how to form a group and communicate. The background of the specification teaches "the UE is unable to know whether other UEs make a random access by using the same resource." *Id*. at 1:64-65. Those disclosures mean that UEs are "unable to know" random access communication in relation to one another. *Id*. There are no series of steps for a POSITA to follow and understand with reasonable certainty because there are no steps for how specialized UE groups are formed and communicate. Thus, this term is indefinite.

C. U.S. Patent No. 9,184,881

1. "a number value of the downlink sub-frame" (claims 1-8, 11-14)

Samsung's Proposed Construction	G+'s Proposed Construction
A number identifying how many downlink sub-frames are used to transmit the data	Plain and ordinary meaning

The term at issue warrants a clarification, specifically in so far as the usage of the word "value." *See* Wicker Decl., ¶55. Samsung's proposal comports with the language of claim 1 where the term appears, and other intrinsic evidence. The relevant portion of claim 1 recites:

> 1. … the eNodeB carries, in downlink control information, ***a number value of the downlink sub-frame*** corresponding to the confirmation information which is fed back by one uplink sub-frame, and transmits data on a plurality of continuous downlink sub-frames after the sub-frame carrying the downlink control information, wherein the number of the downlink sub-frames which transmit the data is equal to a number of the downlink sub-frames corresponding to the confirmation information fed back by the one uplink sub-frame ….

'881 patent at cl. 1. Here, the eNodeB sends downlink control information containing a number identifying how many downlink sub-frames are used to transmit the data (*i.e.,* a number value of the downlink sub-frame), followed by transmitting data on continuous downlink sub-frames. Wicker Decl., ¶57. As such, the user equipment would know how many downlink sub-frames it is supposed to receive and feeds back confirmation information in response to those downlink sub-

frames on one uplink sub-frame. *Id*.

The intrinsic evidence supports this understanding. A preferred embodiment discusses sending "a signaling of the number of the downlink sub-frames" representing "k continuous downlink sub-frames . . . [that] are sent with the data" and which need to be confirmed via an uplink transmission. '881 patent at 7:24-40. The same concept is illustrated in Fig. 3, where the eNodeB sends control information ("the signaling information of DCI format 0") on downlink sub-frame 6, that represents "the number of downlink subframes carrying data" sent to the user equipment, which is 4 downlink sub-frames, followed by data transmissions in the continuous downlink sub-frames 6, 7, 8, and 9, to be confirmed via uplink sub-frame 13. *Id.* at Fig. 3, 9:58-10:19. The prosecution history supports Samsung's proposal as well. *See* Dkt. 98-6 at GCOM000222 ("[T]he eNodeB can inform the user equipment how many downlink sub-frames are used to transmit the data (i.e., a number value of the downlink sub-frame)").

G+ labels Samsung's proposal as "too narrow" because, according to G+, the term at issue means not only "the number of downlink subframes in the set, but also [the] identi[ty] [of] specific downlink sub-frames" that carry data. Dkt. 98 at 19. But claim 1 does not assign the identity of data sub-frames to "a number value" and instead requires "transmitting data on a plurality of continuous downlink sub-frames after the sub-frame carrying the downlink control information." Thus, to confirm the receipt, the user equipment should only know how many data sub-frames it is supposed to get—which is conveyed by "a number value of the downlink sub-frame." G+'s reference to the description in the specification corresponding to Fig. 3, *see* Dkt. 98 at 19 (citing '881 patent at 9:66-10:11) is of no avail. This embodiment comports with claim 1 by illustrating a situation where the control information carries "the number of downlink sub-frames carrying data," and there is no suggestion whatsoever that it also carries the identity of data sub-frames.

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Lastly, G+ relies on the applicant's argument in the prosecution history noted above, which defines the term at issue consistent with Samsung's proposal, and notes that "the eNodeB can inform the user equipment . . . the position of the downlink sub-frames which transmit data (i.e. continuous downlink sub-frames after the sub-frame carrying the downlink control information)." Contrary to G+'s contention, this language does not mean that the identity of downlink data sub-frames are conveyed expressly as part of "the number of downlink sub-frames carrying data."

2. "the downlink sub-frame" / "this downlink sub-frame" (claims 1-14)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite	Not indefinite; plain and ordinary meaning

A POSITA would not be able to ascertain the scope of the "downlink sub-frame" terms with reasonable certainty, for it is unclear if they refer to the same or different "downlink sub-frames." Wicker Decl., ¶69. Claims 1 and 9 that recite the terms at issue are reproduced below.

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1. A method for feeding back confirmation information on a physical uplink shared channel, which is used for enabling a user equipment to feed back to an eNodeB whether data of a downlink sub-frame is correctly received in a situation that a number of the downlink sub-frames is greater than a number of uplink sub-frames in a time division duplex system, wherein the method comprises:

the eNodeB carries, in downlink control information, a number value of the downlink sub-frame corresponding to the confirmation information which is fed back by one uplink sub-frame, and transmits data on a plurality of continuous downlink sub-frames after the sub-frame carrying the downlink control information, wherein the number of the downlink sub-frames which transmit the data is equal to a number of the downlink sub-frames corresponding to the confirmation information fed back by the one uplink sub-frame;

after the user equipment receives the downlink sub-frame which carries the downlink control information, the data is received from the downlink sub-frame which transmits the data after this downlink sub-frame, and the confirmation information of receiving the data is fed back together with uplink data to the eNodeB through a physical uplink shared channel through an uplink sub-frame;

wherein, in a situation that the user equipment feeds back a plurality of groups of the confirmation information, an amount of the confirmation information fed back in each group is equal to a maximum number of codeword streams in this downlink sub-frame, and respective confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame; in the situation that the number of codeword streams of the downlink sub-frames is smaller than the maximum number of the codeword streams of the downlink sub-frame, the user equipment feeds back the confirmation information of the number of the maximum codeword streams, wherein confirmation information without a corresponding codeword stream is set as a predefined fixed value; when the user equipment fails to detect the physical downlink control channel corresponding to the transmitted data in the sub-frame which transmits the data, the user equipment feeds back the negative acknowledgement message as the confirmation information of each codeword stream in a group corresponding to this downlink sub-frame.

9. A method for feeding back confirmation information on a physical uplink shared channel, wherein, when the confirmation information is fed back together with uplink data on the physical uplink shared channel, in a situation that a user equipment fails to detect a physical downlink control channel corresponding to transmitted data in a sub-frame transmitting data, the user equipment feeds back a negative acknowledgement message as confirmation information of this downlink sub-frame; in a situation that the user equipment detects the physical downlink control channel corresponding to the transmitted data in the sub-frame transmitting the data, the user equipment analyzes data in this downlink sub-frame, and feeds back an acknowledgement message as the confirmation information in a situation that the analysis is successful, otherwise, the negative acknowledgement message is fed back as the confirmation information;

wherein

in a situation that the user equipment feeds back a plurality of groups of the confirmation information, an amount of the confirmation information fed back in each group is equal to a maximum number of codeword streams in this downlink sub-frame, and respective confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame;

in a situation that the number of the codeword streams of the downlink sub-frame is smaller than the maximum number of the codeword streams of the downlink sub-frame, the user equipment feeds back the confirmation information of the maximum number of the codeword streams, wherein confirmation information without a corresponding codeword stream is set as a predefined fixed value;

when the user equipment fails to detect the physical downlink control channel corresponding to the transmitted data in the sub-frame which transmits the data, the user equipment feeds back the negative acknowledgement message as the confirmation information of each codeword stream in a group corresponding to this downlink sub-frame.

’881 patent at cls. 1, 9 (highlights added).

The claims contain multiple recitations of “the downlink sub-frame”/”the downlink sub-frames” (yellow) and “this downlink sub-frame” (blue), and it is unclear if they refer to the same or different “downlink sub-frame[s].” Wicker Decl., ¶70. Claims 1 and 9 recite multiple possible antecedent bases for the terms at issue: “a downlink sub-frame” (green) and “a corresponding downlink sub-frame” (gray) in claim 1; “a sub-frame transmitting data” (green) and “a corresponding downlink sub-frame” (gray) in claim 9. Other potentially related limitations add to

the confusion about the claim scope: claim 1 includes "a plurality of continuous downlink sub-frames" (orange), "the sub-frame carrying the downlink control information" (purple), "the downlink sub-frames which transmit the data" (pink), and "the sub-frame which transmits the data" (red); and claim 9 recites "the sub-frame transmitting the data" (pink) and "the sub-frame which transmits the data" (red). *Id.* at ¶¶71-72. The patent specification simply recites the terms at issue and does not provide any clarity. *Id.* at ¶73.

G+'s attempts to explain the meaning of the terms at issue further illustrate the ambiguity in the claim language. G+ alleges that there are three different types of "the downlink sub-frame[s]" in claim 1, *see* Dkt. 98 at 20, but fails to explain how any of them relate to the one and only recitation of "a downlink sub-frame" that appears in the claim 1 preamble. G+ then argues that "[a] POSITA would [] understand that 'an amount of the confirmation information fed back in each group' provides antecedent basis for [a particular recitation of] 'this downlink sub-frame'" in claims 1 and 9. Dkt. 98 at 21. This is nonsensical, and G+ provides no legal authority to support the notion that one claim term can be the antecedent basis for another completely different claim term. Lastly, G+ fails to account for and explain all instances of the "downlink sub-frame" terms in the claims, which further underscores the incomprehensibility of the claim language. [9]

3. "an amount of the confirmation information" (claims 1-14)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite	Not indefinite; plain and ordinary meaning

[9] G+ fails to account for and classify the following instances of the terms at issue: "in a situation that a number of ***the downlink sub-frames*** is greater than a number of uplink sub-frames" (cl. 1); "in the situation that the number of codeword streams of ***the downlink sub-frames*** is smaller than the maximum number of the codeword streams of ***the downlink sub-frame***" (cl. 1); and "in a situation that the number of the codeword streams of ***the downlink sub-frame*** is smaller than the maximum number of the codeword streams of ***the downlink sub-frame***" (cl. 9).

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The term "an amount of the confirmation information" in independent claims 1 and 9 creates confusion as to the scope of these claims, which a POSITA would not be able to ascertained with reasonable certainty. Wicker Decl., ¶75. The relevant portions of claims 1 and 9 recite:

> … in a situation that the user equipment feeds back a plurality of groups of the confirmation information, ***an amount of the confirmation information*** fed back in each group is equal to a maximum number of codeword streams in this downlink sub-frame, and respective confirmation information in each group corresponds to the confirmation information of the codeword stream of a corresponding downlink sub-frame….

'881 patent, cls. 1, 9. A POSITA would not understand if the recited "amount" refers to volume and/or size of confirmation information (*e.g.*, number of bits or bytes), or the number of distinct confirmation information (or pieces of confirmation information). Wicker Decl., ¶77.[10] The specification recites the term at issue verbatim or otherwise parrots the claim language, without clarifying the meaning. *See* '881 patent at 3:1-24, 4:50-57, 5:45-51, 8:61-9:1. *See also* Wicker Decl., ¶79. The prosecution history is likewise unhelpful, as it tracks the claim language without further explanation. *See* Dkt. 98-6 at GCOM000349-352; Wicker Decl., ¶81-82.

G+, despite having claimed that this term needs no construction, now asserts that it means "the number of pieces of ACK/NACK information." Dkt. 98 at 22-23. G+ points to an embodiment which discusses a situation that ACK/NACK of k downlink sub-frames is fed back by one uplink subframe and "'the number of codeword streams of the downlink sub-frame is m,' 'each group [of ACK/NACK information] corresponds to one downlink sub-frame and includes m pieces of the ACK/NACK information,' and that 'each piece of the ACK/NACK information in

[10] As Dr. Wicker explained, "the claim language in question is analogous to a sign offering 'amounts of ice cream' without specifying exactly what is meant by an 'amount.' It could for example, refer to a measurement of the quantity of ice cream, such as ounces or scoops. It could, alternatively, refer to a number of distinct menu items featuring ice cream, such as a number of ice cream cones." Wicker Decl., ¶78.

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the group corresponds to the ACK/NACK information of one codeword stream in the downlink sub-frame corresponding to the group.'" (Dkt. 98 at 22 (citing '881 patent at 9:14-23.) But these disclosures are directed to a certain embodiment—*i.e.*, "a situation that ACK/NACK of k downlink sub-frames is fed back by one uplink subframe and the number of codeword streams of the downlink sub-frame is m" ('881 patent at 9:14-17)—and cannot be used to save the claims from indefiniteness. *See Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1373-1374 (Fed. Cir. 2014) ("Had the phrase been cast as a definition instead of as an example . . . then it would help provide the clarity that the specification lacks. But as the specification is written, . . . a [POSITA] would not understand the 'e.g.' phrase to constitute an exclusive definition of [the term at issue].").

G+ ignores other references to the specification cited by Dr. Wicker as relating to prior art and not relating to the invention. Dkt. 98 at 22. G+ provides no legal authority as to why the background of the invention section of a patent should be given less weight that the rest of the specification. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) ("Importantly, the person of ordinary skill in the art is deemed to read the claim term . . . in the context of the entire patent, including the specification."). If anything, the background section is the most important as it reflects what a POSITA would have known about the state of the prior art. *See V-Formation, Inc. v. Benetton Group SpA*, 401 F.3d 1307, 1310 (Fed. Cir. 2005) (intrinsic record "usually provides the technological and temporal context to enable the court to ascertain the meaning of the claim to one of ordinary skill in the art at the time of the invention").

D. U.S. Patent No. 10,736,130

1. "a processor arranged to . . . " (claim 20)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite § 112(6) governs this claim element **Function:** to execute the stored processor-executable instructions to perform steps of: sending K predefined sequences	Not Indefinite Not governed by 112(f) Plain and Ordinary meaning Plaintiff objects to this as

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on M transmission symbols in a Transmission Time Interval (TTI) to send B bit uplink control information, wherein M is a positive integer, K is an integer, $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1, on each of the M transmission symbols, one of the K predefined sequences is sent, and each of the K predefined sequences has a length of N and is mapped to N subcarriers of the corresponding transmission symbols corresponding to the each of the K predefined sequences, wherein N=2n with n being a positive integer **Corresponding structure:** none	Defendants identified nearly an entire claim and not a claim term for construction

The parties dispute whether this term should be subject to means-plus-function treatment. Claim 20 is drafted in a format consistent with traditional means-plus-function claim limitations, by reciting high-level functions without corresponding structure. The inquiry is not whether the word "processor" has an understood definition, but rather whether the claims and specification "detail the objectives and operations of the 'processor configured to . . .' term[] in a way that connotes structure sufficient to avoid the application of § 112, ¶ 6." *St. Isidore Research, LLC v. Comerica Inc.*, No. 2:15-cv-1390-JRG-RSP, 2016 WL 4988246, at *14 (E.D. Tex. Sept. 19, 2016).

Claim 20 recites function without definite structure. The mere disclosure of a general-purpose processor is not sufficient structure. *See In re Katz Interactive Call Processing Patent Litig.,* 639 F.3d 1303, 1315-16 (Fed. Cir. 2011) (finding general-purpose computer insufficient structure for claims "involv[ing] specific functions that would need to be implemented by programming a general purpose computer to convert it into a special purpose computer capable of performing those specified functions"). To hold otherwise would be contrary to Federal Circuit precedent because it would permit functional claiming of software by reciting that a "processor" is "configured" or "operable" to perform those functions. *See Williamson,* 792 F.3d at 1349 (warning against "proliferation of functional claiming untethered to § 112, para. 6.").

SyncPoint, on which G+ relies, is distinguishable. Whereas the Court found that the claims in *SyncPoint* describe a processor's interaction with structural elements, claim 20 here does not

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recite such interactions. *SyncPoint Imaging, LLC v. Nintendo of Am. Inc.*, 2016 U.S. Dist. LEXIS 677 (E.D. Tex. Jan. 5, 2016). Claim 24 of U.S. Patent No. 6,275,214 in *SyncPoint*, recites:

> [A] processor ***in communication with the camera*** for processing the image to ***detect position of the optical cursor*** and at least one property of the optical cursor and for converting the position and at least one property to corresponding commands ***to control the computer and move an internal cursor to a position*** corresponding to the optical cursor while the optical cursor remains within the output ***displayed on the screen***.

As shown, claim 24 in *SyncPoint* includes recitation of structure and the processors interaction with this structural elements, such as the processor being in communication with the camera.

In contrast, claim 20 of the '130 patent recites high-level functions that the "processor" is "arranged to" perform. Claim 20 itself recites nothing more about the "processor" itself, and the remainder focuses on the functional aspects of the instructions executed by the processor:

> "a processor arranged to ***execute the stored processor-executable instructions to perform steps*** of: sending K predefined sequences on M transmission symbols in a Transmission Time Interval (TTI) to send B-bit uplink control information, wherein M is a positive integer, K is an integer, $1<K<2^B$, B is an integer greater than or equal to 1, on each of the M transmission symbols, one of the K predefined sequences is sent, and each of the K predefined sequences has a length of N and is mapped to N subcarriers of the corresponding transmission symbols corresponding to the each of the K predefined sequences, wherein N=2n with n being a positive integer"

'130 patent at cl. 20. This is confirmed by the limited disclosures of "processor" in the specification, which repeatedly makes clear that the processor executes the program instructions. *Id.* at 2:25-27 ("[T]he processor executes the following processing by invoking the program or the instruction"); 2:39-41 ("[T]he computer program executes the above method for uplink control signal transmission when being invoked by a processor"); 26:15-17 (same).

Further, claim 20 includes functions that would not and cannot be performed by a general purpose processor. For example, claim 20 recites the "***sending*** of K predefined sequences on M

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transmission symbols." As Figure 13 indicates, the embodiments include a transmission unit, which is "arranged to send the K predefined sequences." '130 patent at 2:13-14. Critically, claim 20 does not recite a "transmission unit," much less describes the interaction between a processor and any such "transmission unit." Indeed, the specification references a "processor" as a generic component with a memory. '130 patent at Fig. 14, 22:53-23:4. The patentee, however, is obligated to delineate the structure with which to configure the processor because sufficiently definite structure is required to avoid application of § 112, ¶ 6.

Once the claim is construed under § 112(6), a two-step process takes over. First, the court identifies the claimed function. *Williamson*, 792 F.3d at 1351. Second, the court determines, "what structure, if any, disclosed in the specification corresponds to the claimed function." *Id*. As to step one, because the disputed "processor" term invokes § 112(6), construing the term first requires identifying the claimed function(s). Samsung has identified the function that are subject to 112(6), each of which are enumerated in the parties' Joint Claim Construction Statement. Dkt. 85 at 14-15. G+, in contrast, chose not to identify any claimed functions.

Step two requires identifying corresponding structure to perform the function. For "processor," the specification does not disclose adequate structure, let alone clearly link it to the claimed functions. Claims 20 recites a "processor arranged to" execute instructions to "sending K predefined sequences on M transmission symbols . . . ." But the specification does not disclose or link any corresponding structure to one of the claimed functions. As discussed, the specification discloses that the processor executes program instructions. '130 patent at 2:25-27; 2:39-41; 26:15-17. Figure 14 further shows the processor as being connected to memory. None of these disclosers without an algorithm for performing the claimed functions represents structure clearly linked to the functions. *Augme Techs., Inc. v. Yahoo! Inc*., 755 F.3d 1326, 1338 (Fed. Cir. 2014)

("[D]isclosing a black box that performs the recited function is not a sufficient explanation of the algorithm required to render the means-plus-function term definite.").

Critically, G+ omits proposed structure from its claim construction disclosures and in its expert's declarations. Thus, should the Court agree that § 112(6) applies, G+ has conceded that claim 20 is indefinite.

E. U.S. Patent No. 10,595,443

1. "blind detection" (claims 8-9, 17-18)

Samsung's Proposed Construction	G+'s Proposed Construction
"decoding on the premise of assuming k as a specific value and correspondingly assuming M as a specific value"	Plain and ordinary meaning

The inventors acted as their own lexicographer for the term "blind detection" and provided a specific definition for this term, one that was not understood in the art. While there is no dispute that "blind detection" techniques were known in telecommunication industry prior to the '443 patent, such techniques would not work with the specific purported invention of the '443 patent, and specifically the limitations "M bits of HARQ information" and "k erroneous transmission blocks" recited in the claims. *See* Wicker Decl., ¶¶85, 88-89; Dkt. 98 at 26; *see also* '443 patent, cl. 8. As such, and to make "blind detection" work for their patent, the inventors coined their own definition for "blind detection" along with a detailed algorithm. Wicker Decl., ¶86.

> After receiving the HARQ information from the node 1, the node 2 performs decoding through a blind detection. The blind detection refers to that the node 2 performs decoding on the premise of assuming k as a specific value and correspondingly assuming M as a specific value. If the node 1 adds a cyclic redundancy check (CRC) code to the HARQ information, then the node 2 may judge whether the assumption concerning k and M is feasible by checking through CRC after decoding. If feasible, then the HARQ information as obtained after decoding is just the one as expected; otherwise, repeating the above steps by assuming k as other values until the node 2 is correctly decoded.

'443 patent at 11:10-21; *see also* 13:7-18. The specification describes "blind detection" as the

sequential assumption of values of *k* and *M* followed by attempts at computing the CRC, and when the CRC is found to be a match with what was received, it is assumed that the corresponding values of *k* and *M* are correct. *See* Wicker Decl., ¶89. Thus, this specification clearly sets forth the definition of "blind detection" and reflects the inventors' intent to redefine this term. *See Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

G+ does not explain how the concept of "blind detection" as understood in the art could possibly work with the specific claim limitations. Instead, G+ asserts that Samsung's proposal "could render the claims indefinite," as it is not detailed enough to capture the algorithm provided in the specification. Dkt. 98 at 27. Thus, G+ appears not only to depart from its original proposal that this term needs no construction, but also to espouse Samsung's argument that the patentees acted as their own lexicographer, albeit in a more detailed fashion than proposed by Samsung.[11]

2. "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k" (claims 1-20)

Samsung's Proposed Construction	G+'s Proposed Construction
Indefinite	Not indefinite; plain and ordinary meaning

A POSITA would not be able to ascertain, with reasonable certainty, if the term at issue requires presence of both length types, or in the alternative, just one length type. *See* Wicker Decl., ¶92. The independent claims, where this term appears, use the conjunction "or" between the first and second length types: "a length type of M2 including ***a first length type or a second length type***; the first length type indicating a value of M2 being predefined, and the second length type

[11] G+'s argument that "blind detection" should incorporate portions of the specification that cover repeating the detection process "by assuming k again as other values until achieving correctly decoding," Dkt. 98 at 27, further supports that the patentees acted as their own lexicographer.

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indicating a value of M2 being determined based on k." '443 patent, cls. 1, 8, 10, and 17. This language suggests that claims require the presence of ***either*** a first length type ***or*** a second length type, but not both. *See, e.g.*, *Kustom Signals, Inc. v. Applied Concepts, Inc.*, 264 F.3d 1326, 1331 (Fed. Cir. 2001) ("[T]here is no basis whatsoever for believing that [the patent owner] intended its usage of 'or' somehow to embrace 'and.'"); *Schumer v. Lab. Computer Sys.*, 308 F.3d 1304, 1311 (Fed. Cir. 2002) ("We have consistently interpreted the word 'or' to mean that the items in the sequence are alternatives to each other."). The specification, however, provides disclosures suggesting that the claimed "**or**" between the first and second length types could actually be an "**or**" or an "**and,**" depending on different scenarios. *See* '443 patent at 3:14-18; Wicker Decl., ¶94. Thus, it is unclear if the claims require the use the first length type or the second length type, but not both, or alternatively the use of both length types. *Id.* at ¶95.

G+ arguments are self-contradictory. G+ contends that "every single embodiment and figure disclosed in the '443 Patent contemplates the ability to either generate or interpret 'M bits of HARQ' with either a first length type or a second length type." Dkt. 98 at 29 (emphasis in the original). This suggests that the ***claims do not require the ability to generate or interpret both length types***. G+ then contends the opposite by pointing to an embodiment in the specification in which, when applied to claims, ***requires an ability to generate or interpret both length types***.[12]

[12] G+'s self-contradiction is unsurprising. G+'s infringement contentions only identify evidence that would allegedly be "the first length type indicating a value of M2 being predefined," suggesting that the second length type is not required. *See, e.g.*, Ex. 6 at 23 ("Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits."). In contrast, in IPR2022-01598, G+ took an opposite position and attempted to distinguish prior art by asserting that "[t]he '443 Patent's specification makes clear that ***both formats are required***." Ex. 7 at 27. While this inconsistency was identified in Dr. Wicker's declaration, G+ did not attempt to address this issue and instead simply contended that "[n]othing in either Patent Owner's Preliminary Response in IPR2022-01598 or in G+'s Preliminary Infringement Contentions contradicts" G+'s brief. Dkt. 98 at 29.

G+'s remaining points further obfuscate the issue. G+ asserts that "the length type" may be configured by "radio resource control (RRC) signaling," "a downlink control information (DCI)," or otherwise "determined by the first node; predefined; and determined by the first node based on k." Dkt. 98 at 28 (citing '443 patent at 6:45-50). But the configuration or determination of the length type are not relevant to the main issue here, namely if the claims require both length types or just one. G+'s arguments about threshold values fail for the same reason.

III. CONCLUSION

For the reasons recited above, Samsung requests that the Court adopt Samsung's proposed claim constructions.

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Dated: April 26, 2023

Respectfully submitted,

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CERTIFICATE OF SERVICE

This is to certify that on April 26, 2023, a true and correct copy of the foregoing instrument was delivered to all counsel of record through the court electronic system.

/s/ Melissa R. Smith
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EXHIBIT 1

Merriam-Webster Logo

group

group

1 of 2

noun

'grüp

often attributive

Synonyms of *group*

1

: two or more figures forming a complete unit in a composition

went there as a *group*

2

a

: a number of individuals assembled together or having some unifying relationship

a study *group*

b

: an assemblage of objects regarded as a unit

one of the food *groups*

c (1)

: a military unit consisting of a headquarters and attached battalions

(2)

: a unit of the U.S. Air Force higher than a squadron and lower than a wing

3

a

: an assemblage of related organisms often used to avoid taxonomic connotations when the kind or degree of relationship is not clearly defined

b (1)

: two or more atoms joined together or sometimes a single atom forming part of a molecule

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especially : FUNCTIONAL GROUP

a methyl *group*

(2)

: an assemblage of elements forming one of the vertical columns of the periodic table

c

: a bed or layer of rocks deposited during an era

4

: a mathematical set that is closed under a binary associative operation, contains an identity element, and has an inverse for every element

group

2 of 2

verb

grouped; grouping; groups

transitive verb

1

: to combine in a group

grouped English and Dutch as Germanic languages

2

: to assign to a group : CLASSIFY

The children were *grouped* by age.

intransitive verb

1

: to form a group

The students *grouped* around the table.

2

: to belong to a group

3

: to make groups of closely spaced hits on a target

the gun *grouped* beautifully

R. C. Ruark

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groupable

'grü-pə-bəl

adjective

Synonyms

Noun

array

assemblage

band

bank

batch

battery

block

bunch

clot

clump

cluster

clutch

collection

constellation

grouping

huddle

knot

lot

muster

package

parcel

passel

set

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suite

Verb

assort

break down

categorize

class

classify

codify

compartment

compartmentalize

digest

distinguish

distribute

grade

peg

place

range

rank

relegate

separate

sort

type

See all Synonyms & Antonyms in Thesaurus

Example Sentences

Noun

It'll be easier if we go there as a *group*.

She presented the idea to the *group*.

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We like to let these students work *in groups* whenever possible.

She belongs to an environmental *group*.

She joined a discussion *group*.

A select *group* of scientists has been invited to the conference.

Verb

you should first *group* the invertebrates by genus

group the kids together and we'll see who's missing

See More

Recent Examples on the Web

Noun

Doug Miller is an Anchorage attorney who serves on the Anchorage Transit Advisory Board, a citizen *group* that advises the People Mover bus system.

Michelle Theriault Boots, *Anchorage Daily News*, 26 Jan. 2023

In June 2022, Viacom18, a TV and streaming *group* backed by Mukesh Ambani, paid $3 billion to win an online auction for two packages of digital rights to the men's IPL cricket.

Naman Ramachandran, *Variety*, 25 Jan. 2023

On Wednesday, Ukrainian military spokesman Sergiy Cherevaty confirmed that Kyiv's forces have withdrawn from the eastern town of Soledar after a fierce push by Russia's Wagner mercenary *group*.

Dan Lamothe, *Washington Post*, 25 Jan. 2023

Following the final live show, PEOPLE sat down with judges Bryan and Richie in a *group* interview to discuss the results.

Daniela Avila, *Peoplemag*, 25 Jan. 2023

For example, Willden lobbies for the Nevada Health Care Association and Center for Assisted Living, an industry *group* for nursing homes and assisted living facilities.

Anjeanette Damon, *ProPublica*, 25 Jan. 2023

Rwanda is accused by the Congolese government, the United Nations, and Western allies of supporting the notorious armed M23 rebel *group* in its violent insurgency in eastern DRC, which Kigali denies.

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Larry Madowo, *CNN*, 25 Jan. 2023

Andrea Mercado, who leads the liberal advocacy *group* Florida Rising, estimated that Republicans had outspent Democrats by more than three hundred and fifty million dollars.

Stephania Taladrid, *The New Yorker*, 25 Jan. 2023

There's no need to convene a full-on planning session here, but then again, a *group* text could go a little haywire.

Dana Mcmahan, *The Courier-Journal*, 25 Jan. 2023

Verb

Then tightly *group* a strand of lights to cover a section of a wire wreath frame, attaching the strands with zip ties on the back side.

Sunset Magazine, 10 Dec. 2022

Amazon intends to use it initially to *group* together items in each order just before they are packaged.

Liz Young, *WSJ*, 18 Nov. 2022

The new constitution will also *group* amendments by category, such as branches of government or economic development.

Sarah Swetlik | Sswetlik@al.com, *al*, 19 Oct. 2022

Unlike the new Jacksonians, Biden makes little distinction between the two and in fact tends to *group* them together as authoritarian enemies of democracy.

Jordan Michael Smith, *The New Republic*, 17 Oct. 2022

Use one to *group* similar items such as cleaning supplies.

Mariah Thomas, *Good Housekeeping*, 1 Oct. 2022

Chief Executive Bob Chapek said the company could eventually *group* all its streaming products under its flagship Disney+ app, and could tie that service more closely to its theme-parks business.

Caitlin Ostroff, *WSJ*, 15 Sep. 2022

Line them up a staircase, use them to accent a mantel, or *group* them together for a festive fall table display.

Emily Vanschmus, *Better Homes & Gardens*, 29 Sep. 2022

Click on the app to allow notifications, turn them off, or *group* them.

Adrienne So, *WIRED*, 5 Sep. 2022

See More

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These example sentences are selected automatically from various online news sources to reflect current usage of the word 'group.' Views expressed in the examples do not represent the opinion of Merriam-Webster or its editors. Send us feedback.

Word History

Etymology

Noun and Verb

French *groupe*, from Italian *gruppo*, by-form of *groppo* knot, tangle, of Germanic origin; akin to Old High German *kropf* craw — more at CROP

First Known Use

Noun

1668, in the meaning defined at sense 1

Verb

1706, in the meaning defined at transitive sense 1

Time Traveler

The first known use of *group* was in 1668

See more words from the same year

Phrases Containing *group*

affinity group

diagnosis related group

ginger group

blood group

ABO blood group

alternating group

functional group

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fundamental group

focus group

encounter group

group discussion

group captain

group practice

out-group

interest group

in-group

group therapy

linkage group

pressure group

quotient group

symmetric group

support group

T-group

great group

steering group

factor group

inter-group

group theory

group home

age-group

group dynamics

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splinter group

permutation group

working group

topological group

See More

ictionary Entries Near *group*

ground zero
group
Group A

See More Nearby Entries

ite this Entry

Style

MLA

"Group." *Merriam-Webster.com Dictionary*, Merriam-Webster, https://www.merriam-webster.com/dictionary/group. Accessed 3 Feb. 2023.

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ids Definition

group

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1 of 2 **noun**

'grüp

1

: a number of objects or persons considered as a unit

2

a

: a number of living things having some natural relationship

b

: a combination of atoms commonly found together in a molecule

a methyl *group*

3

: a small band : **COMBO**

a rock *group*

group

2 of 2 **verb**

: to arrange or combine in a group

group children by ages

Medical Definition

group

noun

'grüp

often attributive

1

: a number of individuals assembled together or having some unifying relationship

2

a

: an assemblage of related organisms often used to avoid taxonomic connotations when the kind or degree of relationship is not clearly defined

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b (1)

: an assemblage of atoms forming part of a molecule

especially : FUNCTIONAL GROUP

(2)

: an assemblage of elements forming one of the vertical columns of the periodic table

More from Merriam-Webster on *group*

Nglish: Translation of *group* for Spanish Speakers
Britannica English: Translation of *group* for Arabic Speakers
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WORD OF THE DAY

challah

SAM-GC00073225

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EXHIBIT 2

CERTIFICATE OF TRANSLATOR'S ACCURACY

I (Ms. M. Kuester), declare under the penalty of perjury under the laws of the United States that the forgoing translation is a true and exact translation of this one (1) Simplified Chinese document: (PCT-CN2016-082087_Priority_Application_-_ipApplication.pdf) to the best of my knowledge and I am competent in both English and Simplified Chinese to render such a translation; and further declare that willful false statements and the like so made are punishable by fine or imprisonment, or both under 1001 of Title 18 of the United States Codes.

Melissa Kuester Date: January 23, 2023
M. Kuester

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International application number:		PCT/CN2016/082087
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Certificate

Attached to this certificate are copies of the following patent application documents filed with this Office.

Application Number:	20151036832L1
Application type:	Patent
Invention name:	A random access method, device and system
Application date:	06/26/2015
Applicant:	ZTE Corporation
Inventor or designer:	Zhang Wen, Xia Shuqiang, Dai Bo, Dai Qian, Lu Zhaohua, Liu Kun, Chen Xianming, Shi Jing, Li Xincai, Fang Huiying

Director
Shen Changyu

June 08, 2016

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20150626 2015103683211

150413-I-CP-ZTE

Claims

1. A random access method, characterized in that the method comprises:

The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group.

2、 The method according to claim 1, wherein the first UE is at least one of the following:

Comprised of at least one UE; or,

At least one UE determined according to preset rules; or at least one UE notified by the eNB.

3、 The method according to claim 1, wherein the preamble and/or the time domain resources and/or frequency domain resources are preset, or determined by the group identifier of the UE group, or are notified by the above eNB.

4、 The method according to claim 1, wherein the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, comprising:

The first UE and/or the second UE unscrambles the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset radio network temporary identifier RA-RNTI corresponding to the preamble, and receives the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization;

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

5、 The method according to claim 4, wherein, the first UE and/or the second UE according to at least one TC-RNTI included in the RAR And/or at least one uplink grant determines the TC-RNTI and/or uplink grant allocated to itself, specifically including:

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to the first UE and/or the second UE according to a preset rule according to its own identity.

6、 The method according to claim 1, wherein the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, comprising:

The first UE and/or the second UE determine their respective corresponding RA-RNTIs according to their respective identities and/or preambles, and unscramble the CRC for scheduling the DCI of the RAR according to the respective corresponding RA-RNTIs, And receive the RAR corresponding to itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE or second UE.

7、 The method according to claim 4, wherein after the first UE and/or the second UE monitor the RAR corresponding to the preamble sent by the eNB, the method further comprises: the first UE and /or the second UE sends message 3 according to the uplink grant allocated to itself.

8、 The method according to claim 7, wherein after the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself, it further includes:

The first UE and/or the second UE receives message 4 sent by the eNB.

9. The method according to claim 8, wherein the receiving of the message 4 sent by the eNB by the first UE and/or the second UE includes:

The CRC of the DCI scheduling the message 4 is scrambled using the TC-RNTI allocated to the first UE and/or the second UE.

10. The method according to claim 9, wherein the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determine the radio resources allocated to itself according to the at least one set of radio resources included in the message 4 .

11. The method according to claim 10, wherein the first UE and/or the second UE determines radio resources allocated to itself according to at least one set of radio resources included in the message 4, further comprising:

The UE also determines wireless resources allocated to itself according to its own identity according to a preset rule.

12、 The method according to claim 9, wherein the message 4 includes:

A set of wireless resources allocated to the corresponding first UE or second UE.

13、 The method according to claim 8, wherein after the first UE and/or the second UE receives the message 4 sent by the eNB, further comprising: the first UE and/or the second UE sending the eNB an indication signal for notifying the eNB of successful access of the first UE and/or the second UE.

14、 The method according to claim 13, wherein the indication signal is a scheduling request (SR) or an acknowledgment (ACK) signal.

15. The method according to claim 8, characterized in that after the first UE and/or the second UE receive the message 4 sent by the eNB, further comprising:

The first UE and/or the second UE receives instruction information sent by the eNB for instructing the first UE and/or the second UE to re-initiate random access.

16、 The method according to claim 1, wherein before the first UE in the UE group sends a preamble on a time-frequency resource, further comprising:

The first UE and/or the second UE receives DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, the first UE receives random access request information sent by the second UE.

17、 The method according to claim 16, wherein the first UE and/or the second UE receive the DCI or paging message or RRC signaling sent by the eNB, including at least one of the following:

The DCI, or the CRC that schedules the DCI of the paging message or RRC message, uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identity of the first UE and/or the second UE, or

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

18. The method according to claim 16, wherein the first UE receives the random access request information sent by the second UE, comprising:

The first UE counts the received random access requests of the second UE in the group;

When the count reaches a preset threshold, the first UE sends a preamble on a time-frequency resource.

19、 The method according to claim 1, wherein the first UE in the UE group sends a preamble on a time-frequency resource, specifically comprising:

The first UE periodically sends a preamble on a frequency domain resource.

20、 The method according to claim 8, wherein the message 3 and the message 4 include a group identifier of the UE group or a preset field.

21. The method according to claim 7, wherein the message 3 includes the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset number of UEs.

22、 The method according to claim 3, wherein the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs in the UE group corresponds to the number of UEs included or a preset number of UEs.

23、 A random access method, characterized in that the method comprises:

The evolved base station eNB receives a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein, the first UE is at least one UE in the UE group;

The eNB sends the random access response RAR corresponding to the preamble。

24、 The method according to claim 23, wherein the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used for the first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself from the at least one TC-RNTI and/or uplink grant according to the preset allocation rule according to its own identity, and the second UE is the entire UE group or part of the UEs in the UE.

25、 The method according to claim 23, wherein the RAR includes a TC-RNTI and/or an uplink grant assigned to the corresponding first UE/or second UE, and the second UE is the all or part of UEs in the UE group.

26、 The method according to claim 24, wherein after the eNB sends the RAR corresponding to the preamble, the method further comprises:

The eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

27、 The method according to claim 26, wherein after the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself, the method further comprises:

The eNB sends message 4 to the first UE and/or the second UE.

28、 The method according to claim 27, wherein the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

29、 The method according to claim 28, wherein the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determine allocation according to the at least one set of radio resources included in the message 4 to its own radio resources.

30、 The method according to claim 28, wherein the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

31、 The method according to claim 27, wherein after the eNB sends message 4 to the first UE and/or the second UE, the method further comprises:

The eNB receives an indication signal sent by the first UE and/or the second UE for notifying the eNB that the first UE and/or the second UE have been successfully accessed; the indication signal is a scheduling request SR or acknowledge ACK signal.

32、 The method according to claim 27, wherein after the eNB sends message 4 to the first UE and/or the second UE, the method further comprises:

The eNB sends to the first UE and/or the second UE a message indicating that the first UE and/or

The second UE re-initiates the random access indication information.

33、 The method according to claim 23, wherein before the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, the method further comprises:

The eNB sends DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

34、 The method according to claim 33, wherein the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC of the DCI that schedules the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message contains the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identity of the first UE and/or the second UE, or

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

35、 The method according to claim 23, wherein the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, specifically comprising:

The eNB periodically receives a preamble sent by the first UE on a frequency domain resource.

36. The method according to claim 24, wherein the message 3 and message 4 contain the group identifier of the UE group or a preset field.

37、 The method according to claim 23, wherein the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

38、 A user equipment UE, characterized in that the UE includes: a sending unit and a monitoring unit; wherein,

The sending unit is configured to send a preamble to the evolved base station eNB on a time-frequency resource;

The monitoring unit is configured to monitor the random access response RAR corresponding to the preamble sent by the eNB。

39、 The UE according to claim 38, wherein the monitoring unit includes: a first descrambling subunit, a first receiving subunit, and an allocating subunit, wherein,

The first descrambling subunit is configured to unscramble the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset wireless network temporary identifier RA-RNTI corresponding to the preamble;

The first receiving subunit is configured to receive the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant;

The allocating subunit is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

40. The UE according to claim 39, wherein the allocating subunit is configured to determine the TC-RNTI and/or uplink RNTI allocated to the UE according to a preset rule according to the identity of the UE itself authorized.

41. The UE according to claim 38, wherein the monitoring unit comprises: a determining subunit, a second descrambling subunit and a second receiving subunit, wherein,

The determining subunit is configured to determine the RA-RNTI corresponding to each of the UEs according to their respective identities and/or preambles;

The second descrambling subunit is configured to unscramble the CRC of the DCI scheduling the 20 RARs according to the respective RA-RNTIs corresponding to the UEs;

The second receiving subunit is configured to receive a RAR corresponding to the UE itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the UE.

42. The UE according to claim 39, wherein the sending unit is further configured to send the message 3 according to the uplink grant allocated to the UE itself.

43. The UE according to claim 39, wherein the UE further comprises a receiving unit configured to receive the message 4 sent by the eNB.

44. The UE according to claim 43, wherein the message 4 includes:

The CRC of the DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

45. The UE according to claim 44, wherein the message 4 includes at least one set of radio resources for the UE to determine to allocate to itself.

46、 The UE according to claim 44, wherein the message 4 includes: a set of radio resources allocated to the corresponding UE.

47、 The UE according to claim 43, wherein the sending unit is further configured to send an indication signal for notifying the eNB that the UE has successfully accessed to the eNB.

48、 The UE according to claim 47, wherein the indication signal is a scheduling request (SR) or an acknowledgment (ACK) signal.

49、 The UE according to claim 43, wherein the receiving unit is further configured to receive indication information sent by the eNB for instructing the UE to re-initiate random access.

50. The UE according to claim 38, characterized in that, the UE further comprises a receiving unit configured to receive DCI or paging message or radio resource control RRC signaling sent by the eNB; or, receive the random access request information sent by the second UE.

51. The UE according to claim 50, wherein the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE, or the DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or preamble frequency domain resources.

52. The UE according to claim 38, wherein the sending unit is configured to periodically send a preamble on a frequency domain resource.

53. The UE according to claim 43, wherein the message 3 and the message 4 contain the group identifier of the UE group or a preset field.

54. The UE according to claim 42, wherein the message 3 includes the number of UEs in the UE group having random access requests or the number of UEs included in the UE group or a preset number of UEs.

55. The UE according to claim 38, wherein the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group corresponding to the number of UEs or a preset number of UEs.

56、 An evolved base station eNB, characterized in that the eNB includes: a receiving unit and a sending unit, wherein,

The receiving unit is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein the first UE is at least one UE in the UE group; the sending unit is used to send a random access response RAR corresponding to the preamble.

57、 The eNB according to claim 56, wherein the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used by the first UE and/or the second UE to determine the TC-RNTI and/or uplink grant assigned to itself from the at least one TC-RNTI and/or uplink grant according to its own identity according to preset rules, and the second UE is all or part of the UE.

58、 The eNB according to claim 56, wherein the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is the all or part of UEs in the UE group.

59、 The eNB according to claim 57, wherein the receiving unit is further configured to receive the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

60、 The eNB according to claim 59, wherein the sending unit is further configured to send message 4 to the first UE and/or the second UE.

61. The eNB according to claim 59, wherein the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the

scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

62. The eNB according to claim 61, wherein the message 4 includes at least one set of radio resources for the first UE and/or the second UE to determine to allocate to itself.

63. The eNB according to claim 61, wherein the message 4 includes: a set of radio resources allocated to the corresponding first UE or second UE.

64、 The eNB according to claim 60, wherein the receiving unit is further configured to receive a message sent by the first UE and/or the second UE for notifying the eNB of the first UE and/or an indication signal of successful access by the second UE; the indication signal is a scheduling request SR or an acknowledgment ACK signal.

65、 The eNB according to claim 60, wherein the sending unit is further configured to send to the first UE and/or the second UE a message for instructing the first UE and/or the second UE to re-initiate random access indication information.

66、 The eNB according to claim 56, wherein the sending unit is further configured to send DCI or a paging message or radio resource control (RRC) signaling to the first UE and/or the second UE.

67、 The method according to claim 66, wherein the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identity of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

68. The method according to claim 56, wherein the receiving unit is specifically configured to: periodically receive a preamble sent by the first UE on a frequency domain resource.

69、 The eNB according to claim 57, wherein the message 3 and the message 4 include the group identifier of the UE group or a preset field.

70、 The eNB according to claim 56, wherein the message 3 includes the number of UEs in the UE group having random access requests or the number of UEs included in the UE group.

71、 A random access system, characterized in that the system includes user equipment UE and evolved base station eNB; wherein,

The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group;

The eNB is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

And, send the RAR corresponding to the preamble.

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Manual

A random access method, device and system

Technical Field

This invention relates to the field of wireless communication, in particular to a random access method, device and system.

Technical Background

Machine Type Communication (MTC) User Equipment (referred to as User Equipment or Terminal), also known as Machine to Machine (M2M) user communication equipment, is currently the main application form of the Internet of Things .

In recent years, more and more mobile operators choose Long Term Evolution or Long Term Evolution Advance LTE/LTEA due to the high spectral efficiency of the long-term evolution advanced long-term evolution system. LTEA is the evolution direction of the broadband wireless communication system. MTC multi-type data services based on LTE/LTE-A will also be more attractive.

In the LTE system, random access is a basic function. Only after the UE is synchronized with the uplink of the system through the random access process, can it be scheduled by the system for uplink transmission. There are two types of random access in LTE: contention-based random access and contention-free random access.

The initial random access process is a contention-based access process, which can be divided into four steps.

(1) The UE sends the preamble, and the UE randomly selects an available preamble to send.

(2) The eNB sends a Random access Response (RAR, Random access Response). When the eNB detects the preamble sent by the UE, it will send a response on the downlink synchronization channel (DL-SCH, DownLink-Synchronization Channel), including: the index number of the detected preamble, time adjustment information for uplink synchronization , initial uplink resource allocation (for sending the subsequent message 3), and a temporary cell radio

network temporary identity (TC-RNTI, Temporary Cell Radio Network Temporary Identity). This TC-RNTI will be used in step 4 (conflict resolution) to decide whether to convert to a permanent C-RNTI. UE needs to use a random access radio network temporary identifier RA-RNTI (Random access RNTI) on the PDCCH to monitor the RAR message.

RA-RNTI=I +t_id+10*f_id,

Wherein, t_id refers to the first subframe index number of the PRACH that sends the preamble (0<=t id<10), f_id is the PRACH index in this subframe, that is, the frequency domain position index, (0=<f_id<=6), but for the FDD system, there is only one frequency domain position, so f id is always zero.

(3) UE sends message 3. The UE receives the RAR message and obtains uplink time synchronization and uplink resources. However, it cannot be determined at this time that the RAR message is sent to the UE itself rather than to other UEs. Since the UE's preamble is randomly selected from public resources, there is a possibility that different UEs may send the same access preamble on the same time and frequency resources, so that the same RA-RNTI receives the same RAR and the UE has no way of knowing whether other UEs are using the same resource for random access. For this reason, the UE needs to resolve such random access conflicts through subsequent messages 3 and 4.

(4) The eNB sends message 4, which is a conflict resolution message. If in media access control. Within the time limit of the conflict resolution timer (mac-ContentionResolutionTimer), the UE receives the message 4 returned by the eNB, and the UE ID carried in it matches the one reported to the eNB in the message 3, then the UE considers itself to have won the random access conflict, and random access succeeds. And set the temporary C-RNTI obtained in the RAR message as its own C-RNTI, otherwise, the UE considers that the access fails, and performs the random access re-transmission process according to the above-mentioned rules.

For contention-free random access, the preamble sent by the UE is notified by the eNB, and the uplink synchronization is completed through the first two steps, and there is no conflict resolution process.

Communication requirements for massive machines and equipment in the future: random access concurrent transmission blocking rate <0%, and access density of not less than 10 UEs per square meter within Is-10S. Then in a small cell,

at least tens of thousands of users are connected within Is-10S. In order to meet this requirement, according to the existing random access method, even if the UE accesses uniformly and each subframe can initiate random access, at least hundreds of times the current physical random access channel (PRACH, Physical Random access Channel) resources are needed. However, in an actual situation, UEs are not uniformly accessed, so the number of required resources may be more. In the existing LTE system, for a 20M bandwidth system, if a time-frequency resource accommodates 64 cyclic shifts of a preamble root sequence, even if the entire bandwidth is used to send PRACH, it is not enough.

Contents of the invention

In order to solve the existing technical problems, the embodiments of this invention expect to provide a random access method, device and system, which can save PRACH resources and meet the needs of massive machine communication.

In order to achieve the above object, technical solution of this invention is achieved in that way:

In a first aspect, an embodiment of this invention provides a random access method, the method including:

The first UE in the user equipment UE group sends a preamble to the advanced base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all UEs in the UE group.

In the above scheme, the first UE is at least one of the following:

Comprised of at least one UE; or,

At least one UE determined according to preset rules; or,

At least one UE notified by the eNB.

In the above scheme, the preamble and/or the time domain resource and/or the frequency domain resource are preset, or determined by the group identifier of the UE group, or notified by the eNB.

In the above scheme, the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, including:

The first UE and/or the second UE unscrambles the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset radio network temporary identifier RA-RNTI corresponding to the preamble, and receives the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization;

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

In the above scheme, the first UE and/or the second UE determine the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant contained in the RAR, specifically including:

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to the first UE and/or the second UE according to a preset rule according to its own identity.

In the above scheme, the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, including:

The first UE and/or the second UE determines their respective corresponding RA-RNTIs according to their respective identities and/or preambles, and unscramble the CRC of the DCI that schedules the RAR according to the respective corresponding RA-RNTIs, and receives the RAR corresponding to itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE or second UE.

In the above scheme, after the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, the method further includes: the first UE and/or the second UE according to the Its own uplink authorization sends message 3.

In the above scheme, after the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself, it further includes:

The first UE and/or the second UE receives message 4 sent by the eNB.

In the above scheme, the first UE and/or the second UE receiving the message 4 sent by the eNB including: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

In the above scheme, the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determines the radio resource allocated to itself according to the set of at least one radio resources included in the message 4.

In the above scheme, the first UE and/or the second UE determines radio resources allocated to itself according to at least one set of radio resources included in the message 4, and further includes:

The UE also determines radio resources allocated to itself according to its own identity according to a preset rule.

In the above scheme, the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

In the above scheme, after the first UE and/or the second UE receive the message 4 sent by the eNB, it further includes: the first UE and/or the second UE sends to the eNB for notifying the eNB of an indication signal of successful access by the first UE and/or the second UE.

In the above scheme, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, after the first UE and/or the second UE receive the message 4 sent by the eNB, it further includes:

The first UE and/or the second UE receives indication information sent by the eNB for instructing the first UE and/or the second UE to re-initiate random access.

In the above scheme, before the first UE in the UE group sends a preamble on a time-frequency resource, it further includes:

The first UE and/or the second UE receives the DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, the first UE receives random access request information sent by the second UE.

In the above scheme, the first UE and/or the second UE receive the DCI or paging message or RRC signaling sent by the eNB, including at least one of the following:

The DCI, or the CRC of the DCI that schedules the paging message or the RRC message, is scrambled using the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the first UE receives the random access request information sent by the second UE, including:

The first UE counts the received random access requests of the second UE in the group;

When the count reaches a preset threshold, the first UE sends a preamble on a time-frequency resource.

In the above scheme, one in the UE group sends a preamble on one time-frequency resource, which specifically includes:

The first UE periodically sends a preamble on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

In the above scheme, the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset corresponding to the number of UEs.

In a second aspect, an embodiment of this invention provides a random access method, the method including:

The evolved base station eNB receives a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein, the first UE is at least one UE in the UE group;

The eNB sends a random access response RAR corresponding to the preamble.

In the above scheme, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used for the first UE and/or the second UE to determine the TC-RNTI and/or

the TC-RNTI allocated to itself from the at least one TC-RNTI and/or uplink grant according to its own identity and according to a preset allocation rule or uplink grant, the second UE is all or part of UEs in the UE group.

In the above scheme, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is all or part of the UE group UE.

In the above scheme, after the eNB sends the RAR corresponding to the preamble, the method further includes:

The eNB receives message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

In the above scheme, after the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself, the method further includes:

The eNB sends message 4 to the first UE and/or the second UE.

In the above scheme, the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI scheduling the message 4 is added using the TC-RNTI allocated to the first UE and/or the second UE disturb.

In the above scheme, the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determines the radio resources allocated to itself according to the at least one set of radio resources included in the message 4 .

In the above scheme, the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

In the above scheme, after the eNB sends message 4 to the first UE and/or the second UE,

The method also includes:

The eNB receives an indication signal sent by the first UE and/or the second UE for notifying the eNB that the first UE and/or the second UE have been successfully accessed; the indication signal is a scheduling request SR or acknowledge ACK signal.

In the above scheme, after the eNB sends message 4 to the first UE and/or the second UE, the method further includes:

The eNB sends indication information for instructing the first UE and/or the second UE to re-initiate random access to the first UE and/or the second UE.

In the above scheme, before the eNB receives the preamble sent by the first UE in the user equipment UE group on a time-frequency resource, the method further includes:

The eNB sends DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

In the above scheme, the DCI or paging message or RRC signaling includes at least one of the following forms

The DCI, or the CRC of the DCI that schedules the paging message or the RRC message, uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, specifically including:

The eNB periodically receives a preamble sent by the first UE on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

In a third aspect, an embodiment of this invention provides a user equipment UE, where the UE includes: a sending unit and a monitoring unit; wherein,

The sending unit is configured to send a preamble to the evolved base station eNB on a time-frequency resource; the monitoring unit is configured to monitor the random access response RAR corresponding to the preamble sent by the eNB。

In the above scheme, the monitoring unit includes: a first descrambling subunit, a first receiving subunit and an allocating subunit, wherein,

The first descrambling subunit is configured to unscramble the cyclic redundancy check code CRC of the downlink control information DCI that schedules

the RAR according to the preset radio network temporary identifier RA-RNTI corresponding to the preamble;

The first receiving subunit is configured to receive the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant;

The allocating subunit is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

In the system proposed above, the allocating subunit is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to a preset rule according to the UE's own identity.

In the system proposed above, the monitoring unit includes: a determining subunit, a second descrambling subunit and a second receiving subunit, wherein,

The determining subunit is configured to determine the RA-RNTI corresponding to each of the UEs according to their respective identities and/or preambles;

The second descrambling subunit is configured to unscramble the CRC of the DCI that schedules the RAR according to the respective RA-RNTIs corresponding to the UEs;

The second receiving subunit is configured to receive a RAR corresponding to the UE itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the UE.

In the system proposed above, the sending unit is further configured to send message 3 according to the uplink grant allocated to the UE itself.

In the system proposed above, the UE further includes: a receiving unit configured to receive the message 4 sent by the eNB.

In the above scheme, the message 4 includes:

The CRC of the DCI of the scheduling message 4 is scrambled using the TC-RNTI allocated to the first UE and/or the second UE.

In the above scheme, the message 4 includes at least one set of radio resources for the UE to determine to allocate to itself.

In the above scheme, the message 4 includes: a set of radio resources allocated to the corresponding UE.

In the above scheme, the sending unit is further configured to send to the eNB an indication signal for notifying the eNB that the UE has successfully accessed.

In the above scheme, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, the receiving unit is further configured to receive instruction information sent by the eNB for instructing the UE to re-initiate random access.

In the above scheme, the UE further includes a receiving unit, configured to receive DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, receiving the random access request sent by the second UE from 。

In the above scheme, the DCI or paging message or RRC signaling, including at least one of the following: DCI, or the CRC of the DCI scheduling the paging message or RRC message is scrambled using the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the sending unit is configured to periodically send a preamble on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

In the above scheme, the preamble and/or time domain resources and/or frequency domain resources correspond to the number of UEs with random access

requests in the UE group or the number of UEs included in the UE group or a preset number of UEs.

In a fourth aspect, an embodiment of this invention provides an evolved base station eNB, where the eNB includes: a receiving unit and a sending unit, wherein,

The receiving unit is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein the first UE is at least one UE in the UE group;

The sending unit is configured to send a random access response RAR corresponding to the preamble。

In the above scheme, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the set rule determines the TC-RNTI and/or uplink grant allocated to itself from the at least one TC-RNTI and/or uplink grant, and the second UE is all or part of UEs in the UE group.

In the above scheme, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is all or part of UEs in the UE group .

In the above scheme, the receiving unit is further configured to receive the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

In the above scheme, the sending unit is further configured to send message 4 to the first UE and/or the second UE.

In the above scheme, the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by the TC-RNTI allocated to the first UE and/or the second UE.

In the above scheme, the message 4 includes at least one set of radio resources for the first UE and/or the second UE to determine to allocate to itself.

In the above scheme, the message 4 includes: a set of radio resources allocated to the corresponding first UE or second UE.

In the above scheme, the receiving unit is further configured to receive a message sent by the first UE and/or the second UE for notifying the eNB that the

first UE and/or the second UE have successfully accessed an indication signal; the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, the sending unit is further configured to send instruction information for instructing the first UE and/or the second UE to re-initiate random access to the first UE and/or the second UE.

In the above scheme, the sending unit is further configured to send DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

In the above scheme, the DCI or the paging message or RRC signaling includes at least one of the following: the CRC of the DCI or the DCI scheduling the paging message or RRC message is added with the group identity of the UE group disturb; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the receiving unit is specifically configured to: periodically receive a preamble sent by the first UE on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

In a fifth aspect, an embodiment of this invention provides a random access system, the system includes a user equipment UE and an evolved base station eNB; wherein,

The first UE in the user equipment UE group sends a preamble to the advanced base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group;

The eNB is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

And, send the RAR corresponding to the preamble。

In the random access method, device and system provided by the embodiments of this invention, one or more UEs in the user equipment UE group send a preamble to the evolved base station eNB on a time-frequency resource to instruct the eNB to perform UE Random access processing of some or all UEs in the group. in this way,

A group of UEs only need to occupy one PRACH resource (including time-domain resources, frequency-domain resources and preamble) in one random access. In this way, PRACH resources can be greatly saved to meet the needs of a huge number of machine communications.

Image Descriptions

FIG. 1 is a schematic flowchart of a random access method provided by an embodiment of this invention;

FIG. 2 is a schematic flowchart of another random access method provided by an embodiment of this invention;

FIG. 3 is a schematic diagram of a non-contention-based random access method provided by an embodiment of this invention;

FIG. 4 is a schematic diagram of a method for sending a paging message by an eNB to trigger a UE group access provided by an embodiment of this invention;

FIG. 5 is a schematic structural diagram of a UE provided by an embodiment of this invention;

FIG. 6 is a schematic structural diagram of another UE provided by an embodiment of this invention;

FIG. 7 is a schematic structural diagram of another UE provided by an embodiment of this invention;

FIG. 8 is a schematic structural diagram of an eNB provided by an embodiment of this invention.

Detailed Descriptions

The technical schemes in the embodiments of this invention will be clearly and completely described below in conjunction with the drawings of the embodiments of this invention.

Embodiment 1

Referring to FIG. 1, it shows a flow of a random access method provided by an embodiment of this invention. The method can be applied to the user equipment UE side, and the method can include:

S101: The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

S102: The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB.

Wherein, the first UE is at least one UE in the UE group, and the first UE can be a representative of the UE group; and the second UE can be all or part of the UE in the UE group, that is, it has random access to the requesting UE, therefore, the first UE may be included in the second UE.

It should be noted that the first UE may be at least one of the following:

Comprised of at least one UE; or,

At least one UE determined according to preset rules; or,

At least one UE notified by the eNB.

Moreover, the preamble and/or the time domain resource and/or frequency domain resource may be preset, or determined by the group identifier of the UE group, or notified by the eNB.

Optionally, the first UE and/or the second UE in the UE group monitors the RAR corresponding to the preamble sent by the eNB, which may include:

The first UE and/or the second UE schedules the cyclic redundancy check of downlink control information (DCI, Downlink Control Information) of the RAR according to the preset wireless network temporary identifier RA-RNTI corresponding to the preamble Code (CRC, Cyclic Redundancy Check) for unscrambling, and receive the RAR; wherein, the RAR includes at least one

temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant; and,

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant contained in the RAR; specifically, the first UE and/or the second UE may determine the TC-RNTI and/or uplink grant allocated to the first UE and/or the second UE according to a preset rule according to its own identity.

Optionally, the first UE and/or the second UE in the UE group monitors the RAR corresponding to the preamble sent by the eNB, which may include:

The first UE and/or the second UE determine their respective corresponding RA-RNTIs according to their respective identities and/or preambles, and unscramble the CRC of the DCI that schedules the RAR according to the respective corresponding RA-RNTIs, and receives the RAR corresponding to itself. The RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE or second UE.

For example, after the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, this embodiment may further include: the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself.

Further, after the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself, this embodiment may further include: the first UE and/or the second UE receives the message 4 sent by the eNB.

It should be noted that receiving the message 4 sent by the eNB by the first UE and/or the second UE includes: scheduling the CRC of the DCI of the message 4 using the TC-RNTI allocated to the first UE and/or the second UE Do scrambling.

Specifically, the message 4 may include at least one set of radio resources, and the first UE and/or the second UE determines the radio resources allocated to itself according to the at least one set of radio resources included in the message 4; in detail,

the UE may also determine the radio resource allocated to itself from message 4 according to its own identity according to a preset rule.

Specifically, the message 4 may also include a set of radio resources allocated to the corresponding first UE or second UE.

Optionally, after the first UE and/or the second UE receive the message 4 sent by the eNB, this embodiment may further include: the first UE and/or the second UE send to the eNB for notifying the eNB with an indication signal of successful access by the first UE and/or the second UE; wherein, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

Optionally, after the first UE and/or the second UE receive the message 4 sent by the eNB, this embodiment may further include: the first UE and/or the second UE receive the message sent by the eNB indicating that the first UE and/or a second UE re-initiate random access indication information.

For example, before the first UE in the UE group sends a preamble on a time-frequency resource, this embodiment may further include:

The first UE and/or the second UE receives the DCI or paging message sent by the eNB or

Radio resource control RRC signaling;

Or, the first UE receives random access request information sent by the second UE.

Further, the first UE and/or the second UE receive the DCI or paging message or RRC signaling sent by the eNB, including at least one of the following:

The DCI, or the CRC of the DCI that schedules the paging message or the RRC message, is scrambled using the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

Further, the first UE receives the random access request information sent by the second UE, including:

The first UE counts the received random access requests of the second UE in the group;

When the count reaches a preset threshold, the first UE sends a preamble on a time-frequency resource.

For example, the first UE in the UE group sends a preamble on a time-frequency resource, which may specifically include: the first UE periodically sends a preamble on a frequency domain resource.

It should be noted that, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In addition, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

Further, the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset UE corresponding to the number.

This embodiment provides a random access method. The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource, and then the first UE and/or the second UE in the UE group monitor the random access response RAR corresponding to the preamble sent by the eNB, and complete uplink authorization and resource allocation, so that a group of UEs only need to occupy one PRACH resource (including time domain resources, frequency domain resources and preamble) in a random access. In this way, PRACH resources can be greatly saved to meet the needs of a huge number of machine communications.

Embodiment 2

Referring to FIG. 2, it shows a flow of a random access method provided by an embodiment of this invention. The method can be applied to the eNB side, and the method can include:

S201: The eNB receives a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

S202: The eNB sends a random access response RAR corresponding to the preamble.

Optionally, the RAR may include at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR may be used for the first UE and/or the second UE to determine the TC-RNTI

and/or allocated to itself from the at least one TC-RNTI and/or uplink grant according to its own identity and according to preset rules Uplink Authorization.

Optionally, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE.

It should be noted that the first UE described in S201 to S202 above is at least one UE in the UE group, and the first UE can be a representative of the UE group; and the second UE can be all or part of UEs in the UE group, that is, UEs with a random access request, therefore, the first UE may be included in the second UE.

Further, after the eNB sends the RAR corresponding to the preamble, this embodiment may further include: the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

Moreover, after the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself, this embodiment may further include:

The eNB sends a message 4 to the first UE and/or the second UE。

It should be noted that the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

Specifically, the message 4 may include at least one set of radio resources, and the first UE and/or the second UE determines the radio resources allocated to itself according to the at least one set of radio resources included in the message 4 .

Alternatively, the message 4 may also include a set of radio resources allocated to the corresponding first UE or second UE.

Further, after the eNB sends the message 4 to the first UE and/or the second UE, this embodiment may further include: the eNB receives the message sent by the first UE and/or the second UE for sending the message to the eNB informing the first UE and/or the second UE of an indication signal of successful access; wherein the indication signal is a scheduling request SR or an acknowledgment ACK signal.

Alternatively, after the eNB sends message 4 to the first UE and/or the second UE, this embodiment may further include: the eNB sends to the first UE and/or the

second UE a message indicating that the first UE and the /or the second UE re-initiates the random access indication information.

For example, before the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, this embodiment may further include:

The eNB sends DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

Further, the DCI or paging message or RRC signaling includes at least one of the following:

The DCI, or the CRC that schedules the DCI of the paging message or RRC message, uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

Specifically, the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, specifically including:

The eNB periodically receives a preamble sent by the first UE on a frequency domain resource. It should be noted that the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In addition, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

This embodiment provides a random access method such that after receiving the preamble sent by the first UE in the UE group on a time-frequency resource, the eNB sends the random access response RAR corresponding to the preamble, so that the UE completes the uplink authorization and resource allocation, so that a group of UEs only need to occupy one PRACH resource (including time-domain resources, frequency-domain resources and preamble) in a random access. In this way, PRACH resources can be greatly saved to meet the requirements of a huge number of machine communications need.

Embodiment 3

Based on the same technical concept of the above two embodiments, this embodiment introduces the technical solutions of the above two embodiments in detail through the following four specific examples. It should be noted that the following four examples are only used to implement this invention Those with technical qualifications can combine the technical solutions of these four specific examples as needed without any creative work, and this embodiment of this invention will not repeat them here.

In the following example, multiple (two or more) UEs form a UE group, a group of UEs has a group ID as the group identifier, and each UE has its own ID number within the group, that is, its own identification information. Groups can be formed in one of the following ways:

(1) For a fixed UE installed by an operator or a UE that is relatively close and fixed and has the same service (such as a vehicle, the same compartment of a train or subway), the operator will operate, manage and maintain (OAM, Operation Administration and Maintenance) in the background to configure these UEs as a group;

(2) The network side detects the TA values of all connected terminals, and if the TA values of some terminals remain the same for a period of time, configures these terminals as a group;

(3) Using a positioning system, configure a group of UEs with relatively close positioning distances.

(4) In the case that UEs can communicate with each other, for example, using the discovery technology in D2D, UEs spontaneously form a group. The UE spontaneously forms a group, which is similar to "discovery" in the existing D2D technology. (It can only be used when UEs in the group can communicate).

Example 1

Example 1 provides a non-contention-based random access method, referring to Figure 3, this example includes the following steps:

Step 301: When the UE is in the connected state, the eNB assigns a group identifier or group ID to the UE group, that is, a group Radio Network Temporary Identifier (RNTI, Radio Network Temporary Identifier).

Step 302: eNB notifies UE group to complete uplink synchronization;

The eNB notifies the group of UEs to perform random access to complete uplink synchronization, and the notification signaling may be physical layer signaling or high layer signaling.

The physical layer signaling may be a DCI, and the cyclic redundancy check (CRC, Cyclic Redundancy Check) code uses the group RNTI for scrambling or masking; the method of scrambling or masking can be the way of doing XOR bit by bit, for example, the group RNTI is 16 bits, and the CRC is also 16 bits, XOR is performed between the bits corresponding to the two, and for example, the group RNTI is "0000H010000HH", and the CRC is "1111001111110011", then after scrambling the CRC with this group of RNTI, "1111111011111100" is obtained. Correspondingly, the UE that has received the scrambled CRC performs bit-wise XOR of the scrambled CRC with the group RNTI to obtain the CRC before scrambling;

The high-level signaling may also be RRC signaling, and the high-level signaling may be public information sent to the UE group, or RRC signaling sent to a UE, and the RRC signaling is used to notify the UE For group access, for example, a bit indication is used in the RRC signaling to notify the UE of group access.

Specifically, the notification signaling (DCI or RRC signaling) may only include preamble-related information, for example, include a preamble index information, so that after receiving the notification signaling, the preamble to be sent can be determined according to the preamble-related information, and the time-frequency resource for sending the preamble can be preset, for example, a fixed time-frequency resource preset by the UE group, or a time-frequency resource agreed in advance between the UE group and the eNB; alternatively, the notification signaling may further include time-domain resource information, that is, sending subframe information, which is used to instruct UEs in the UE group to send the preamble on the subframe, so that the notification is received after the signaling, the frequency domain information for sending the preamble may be preset, for example, a fixed frequency domain resource preset by the UE group, or a frequency domain resource agreed in advance between the UE group and the eNB; alternatively, the notification signaling includes preamble related information and a frequency domain resource information, so that after receiving the notification signaling, the subframe information for sending the preamble can be preset, for example, preset by the UE group A fixed time domain resource, or a

time domain resource agreed in advance between the UE group and the eNB; alternatively, the notification signaling may include preamble related information and time-frequency resource information (including time-domain resource information and frequency-domain resource information, and the time-domain resource information is subframe information); alternatively, the notification signaling may not include preamble-related information, time-domain resource information, and frequency-domain resource information, and one or more UEs in the UE group receiving the notification signaling directly send the preamble agreed with the eNB to the eNB through the time-frequency domain resource agreed in advance.

Step 303: One or more UEs in the UE group send a preamble to the eNB on behalf of the UEs in the group.

After receiving the above notification signaling, the UEs in the UE group send a corresponding (notified by eNB, or preset or agreed) preamble on the corresponding (notified by eNB, or preset or agreed) time-frequency resources;

Specifically, the UE sending the preamble is the first UE, which can be one of the following:

(1) One or more fixed UEs;

For example, pre-designate the UE whose number is 0 to send the preamble, or pre-designate the UE with an even number in the UE group to send the preamble, or designate all UEs to send the preamble.

(2) One or part of UEs determined according to preset rules;

For example, the UE sending the preamble is determined according to the number of the UE sending the preamble and the subframe number of the subframe of the received physical layer signaling or high-level signaling; for example, if the received subframe is an odd number, the odd numbered UE sends a preamble, and if an even-numbered subframe is received, the UE with an even number sends a preamble.

(3) One or more UEs specified in the notification signaling sent by the eNB;

In this case, the physical layer signaling or high layer signaling also needs to include the number information of the UE that initiates the random access.

After the UE sends the preamble, all UEs monitor the RAR, and the CRC of the PDCCH that schedules the RAR is scrambled or masked with the RA-RNTI, so the

RA-RNTI can be preset, for example, it is bound to the sending time of the preamble and the frequency domain resources sent (in FDD, just the sending time):

RA-RNTI= 1 + t id+10*f _id

When the time-frequency resources are fixed, the RA-RNTI is also fixed. In this case, all UEs monitor the PDCCH scrambled by the RA-RNTI to obtain the RAR。

Alternatively, the time-frequency resource may not be fixed, for example, the frequency domain resource may be fixed, but the time domain resource may not be fixed. This situation may only occur when there is only one UE that sends the preamble. At this time, the UE that sends the preamble monitors the PDCCH scrambled by the RA-RNTI obtained by calculating the transmitted time-frequency resources, and other UEs need to monitor multiple PDCCHs scrambled by the RA-RNTI obtained by calculating all possible time-frequency resources.

After the UE monitors the PDCCH scrambled by the RA-RNTI, it receives the PDSCH scheduled by it, and then obtains the TA information.

The random access in the prior technique is independently completed by each UE, however, in this example, a group of UEs only occupy one PRACH resource (including time domain resources, frequency domain resources and preamble) in one random access, thus greatly saving PRACH resources.

Example 2

A method for triggering a UE group access by sending a paging message by an eNB is provided, see FIG. 4, the example includes the following steps:

Step 401: the eNB sends a paging message to the UE group;

Specifically, the paging message is used to wake up all or part of UEs in the idle state in the UE group to perform random access.

The paging message includes at least one of the following:

(1) Group ID. The group ID may be included in the paging message, or the CRC of the PDCCH scheduling the paging message may be scrambled by using the group ID.

(2) The number of the UE that initiates random access, that is, UE-ID.

(3) The preamble ID can also be preset without notification.

(4) Time domain and/or frequency domain resources may also be preset without notification, or time domain resources are preset, and frequency domain

resources are notified, or frequency domain resources are preset, and time domain resources are notified.

(5) The number (UE-ID) of some UEs in the group, this information will only be included when some UEs are awakened to perform random access.

When the above paging message does not include the number of the UE initiating random access, that is, UE-ID, the UE initiating random access may be determined in the following manner:

a、 One or more UEs in the specified UE group initiate random access, for example, the UE with a predefined number 0 sends a preamble, or the UE with a predefined even number sends a preamble, or all UEs.

b、 One or more UEs determined according to a certain rule to initiate random access, for example, determine the one that initiates random access according to the corresponding relationship between the number of the UE that sent the preamble and the subframe that received the physical layer signaling or high-level signaling or multiple UEs; for example, if an odd-numbered subframe is received, the odd-numbered UE sends a preamble, and if it is an even-numbered subframe, the even-numbered UE sends a preamble;

It should be noted that the one or more UEs that initiate the random access determined in the above manner may be the same as or different from the UEs that the eNB requires to wake up, and such differences include: some or all of them are different.

Step 402: After receiving the paging message, UEs in the UE group perform random access; specifically, random access can be achieved in the following three ways:

Method 1:

Step 1: The one or more UEs that initiate random access send a preamble on the time-frequency resource.

Step 2: After receiving the preamble, eNB sends a RAR, which carries TA and at least one of the following information:

(1) TC-RNTI information;

Specifically, the TC-RNTI information may include M TC-RNTIs, where M is the number of UEs in the group, or the number of UEs that need to be woken up, or a preset value; the M TCs - RNTI can be in the form of an absolute value, that is, a 16-

bit C-RNTI, or an absolute value of one C-RNTI and a relative value of M-l C-RNTIs relative to the absolute value, all UEs or some UEs in the group that need to be woken up correspond to different TC-RNTIs according to preset rules, for example, corresponding to UE-ID in order from small to large, or randomly corresponding; or,

The TC-RNTI information may be a TC-RNTI, and all UEs or some UEs in the group correspond to TC-RNTI, TC-RNTI+1, TC-RNTI+2, and TC-RNTI+..., M-I according to preset rules, for example, according to the UE-IDs corresponding in ascending order, or randomly.

(2) Uplink authorization (UL grant, UpLink grant) information;

For example, the grant information may be M independent UL grant information, or one UL grant information including M scheduling information; all UEs or some UEs in the group correspond to different UL grant information according to preset rules; for example , corresponding to UE-ID in ascending order, or randomly; or,

The UL grant information may be a UL grant, and all UEs or some UEs in the group that need to be awakened correspond to the UL grant assigned to them according to preset rules; for example, assuming that the resources in the UL grant are allocated as physical resource bearers (PRB, Physical Resource Bearer) #0-3, each UE determines the resources allocated to the UE according to its own number, for example, UE #1 corresponds to PRB #4-7, or corresponds randomly, and other UE information, such as modulation and coding strategy (MCS, Modulation and Coding Scheme), etc. are the same as those in the UL grant。

Alternatively, in step 2, the eNB may also send M RARs.

Wherein, each RAR uses a different RA-RNTI for scrambling. The UE determines an RA-RNTI to unscramble the CRC of the DCI according to its own number (UE-ID) and preset rules, and receives the corresponding RAR 0 For example, the RA-RNTI of the UE whose UE-ID is UE 0 is determined according to the time-frequency resource for sending the preamble, and UE 1, UE 2 to UE n respectively correspond to RA-RNTI+1, RA-RNTI+2 to RA-RNTI+n in turn; Alternatively, UEs with different numbers may also correspond to RA-RNTI+1, the RA-RNTI+2, ... any one of RA-RNTI+n.

Step 3: All or some UEs in the group (all or some UEs refer to all or some UEs that the eNB requires to be woken up) respectively send Msg 3 on resources corresponding to their own UL grant.

Step 4: For the Msg 3 sent in Step 3, the eNB sends Msg 4 respectively.

It should be noted that the reception of RAR is more important in this method; in order to avoid the UE missing RAR detection, the RAR can be resent within a window。

In the case that some UEs fail to receive the RAR, the eNB may resend the paging message to notify these UEs to access.

Method 2:

Step 1: The one or more UEs that initiate random access send a preamble on the time-frequency resource.

Step 2: After receiving the preamble, eNB sends RAR, which carries a TA information, a TC-RNTI and a UL grant in the RAR.

Step 3: All or some UEs in the group (all or some UEs refer to all or some UEs that the eNB requires to wake up) monitor the RAR to obtain TA and TC-RNTI.

Step 4: One or more UEs send Msg 3, where the one or more UEs may be the one or more UEs that sent the preamble in step 1 or a preset UE among the multiple UEs (for example, the UEID with the smallest value), the sent Msg 3 carries a group ID or a preset value, and the preset value is commonly known by UEs in the group.

Step 5: The eNB sends Msg 4, which carries the group ID. Msg 4 is scrambled with the above-mentioned TC-RNTI. The Msg 4 may also include M-1 C-RNTIs, or may not include them. For the case where M-1 C-RNTIs are included in Msg4, all or some UEs in the group (all or some UEs refer to all or some UEs that the eNB requires to wake up) can choose a TC-RNTI as its own C-RNTI according to its own group number; for example, the UE numbered UE 5 corresponds to the fifth TC-RNTI; or, the UE can also randomly select a TC-RNTI as its own C-RNTI; if Msg 4 does not contain a TC-RNTI, all UEs in the group or some UEs can calculate a C-RNTI according to the preset formula according to their own group numbers as their own C-RNTI. For example, if the number is UE 5, then add 5 to the TC-RNTI of the CRC of the DCI corresponding to the scrambling scheduling Msg 4; or, the UE may also randomly select one from the TC-RNTI to the TC-RNTI+M-I. Further, the Msg 4 may also include one or M pieces of radio resource configuration information, such as CQI feedback resources, SR resources and so on.

For the case where Msg 4 includes M radio resource configuration information, all UEs in the group or some UEs can select a set of radio resource

configuration information as their own radio resource configuration according to their own group numbers. The selection method here can be the same as that of the above TC - RNTI or the selection can be done in a similar manner. For the case where Msg 4 includes 1 radio resource configuration information, all or some UEs in the group can obtain their own radio resource configuration according to their own group numbers according to the preset formula. For example, if the radio resource configuration includes SR configuration, the number A UE may consider its own SR configuration as the SR resource 5; or, a random selection method may be used to determine SR configurations corresponding to different UEs.

In this way, the reception of RAR and Msg 4 is more important. In order to prevent the UE from missing RAR Msg 4, the RAR and Msg 4 can be sent repeatedly within a window.

Method 3

Step 1: The one or more UEs send a preamble on the time-frequency resource.

Step 2: The eNB sends RAR, which carries a TA information, M TC-RNTIs and a UL grant.

All UEs in the group or some UEs (only wake up some UEs for random access) monitor RAR to obtain TA and TC-RNTI.

In the first step, the one or more UEs that send the preamble or a preset UE among the multiple UEs (such as the one with the smallest UE ID) sends Msg 3, carrying a group ID or a preset value.

Step 3: The eNB sends a Msg 4, which carries the group ID or the preset value, and the UE monitors the Msg 4.

Specifically, the eNB can send a Msg 4, which can be obtained by scrambling the TC-RNTI in Msg 3, and contains one or M sets of radio resources (it can also continue to carry multiple TC. RNTI).

The UE determines the C-RNTI and radio resources allocated to itself in a manner similar to that in mode 2a; or,

The eNB sends multiple Msg 4, and the multiple Msg 4 are respectively scrambled with M TC-RNTIs, and the UE selects a TC-RNTI according to its own number or at random, and receives the TC-RNTI scrambled Msg4 scheduled by the DCI.

In the case that some UEs fail to receive the RAR, the eNB may re-page these UEs for access.

Example 3

Example 3 provides a method for a group of UEs to compete for access, and the example includes the following steps:

Step 501: One or more UEs in the UE group periodically send a preamble to the eNB on a time-frequency domain resource, thereby initiating random access to the eNB; the UE sending the preamble may be one of the following: (1) Fixed one or more UEs;

For example, pre-designate the UE whose number is 0 to send the preamble, or pre-designate the UE with an even number in the UE group to send the preamble, or designate all UEs to send the preamble.

(2) One or part of UEs determined according to preset rules;

For example, the UE sending the preamble is determined according to the number of the UE sending the preamble and the subframe number of the subframe of the received physical layer signaling or high-layer signaling; For example, if an odd-numbered subframe is received, the odd-numbered UE sends a preamble, and if an even-numbered subframe is received, the even-numbered UE sends a preamble.

The sending period and the offset of the subframe for sending the preamble can be set in advance according to actual needs, and the set sending period and the offset of the subframe for sending the preamble are known to all UEs in the group.

There may be two situations when initiating random access: one situation is that the services of the UEs in the group are the same, and the whole group must access each access; another situation is that only some UEs in the group need to access each access.

In the latter case, the number of UEs accessed may be random.

Specifically, random access can be implemented in the following three ways:

Method 1:

Step 1: The one or more UEs that initiate random access send a preset preamble on a preset time-frequency resource. The preamble resource has a corresponding relationship with the group ID.

Step 2: After the eNB receives the preamble, the eNB learns that the UE is accessing on behalf of a group of UEs through the PRACH resource (time-frequency resource information or preamble information) sent by the UE; after that, the eNB sends a RAR, which carries TA , and at least one of the following information:

(1) TC-RNTI information;

Specifically, the TC-RNTI information may include M TC-RNTIs, where M is the number of UEs in the group, or the number of UEs that need to initiate random access, or a preset value; Before this step, there is a one-to-one correspondence between the preamble sent by the UE and the time-frequency resources used for sending the preamble and the UE group, and if the eNB knows the information of the UE group in advance, such as the number of UEs in the UE group, then the eNB can determine the UE group that initiates random access through the received preamble and time-frequency resource information, thereby determining the information of the UE group, and thus knowing the number M of UEs of the group of UEs, or M can also be a preset value; In addition, when the UE sends the preamble, it can also carry the number M of UEs in the group, or the number M of UEs in the UE group that need to initiate random access, or carry a preset value M; the M TC-RNTI may be in the form of an absolute value, that is, a 16-bit C-RNTI; or it may be an absolute value of one C-RNTI and a relative value of M-1 C-RNTIs relative to the absolute value. In this way, after receiving the TC-RNTI information, all UEs or some UEs in the UE group that need to initiate random access determine their own TC-RNTI according to preset rules, for example, according to the order of UE-ID from small to large corresponding to different TC-RNTIs, or randomly corresponding to TC-RNTIs; or,

The TC-RNTI information may be a TC-RNTI, and all UEs or some UEs in the group correspond to TC-RNTI, TC-RNTI+1, TC-RNTI+2, ..., and TC-RNTI+M-I according to preset rules, for example, according to the UE-IDs correspond in ascending order, or randomly.

(2) Uplink authorization (UL grant, UpLink grant) information;

For example, the UL grant information may be M independent UL grant information, or one UL grant information including M scheduling information; all UEs or some UEs in the group correspond to different UL grant information

according to preset rules; For example, corresponding to UE-ID in ascending order, or randomly; or,

The UL grant information may be a UL grant, and all UEs or some UEs in the group that need to perform random access are allocated to their own UL grants according to preset rules; for example, assuming that the resource allocation in the UL grant is Physical resource bearer (PRB, Physical Resource Bearer) 0-3, each UE determines the resources allocated to the UE according to its own number, for example, UE 1 corresponds to PRB 4-7, or corresponds randomly, and other UE information, such as modulation and coding strategies (MCS, Modulation and Coding Scheme), etc. are the same as those in UL grant.

Or, in step 2, eNB can also send M RARs.

Wherein, each RAR uses a different RA-RNTI for scrambling. The UE determines an RA-RNTI to unscramble the CRC of the DCI according to its own number (UE-ID) and preset rules, and receives the corresponding RAR 0 For example, the RA-RNTI of the UE whose UE-ID is UE #0 is determined according to the time-frequency resource for sending the preamble, and UE #1, UE #2 to UE#n respectively correspond to RA-RNTI+1, RA-RNTI+2 to RA-RNTI+n in turn; Alternatively, UEs with different numbers may also correspond to RA-RNTI +1, any of the RA-RNTI+2, and RA-RNTI+n.

Step 3: All UEs or some UEs in the UE group ((E) that need to perform random access respectively send Msg 3 on resources corresponding to their own UL grants.

Step 4: The eNB sends Msg 4 respectively according to the received Msg 3, and the number of the Msg 4 sent is the same as the number of the Msg 3 received by the eNB.

In this mode, the reception of the RAR is more important. In order to prevent the UE from missing the RAR detection, it may be considered to repeatedly send the RAR within a window.

If the access fails, the group of UEs can re-initiate access, or access according to the existing method, that is, a single UE initiates random access.

Method 2:

Step 1: The one or more UEs that initiate random access send a preset preamble on a preset time-frequency resource. The preamble resource has a corresponding relationship with the group ID.

Step 2: After the eNB receives the preamble, the eNB learns that the UE is accessing on behalf of a group of UEs through the PRACH resource (time-frequency resource information or preamble information) sent by the UE; after that, the eNB sends a RAR, which carries TA, TC-RNTI and other information 。

Step 3: All UEs in the UE group or some UEs (UEs requiring random access) monitor the RAR to obtain TA and TC-RNTI.

Step 4: One or more UEs send Msg 3, where the one or more UEs can be the one or more UEs that sent the preamble in step 1 or a preset UE among the multiple UEs (for example, the UEID with the smallest value), and the sent Msg 3 carries a group ID.

Step 5: The eNB sends Msg 4, which carries the group ID. The Msg 4 is scrambled by the TC-RNTI. The Msg 4 may also include M-1 C-RNTIs, or may not include them. Further, the Msg 4 may also include one or M pieces of radio resource configuration information, such as CQI feedback resources, SR resources, etc. The UE can determine the C-RNTI allocated to itself and the radio resource configuration information in a manner similar to the manner 2 in the second example.

In this method, the reception of RAR and Msg 4 is more important. In order to prevent the UE from missing detection of RAR and Msg 4, it may be considered to repeatedly send RAR and Msg 4 within a window.

Method 3:

Step 1: The one or more UEs send a preset preamble on a preset time-frequency resource. The preamble resource has a corresponding relationship with the group ID.

Step 2: The eNB learns through the PRACH resource (time-frequency resource information or preamble information) sent by the UE that the UE accesses on behalf of a group of UEs; after that, the eNB sends a RAR, which carries TA, M TC-RNTI and other information.

Step 3: All UEs or some UEs in the group (all UEs or some UEs refer to UEs that need to perform random access) monitor RAR to obtain TA and TC-RNTI.

Step 4: The one or more UEs that sent the preamble in step 1 or a preset UE among the multiple UEs (for example, the one with the smallest UEID) sends a Msg 3, the Msg 3 carries a group ID, and the Msg 3 is scrambled with a TC-RNTI, and the TC-RNTI may be the first TC-RNTI among the TC-RNTIs obtained in step 3.

Step 5: eNB sends Msg 4, and all UEs or some UEs in the group (all UEs or some UEs refer to UEs that need to perform random access) monitor Msg4. Msg 4 may be one of the following:

a. A Msg 4 obtained by scrambling the TC-RNTI in Msg 3, the Msg 4 may carry a group ID, and may also include one or M sets of wireless resources, or it may also continue to carry multiple of the M TC-RNTIs in step 2. Further, the Msg 4 may also include one or M pieces of radio resource configuration information, such as CQI feedback resources, SR resources and so on. The UE that receives the Msg 4 may determine the C-RNTI allocated to itself and the radio resource configuration information in a manner similar to the method 2 in Example 2.

b. The monitored Msg 4 can be multiple Msg 4, and the multiple Msg 4 are respectively scrambled with M TC-RNTIs. Msg 4 can carry group ID. Msg 4 supports Hybrid Automatic Repeat reQuest (HARQ, Hybrid Automatic Repeat reQuest), so, in this case, each UE can feed back its corresponding Msg 4 and send an ACK confirmation message, which can avoid waste of resources. In this case, if the eNB does not receive the ACK sent by the UE, it considers that this set of resources is not used by the UE.

In the above three ways, if the UE fails to access, the group of UEs can re-initiate random access, or implement the access of corresponding UEs in the existing way, that is, a single UE initiates random access alone.

Furthermore, if two UEs select the same wireless resource (including C-RNTI, wireless air interface resources, etc.), the uplink data sent by them will always collide, resulting in a failure to send. If the eNB finds that these UEs always fail to transmit, they can send indication signaling to make them re-access.

If the number of UEs that correctly receive Msg4 is less than the number of radio resources allocated by the eNB, there will be waste. The OUE can send a message to indicate that it occupies a certain set of resources. If the eNB does not receive the information for a certain set of resources, the eNB considers that the set of resources is not occupied by the UE. For example, a time window is defined. Within this time window, the UE sends an indication message indicating that it occupies the set of resources (TC-RNTI, radio resource). The indication information can be SR, ACK, etc. If the eNB does not receive the information indicated, the eNB considers this set of resources to be wasted resources and it can be allocated to other UEs.

Example 4

Example 4 provides a method for a group of UEs to compete for access. In this example, the UEs in the UE group can communicate with each other. Specifically, the UEs in the group can use short-distance communication methods such as WIFI and D2D to realize interaction.

In this example, when members in the group need to initiate random access, they first report to the first UE (hereinafter referring to as the first UE as the group leader), and the group leader can perform access according to a certain period, such as once every 100mS, If all UEs within 100 mS have no random access request, no access is initiated; if one or more UEs have random access requests, the group leader initiates random access; or, the group leader initiates random access when the accumulated random access requests reach a certain number. The group leader can be preset, or be fixed as a UE with a certain ID number, such as a UE with an ID number of 0, or determine a UE in the UE group as the group leader according to a certain rule; or,

When UEs of the same service type may be divided into a group, and these UEs will initiate random access at a fixed time, then the group leader will initiate random access instead of the whole group of UEs at a fixed time.

The process in which the group leader performs random access on behalf of the entire group of UEs or some UEs is given below in modes 1 to 3.

Method 1:

Step 1: The group leader sends a preamble on the designated time-frequency resource;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE, and sends RAR, which carries TA, TC-RNTI and other information。

Step 3: The group leader sends Msg 3, and Msg 3 carries the number M of UEs in the group that need random access;

Step 4: The eNB sends Msg 4, Msg 4 is scrambled with TC-RNTI, Msg 4 contains M-1 C-RNTI values, or M-1 different values of TC-RNTI, or may not be included; further, the Msg 4 may also include one set or M sets of radio resource configuration information, such as CQI feedback resources, SR resources, and the like.

Step 5: The group leader notifies the UEs with random access needs of these information, which may be notified by broadcast or unicast, which is not limited here.

Method 2:

Step 1: The group leader sends a preamble on a certain time-frequency resource, the PRACH resource corresponds to the number M of UEs that need to perform random access, or the eNB knows the number of random access requests;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE sending the preamble, and sends RAR, which carries information such as TA and a TC-RNTI.

Step 3: The group leader sends Msg 3;

Step 4: The eNB sends Msg 4, Msg 4 is scrambled with TC-RNTI, Msg 4 contains M-1 C-RNTI values, or M-1 difference values with TC-RNTI, or may not include, the remaining TC-RNTI values allocated RNTI is obtained according to preset rules, such as TC-RNTI, TC-RNTI+1,..., TC-RNTI+M-1 and so on, the Msg 4 may also include one or M sets of radio resource configuration information, such as CQI feedback resources, SR resources, etc., if it is a set of radio resource configuration information, the rest of the allocated radio resources Obtained according to preset rules. If it is a set of radio resource configuration information, the rest of the allocated wireless resources are obtained according to preset rules.

When the group leader notifies the UEs with scheduling requests of these information, it may use broadcast or unicast, which is not limited here.

Method 3:

Step 1: The group leader sends a preamble on a certain time-frequency resource, the PRACH resource corresponds to the number M of UEs that need random access, or the number of random access requests known by the eNB;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE, and sends RAR, which carries information such as TA and M TC-RNTIs.

Step 3: UE: Send Msg 3, and the Msg 3 uses one of the M TC-RNTIs for scrambling.

Step 4: eNB sends Msg 4, Msg 4 is scrambled with TC-RNTI in Msg 3, and Msg 4 includes 1 or M sets of radio resources (M TC-RNTIs can also be carried continuously).

Method 4:

In this method, the group members know the PRACH resources (including time-frequency resources and preamble) sent by the group leader through short-distance communication, so as to know the RA-RNTI.

The process of achieving random access includes the following steps:

Step 1: The group leader UE sends a preamble on a certain time-frequency resource, and the PRACH resource corresponds to the number M of UEs that need to perform random access;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE, and sends RAR, which carries TA, TC-RNTI information and UL grant information. This is similar to Method 1 in Example 2.

Step 3: UEs with access requests in the group send Msg 3 on the resources corresponding to their corresponding UL grants;

Step 4: The eNB sends Msg4 respectively according to the received Msg 3, and the number of the Msg 4 sent is the same as the number of the Msg 3 received by the eNB.

In this example, in order to prevent the UE from missing the RAR detection, the eNB can repeatedly send the RAR within a window.

Method 5

In this method, the group members know the PRACH resources (including time-frequency resources and preamble) sent by the group leader through short-distance communication, so as to know the RA-RNTI.

The random access procedure includes the following steps:

Step 1: The group leader sends a preamble on a certain time-frequency resource;

Step 2: The eNB learns that the UE sending the PRACH resource is the group leader through the received PRACH resource (time-frequency resource information or preamble information), and sends RAR, which carries information such as TA and TC-RNTI.

Step 3: All UEs or UEs in the group that have access requests monitor the RAR to obtain TA and TC-RNTI.

Step 4: After listening to the RAR, the group leader UE sends Msg 3, carrying the group ID or a preset value, and the number M of UEs in the group that need to perform random access. The group ID or a preset value may be notified by the group leader, notified by the network side, or preset.

Step 5: eNB sends Msg 4, carrying the group ID or preset value in the previous step, Msg 4 is scrambled with TC-RNTI, Msg can also include M-1 C-RNTI values, and one or M sets of radio resource configuration information. All UEs/UEs with access requests in the group listen to Msg 4 scrambled by TC-RNTI, and obtain their own C-RNTI and radio resource configuration information according to preset rules.

Before this method is implemented, the group member UE should know the PRACH resource (time frequency, preamble) sent by the group leader UE, so as to know that the reception of RAR and Msg 4 in RA-RNTI 0 is more important in this method. In order to avoid UE missing RAR and Msg 4, it may be considered to send RAR and Msg 4 repeatedly within a window.

Method 6:

The group member UE knows the PRACH resource (including time-frequency resource and preamble) sent by the group leader UE, so as to know the RA-RNTI.

The random access procedure in this example includes the following steps:

Step 1: The UE sends a preamble on a certain time-frequency resource, and the PRACH resource corresponds to the number M of UEs that need to perform random access, or the number of random access requests known by the eNB;

Step 2: The eNB learns that the UE is the group leader through the received PRACH resources (time-frequency resource information or preamble information), and sends RAR, which carries information such as TA and TC-RNTI. Step 3: UEs with access requests in the group monitor RAR and get TA and TC-RNTI. Step 4: The group leader sends Msg 3, carrying an ID known to all UEs in the group;

Step 5: After receiving Msg 3, eNB sends Msg 4. Msg 4 is scrambled with TC-RNTI. Msg 4 contains M-1 C-RNTI values, or M-1 difference values with TC-RNTI, and includes a set or M sets of radio resources.

Step 6: All UEs in the UE group or UEs in the group with access requests listen to Msg 4 scrambled by the TC-RNTI, and obtain their own C-RNTI and radio resource configuration information according to preset rules or randomly.

Method 7:

The group member UE knows the PRACH resource (including time-frequency resource and preamble) sent by the group leader UE, so as to know the RA-RNTI.

The random access process in this mode includes the following steps:

Step 1: The UE sends a preamble on a certain time-frequency resource, and the PRACH resource corresponds to the number M of UEs that need to perform random access, or the number of random access requests known by the eNB;

Step 2: The eNB learns that the UE sending the PRACH resource is the group leader through the received PRACH resource (time-frequency resource information or preamble information), and sends RAR, which carries information such as TA and multiple TC-RNTIs.

Step 3: The group leader uses a TC-RNTI to send Msg 3, carrying the group ID or a preset value.

Step 4: After receiving Msg 3, eNB sends Msg 4. Msg 4 can be a message scrambled with the TC-RNTI in Msg 3. The Msg 4 contains one or M sets of radio resources (it can also continue to carry multiple TC -RNTI). All UEs/UEs with access requests in the group listen to Msg 4 scrambled by TC-RNTI, and obtain their own C-RNTI and radio resource configuration automatically according to preset rules. 。

Alternatively, the eNB may also send multiple Msg 4s, which are respectively scrambled with multiple TC-RNTIs. All UEs or UEs in the group that need random access determine their corresponding C-RNTI according to preset rules or randomly, and receive Msg 4 corresponding to the C-RNTI.

If two UEs select the same radio resources (including C-RNTI, radio interface resources, etc.), the uplink data they send will always collide, resulting in transmission failure. If the eNB finds that these UEs always fail to transmit, it can send an indication signal order to reconnect it.

If the number of UEs that correctly receive Msg 4 is less than the number of radio resources allocated by the eNB, there will be waste. The OUE can send a message to indicate that it occupies a certain set of resources. If the eNB does not receive the information for a certain set of resources, the eNB considers that the set of resources is not occupied by the UE. For example, define a time window. Within

this time window, the UE should send an indication message indicating that it occupies the set of resources (TC-RNTI, radio resource). The indication information can be SR, ACK, etc. If the eNB does not receive the indication that this information is used, the eNB considers this set of resources to be wasted resources and it can be allocated to other UEs.

Embodiment 4

Based on the same technical concept as the above-mentioned embodiments, see FIG. 5, which shows that an embodiment of this invention provides a user equipment UE50, which may include: a sending unit 501 and a monitoring unit 502; wherein,

The sending unit 501 is configured to send a preamble to the evolved base station eNB on a time-frequency resource;

The monitoring unit 502 is configured to monitor the random access response RAR corresponding to the preamble sent by the eNB.

For example, referring to FIG. 6, the monitoring unit 502 includes: a first descrambling subunit 5021A, a first receiving subunit 5022A, and an allocation subunit 5023A, wherein,

The first descrambling subunit 5021A is configured to unscramble the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset wireless network temporary identifier RA-RNTI corresponding to the preamble;

The first receiving subunit 5022A is configured to receive the RAR, where the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant;

The allocating subunit 5023A is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

Further, the allocating subunit 5023A is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to a preset rule according to the UE's own identity.

For example, referring to FIG. 7, the monitoring unit 502 includes: a determining subunit 5021B, a second descrambling subunit 5022B, and a second receiving subunit 5023B, wherein,

The determining subunit 5021B is configured to determine the RA-RNTI corresponding to each of the UEs according to their respective identities and/or preambles;

The second descrambling subunit 5022B is configured to unscramble the CRC of the DCI that schedules the RAR according to the RA-RNTI corresponding to each of the UEs;

The second receiving subunit 5023B is configured to receive the RAR corresponding to the UE itself, and the RAR includes a TC-RNTI and/or an uplink grant allocated to the UE.

In the above scheme, the sending unit 501 is further configured to send the message 3 according to the uplink grant allocated to the UE itself.

In the above scheme, referring to FIG. 6 and FIG. 7, the UE further includes a receiving unit 503 configured to receive the message 4 sent by the eNB.

Further, the message 4 includes:

The CRC of the DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

Further, the message 4 includes at least one set of radio resources for the UE to determine to allocate to itself.

Further, the message 4 includes: a set of radio resources allocated to the corresponding UE.

For example, the sending unit 501 is further configured to send to the eNB an indication signal for notifying the eNB that the UE has successfully accessed.

Further, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, the receiving unit 503 is further configured to receive instruction information sent by the eNB for instructing the UE to re-initiate random access.

For example, the receiving unit 503 is further configured to receive DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, receiving the random access request sent by the second UE from 。

Further, the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

For example, the sending unit 501 is configured to periodically send a Preamble on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

In the above scheme, the preamble and/or time domain resources and/or frequency domain resources correspond to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset number of UEs.

Embodiment 6

Based on the same technical concept as the previous embodiments, see FIG. 8, which shows that an embodiment of this invention provides an evolved base station eNB 80, which may include: a receiving unit 801 and a sending unit 802, wherein,

The receiving unit 801 is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein, the first UE has at least one UE in the UE group; the sending Unit 802, configured to send a random access response RAR corresponding to the preamble。

For example, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used for the first UE and or the second UE to determine the TC-RNTI and/or uplink allocated to itself from the at least one TC-RNTI and/or uplink grant according to its own identity and according to preset rules authorization, the second UE is all or part of the UE group.

For example, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is all or part of UEs in the UE group.

Further, the receiving unit 801 is further configured to receive the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

Further, the sending unit 802 is further configured to send message 4 to the first UE and/or the second UE.

Further, the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

Optionally, the message 4 includes at least one set of radio resources for the first UE and/or the second UE to determine to allocate to itself.

Optionally, the message 4 includes: a set of radio corresponding the first UE or the second UE.

For example, the receiving unit 801 is further configured to receive a message sent by the first UE and/or the second UE for notifying the eNB that the first UE and/or the second UE have successfully accessed indication signal; The indication signal is a scheduling request SR or an acknowledgment ACK signal.

For example, the sending unit 802 is further configured to send indication information for instructing the first UE and/or the second UE to re-initiate random access to the first UE and/or the second UE.

For example, the sending unit 802 is further configured to send DCI or paging message or radio resource control RRC signaling to the first UE and/or the second UE.

Further, the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

For example, the receiving unit 801 is specifically configured to: periodically receive a preamble sent by the first UE on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

In addition, based on the same technical concept as the above embodiments, an embodiment of this invention also provides a random access system, the system including a user equipment UE and an evolved base station eNB; wherein,

The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group;

The eNB is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

And, send the RAR corresponding to the preamble。

Those with technical qualifications should understand that the embodiments of this invention may be provided as methods, systems, or computer program products. Accordingly, this invention can take the form of a hardware embodiment, a software embodiment, or an embodiment combining software and hardware aspects. Furthermore, this invention may take the form of a computer program product embodied on one or more computer-usable storage media (including but not limited to disk storage and optical storage, etc.) having computer-usable program code embodied therein.

This invention is described with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It should be understood that each

procedure and/or block in the flowchart and/or block diagram, and a combination of procedures and/or blocks in the flowchart and/or block diagram can be realized by computer program instructions. These computer program instructions may be provided to a general purpose computer, special purpose computer, embedded processor, or processor of other programmable data processing equipment to produce a machine such that the instructions executed by the processor of the computer or other programmable data processing equipment produce an apparatus for realizing the functions specified in one or more procedures of the flowchart and/or one or more blocks of the block diagram.

These computer program instructions may also be stored in a computer-readable memory capable of directing a computer or other programmable data processing apparatus to operate in a specific manner, such that the instructions stored in the computer-readable memory produce an article of manufacture comprising instruction means for implementing the functions specified in one or more of the flow charts and/or one or more blocks of the block diagram.。

These computer program instructions may also be loaded onto a computer or other programmable data processing device, causing a series of operational steps to be performed on the computer or other programmable device to produce a computer-implemented process; the instructions executed on the computer or other programmable devices thus provide steps for realizing the functions specified in one or more procedures of the flowchart and/or one or more blocks of the block diagram.

The above descriptions are only preferred embodiments of this invention, and are not intended to limit the protection scope of this invention.

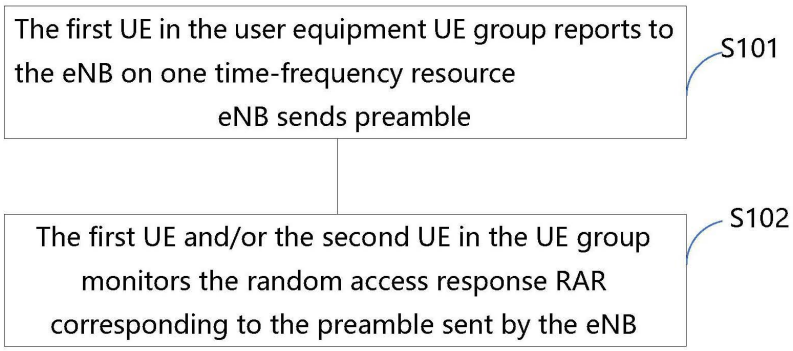


Figure 1

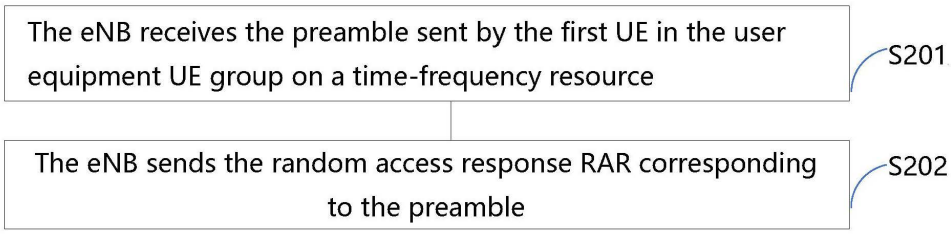


Figure 2

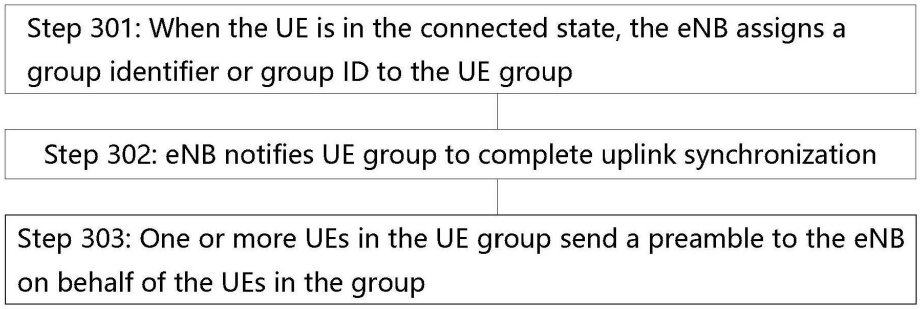


Figure 3

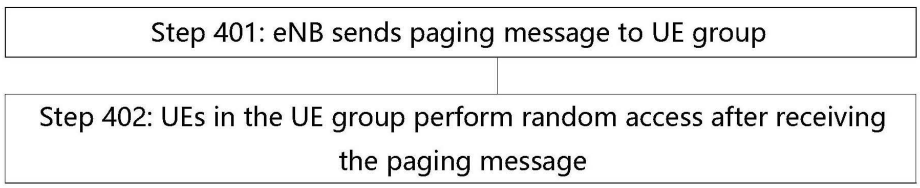


Figure 4

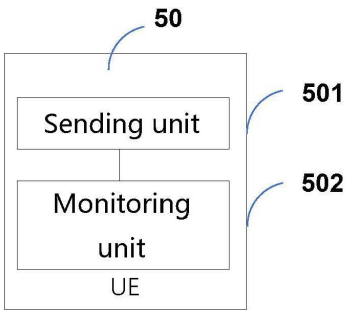


Figure 5

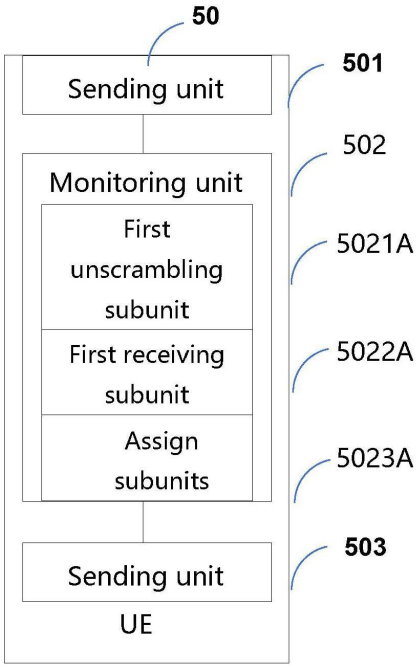


Figure 6

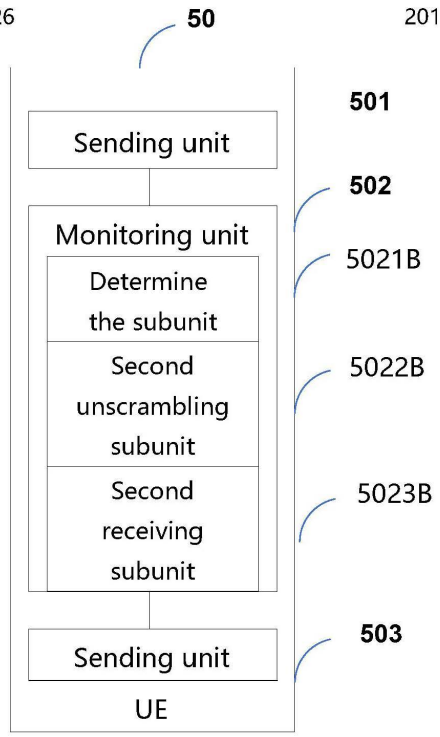


Figure 7

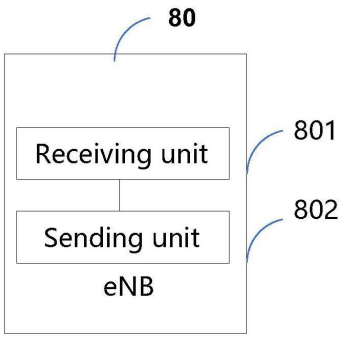


Figure 8

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EXHIBIT 3

CERTIFICATE OF TRANSLATOR'S ACCURACY

I (Ms. M. Kuester), declare under the penalty of perjury under the laws of the United States that the forgoing translation is a true and exact translation of this one (1) Simplified Chinese document: (WO2016206497A1_Original_document_20230120152738.pdf) to the best of my knowledge and I am competent in both English and Simplified Chinese to render such a translation; and further declare that willful false statements and the like so made are punishable by fine or imprisonment, or both under 1001 of Title 18 of the United States Codes.

Melissa Kuester Date: January 23, 2023
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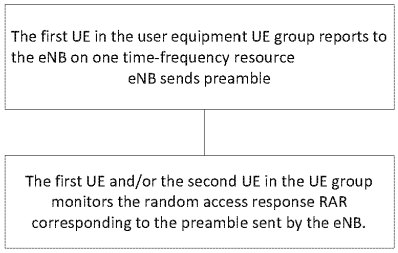
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(54) RANDOM ACCESS METHOD, DEVICE AND SYSTEM

(54) Title of Invention. A random-access method, device and system



S101 At first user equipment (UE) in a I-JE group transmits, according to a time-frequency resource, a preamble to an evolved node B (eNB)

S102 A second UE in the UE group and/or the first UE monitor(s) for a random access response (RAR) corresponding to the preamble transmitted by the eNB

(57) Abstract: A random access method comprises: transmitting, by a first user equipment (UE) in a UE group, and according to a time-frequency resource, a preamble to an evolved node B (eNB); and monitoring by a second UE in the UE group and/or the first UE, for a random access response (RAR) corresponding to the preamble transmitted by the eNB, wherein the first UE is at least one UE in the UE group, and the second UE is all or a part of the UEs in the UE group.

(57) **Abstract:** A random access method includes: a first UE in a user equipment UE group sends a preamble to an evolved base station eNB on a time-frequency resource; the first UE and/or UEs in the UE group The second UE monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein, the first UE is at least one UE in the UE group, and the second UE is all or part of the UE group.

(81) Designated State (requires every available national protection unless otherwise specified):

AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DR, DM, DO, DZ, EC, EE, EG, ES, Fl, GB, GD, GE, GH, GM, GT, HN, HR, HU, D, IL, IN, IR, IS, JP, RE, KG, RN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NL, 0M, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, sy, TH, TJ, TM, TN, TR, TT, TZ, [JA, UG, US, UZ, VC, VN, LA, ZM, ZWC

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Declaration under Rule 4.17:

- Rules concerning the applicant's right to apply for and be granted a patent (4.17(ii))
- Inventorship (Rule 4.17(iv))

The International announces:

- including the international search report (Article 21(3) of the Treaty).

A random access method, device and system

Technical Field

This invention relates to the field of wireless communication, in particular to a random access method, device and system.

Technical Background

Machine Type Communication (MTC) User Equipment (referred to as User Equipment or Terminal), also known as Machine to Machine (M2M) user communication equipment, is currently the main application form of the Internet of Things.

In recent years, more and more mobile operators choose Long Term Evolution or Long Term Evolution Advance LTE/LTEA due to the high spectral efficiency of the long-term evolution advanced long-term evolution system. LTEA is the evolution direction of the broadband wireless communication system. MTC multi-type data services based on LTE/LTE-A will also be more attractive.

In the LTE system, random access is a basic function. Only after the UE is synchronized with the uplink of the system through the random access process, can it be scheduled by the system for uplink transmission. There are two types of random access in LTE: contention-based random access and contention-free random access.

The initial random access process is a contention-based access process, which can be divided into four steps.

(1) The UE sends the preamble, and the UE randomly selects an available preamble to send.

(2) The eNB sends a Random access Response (RAR, Random access Response). When the eNB detects the preamble sent by the UE, it will send a response on the downlink synchronization channel (DL-SCH, DownLink-Synchronization Channel), including: the index number of the detected preamble, time adjustment information for uplink synchronization , initial uplink resource allocation (for sending the subsequent message 3), and a temporary cell radio network temporary identity (TC-RNTI, Temporary Cell Radio Network Temporary Identity). This TC-RNTI will be used in step 4 (conflict resolution) to decide whether to convert to a permanent C-RNTI. UE needs to use a random access radio network

temporary identifier RA-RNTI (Random access RNTI) on the PDCCH to monitor the RAR message.

RA-RNTI=I +t_id+10*f_id,

Wherein, t_id refers to the first subframe index number of the PRACH that sends the preamble (0<=t id<10), f_id is the PRACH index in this subframe, that is, the frequency domain position index, (0=<f_id<=6), but for the FDD system, there is only one frequency domain position, so f id is always zero.

(3) UE sends message 3. The UE receives the RAR message and obtains uplink time synchronization and uplink resources. However, it cannot be determined at this time that the RAR message is sent to the UE itself rather than to other UEs. Since the UE's preamble is randomly selected from public resources, there is a possibility that different UEs may send the same access preamble on the same time and frequency resources, so that the same RA-RNTI receives the same RAR and the UE has no way of knowing whether other UEs are using the same resource for random access. For this reason, the UE needs to resolve such random access conflicts through subsequent messages 3 and 4.

(4) The eNB sends message 4, which is a conflict resolution message. If in media access control. Within the time limit of the conflict resolution timer (mac-ContentionResolutionTimer), the UE receives the message 4 returned by the eNB, and the UE ID carried in it matches the one reported to the eNB in the message 3, then the UE considers itself to have won the random access conflict, and random access succeeds. And set the temporary C-RNTI obtained in the RAR message as its own C-RNTI, otherwise, the UE considers that the access fails, and performs the random access retransmission process according to the above-mentioned rules.

For contention-free random access, the preamble sent by the UE is notified by the eNB, and the uplink synchronization is completed through the first two steps, and there is no conflict resolution process.

Communication requirements for massive machines and equipment in the future: random access concurrent transmission blocking rate <0%, and access density of not less than 10 UEs per square meter within Is-10S. Then in a small cell, at least tens of thousands of users are connected within Is-10S. In order to meet this requirement, according to the existing random access method, even if the UE accesses uniformly and each subframe can initiate random access, at least hundreds

of times the current physical random access channel (PRACH, Physical Random access Channel) resources are needed. However, in an actual situation, UEs are not uniformly accessed, so the number of required resources may be more. In the existing LTE system, for a 20M bandwidth system, if a time-frequency resource accommodates 64 cyclic shifts of a preamble root sequence, even if the entire bandwidth is used to send PRACH, it is not enough.

Contents of the invention

In order to solve the existing technical problems, the embodiments of this invention expect to provide a random access method, device and system, which can save PRACH resources and meet the needs of massive machine communication.

In order to achieve the above object, technical solution of this invention is achieved in that way:

In a first aspect, an embodiment of this invention provides a random access method, the method including:

The first UE in the user equipment UE group sends a preamble to the advanced base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all UEs in the UE group.

In the above scheme, the first UE is at least one of the following:

Comprised of at least one UE; or,

At least one UE determined according to preset rules; or,

At least one UE notified by the eNB.

In the above scheme, the preamble and/or the time domain resource and/or the frequency domain resource are preset, or determined by the group identifier of the UE group, or notified by the eNB.

In the above scheme, the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, including:

The first UE and/or the second UE unscrambles the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according

to the preset radio network temporary identifier RA-RNTI corresponding to the preamble, and receives the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization;

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

In the above scheme, the first UE and/or the second UE determine the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant contained in the RAR, specifically including:

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to the first UE and/or the second UE according to a preset rule according to its own identity.

In the above scheme, the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, including:

The first UE and/or the second UE determines their respective corresponding RA-RNTIs according to their respective identities and/or preambles, and unscramble the CRC of the DCI that schedules the RAR according to the respective corresponding RA-RNTIs, and receives the RAR corresponding to itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE or second UE.

In the above scheme, after the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, the method further includes: the first UE and/or the second UE according to the Its own uplink authorization sends message 3.

In the above scheme, after the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself, it further includes:

The first UE and/or the second UE receives message 4 sent by the eNB.

In the above scheme, the first UE and/or the second UE receiving the message 4 sent by the eNB including: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

In the above scheme, the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determines the radio resource

allocated to itself according to the set of at least one radio resources included in the message 4.

In the above scheme, the first UE and/or the second UE determines radio resources allocated to itself according to at least one set of radio resources included in the message 4, and further includes:

The UE also determines radio resources allocated to itself according to its own identity according to a preset rule.

In the above scheme, the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

In the above scheme, after the first UE and/or the second UE receive the message 4 sent by the eNB, it further includes: the first UE and/or the second UE sends to the eNB for notifying the eNB of an indication signal of successful access by the first UE and/or the second UE.

In the above scheme, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, after the first UE and/or the second UE receive the message 4 sent by the eNB, it further includes:

The first UE and/or the second UE receives indication information sent by the eNB for instructing the first UE and/or the second UE to re-initiate random access.

In the above scheme, before the first UE in the UE group sends a preamble on a time-frequency resource, it further includes:

The first UE and/or the second UE receives the DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, the first UE receives random access request information sent by the second UE.

In the above scheme, the first UE and/or the second UE receive the DCI or paging message or RRC signaling sent by the eNB, including at least one of the following:

The DCI, or the CRC of the DCI that schedules the paging message or the RRC message, is scrambled using the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the first UE receives the random access request information sent by the second UE, including:

The first UE counts the received random access requests of the second UE in the group;

When the count reaches a preset threshold, the first UE sends a preamble on a time-frequency resource.

In the above scheme, one in the UE group sends a preamble on one time-frequency resource, which specifically includes:

The first UE periodically sends a preamble on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

In the above scheme, the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset corresponding to the number of UEs.

In a second aspect, an embodiment of this invention provides a random access method, the method including:

The evolved base station eNB receives a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein, the first UE is at least one UE in the UE group;

The eNB sends a random access response RAR corresponding to the preamble.

In the above scheme, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used for the first UE and/or the second UE to determine the TC-RNTI and/or the TC-RNTI allocated to itself from the at least one TC-RNTI and/or uplink grant

according to its own identity and according to a preset allocation rule or uplink grant, the second UE is all or part of UEs in the UE group.

In the above scheme, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is all or part of the UE group UE.

In the above scheme, after the eNB sends the RAR corresponding to the preamble, the method further includes:

The eNB receives message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

In the above scheme, after the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself, the method further includes:

The eNB sends message 4 to the first UE and/or the second UE.

In the above scheme, the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI scheduling the message 4 is added using the TC-RNTI allocated to the first UE and/or the second UE disturb.

In the above scheme, the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determines the radio resources allocated to itself according to the at least one set of radio resources included in the message 4.

In the above scheme, the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

In the above scheme, after the eNB sends message 4 to the first UE and/or the second UE,

The method also includes:

The eNB receives an indication signal sent by the first UE and/or the second UE for notifying the eNB that the first UE and/or the second UE have been successfully accessed; the indication signal is a scheduling request SR or acknowledge ACK signal.

In the above scheme, after the eNB sends message 4 to the first UE and/or the second UE, the method further includes:

The eNB sends indication information for instructing the first UE and/or the second UE to re-initiate random access to the first UE and/or the second UE.

In the above scheme, before the eNB receives the preamble sent by the first UE in the user equipment UE group on a time-frequency resource, the method further includes:

The eNB sends DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

In the above scheme, the DCI or paging message or RRC signaling includes at least one of the following forms:

The DCI, or the CRC of the DCI that schedules the paging message or the RRC message, uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, specifically including:

The eNB periodically receives a preamble sent by the first UE on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

In a third aspect, an embodiment of this invention provides a user equipment UE, where the UE includes: a sending unit and a monitoring unit; wherein,

The sending unit is configured to send a preamble to the evolved base station eNB on a time-frequency resource; the monitoring unit is configured to monitor the random access response RAR corresponding to the preamble sent by the eNB。

In the above scheme, the monitoring unit includes: a first descrambling subunit, a first receiving subunit and an allocating subunit, wherein,

The first descrambling subunit is configured to unscramble the cyclic redundancy check code CRC of the downlink control information DCI that schedules

the RAR according to the preset radio network temporary identifier RA-RNTI corresponding to the preamble;

The first receiving subunit is configured to receive the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant;

The allocating subunit is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

In the system proposed above, the allocating subunit is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to a preset rule according to the UE's own identity.

In the system proposed above, the monitoring unit includes: a determining subunit, a second descrambling subunit and a second receiving subunit, wherein,

The determining subunit is configured to determine the RA-RNTI corresponding to each of the UEs according to their respective identities and/or preambles;

The second descrambling subunit is configured to unscramble the CRC of the DCI that schedules the RAR according to the respective RA-RNTIs corresponding to the UEs;

The second receiving subunit is configured to receive a RAR corresponding to the UE itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the UE.

In the system propsoed above, the sending unit is further configured to send message 3 according to the uplink grant allocated to the UE itself.

In the system proposed above, the UE further includes: a receiving unit configured to receive the message 4 sent by the eNB.

In the above scheme, the message 4 includes:

The CRC of the DCI of the scheduling message 4 is scrambled using the TC-RNTI allocated to the first UE and/or the second UE.

In the above scheme, the message 4 includes at least one set of radio resources for the UE to determine to allocate to itself.

In the above scheme, the message 4 includes: a set of radio resources allocated to the corresponding UE.

In the above scheme, the sending unit is further configured to send to the eNB an indication signal for notifying the eNB that the UE has successfully accessed.

In the above scheme, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, the receiving unit is further configured to receive instruction information sent by the eNB for instructing the UE to re-initiate random access.

In the above scheme, the UE further includes a receiving unit, configured to receive DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, receiving the random access request sent by the second UE from 。

In the above scheme, the DCI or paging message or RRC signaling, including at least one of the following: DCI, or the CRC of the DCI scheduling the paging message or RRC message is scrambled using the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the sending unit is configured to periodically send a preamble on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

In the above scheme, the preamble and/or time domain resources and/or frequency domain resources correspond to the number of UEs with random access

requests in the UE group or the number of UEs included in the UE group or a preset number of UEs.

In a fourth aspect, an embodiment of this invention provides an evolved base station eNB, where the eNB includes: a receiving unit and a sending unit, wherein,

The receiving unit is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein the first UE is at least one UE in the UE group;

The sending unit is configured to send a random access response RAR corresponding to the preamble。

In the above scheme, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the set rule determines the TC-RNTI and/or uplink grant allocated to itself from the at least one TC-RNTI and/or uplink grant, and the second UE is all or part of UEs in the UE group.

In the above scheme, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is all or part of UEs in the UE group.

In the above scheme, the receiving unit is further configured to receive the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

In the above scheme, the sending unit is further configured to send message 4 to the first UE and/or the second UE.

In the above scheme, the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by the TC-RNTI allocated to the first UE and/or the second UE.

In the above scheme, the message 4 includes at least one set of radio resources for the first UE and/or the second UE to determine to allocate to itself.

In the above scheme, the message 4 includes: a set of radio resources allocated to the corresponding first UE or second UE.

In the above scheme, the receiving unit is further configured to receive a message sent by the first UE and/or the second UE for notifying the eNB that the

first UE and/or the second UE have successfully accessed an indication signal; the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, the sending unit is further configured to send instruction information for instructing the first UE and/or the second UE to re-initiate random access to the first UE and/or the second UE.

In the above scheme, the sending unit is further configured to send DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

In the above scheme, the DCI or the paging message or RRC signaling includes at least one of the following: the CRC of the DCI or the DCI scheduling the paging message or RRC message is added with the group identity of the UE group disturb; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

In the above scheme, the receiving unit is specifically configured to: periodically receive a preamble sent by the first UE on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

In a fifth aspect, an embodiment of this invention provides a random access system, the system includes a user equipment UE and an evolved base station eNB; wherein,

The first UE in the user equipment UE group sends a preamble to the advanced base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group;

The eNB is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

And, send the RAR corresponding to the preamble。

In the random access method, device and system provided by the embodiments of this invention, one or more UEs in the user equipment UE group send a preamble to the evolved base station eNB on a time-frequency resource to instruct the eNB to perform UE Random access processing of some or all UEs in the group. in this way,

A group of UEs only need to occupy one PRACH resource (including time-domain resources, frequency-domain resources and preamble) in one random access. In this way, PRACH resources can be greatly saved to meet the needs of a huge number of machine communications.

Image Descriptions

FIG. 1 is a schematic flowchart of a random access method provided by an embodiment of this invention;

FIG. 2 is a schematic flowchart of another random access method provided by an embodiment of this invention;

FIG. 3 is a schematic diagram of a non-contention-based random access method provided by an embodiment of this invention;

FIG. 4 is a schematic diagram of a method for sending a paging message by an eNB to trigger a UE group access provided by an embodiment of this invention;

FIG. 5 is a schematic structural diagram of a UE provided by an embodiment of this invention;

FIG. 6 is a schematic structural diagram of another UE provided by an embodiment of this invention;

FIG. 7 is a schematic structural diagram of another UE provided by an embodiment of this invention;

FIG. 8 is a schematic structural diagram of an eNB provided by an embodiment of this invention.

Detailed Descriptions

The technical schemes in the embodiments of this invention will be clearly and completely described below in conjunction with the drawings of the embodiments of this invention.

Embodiment 1

Referring to FIG. 1 , it shows a flow of a random access method provided by an embodiment of this invention. The method can be applied to the user equipment UE side, and the method can include:

S101: The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

S102: The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB.

Wherein, the first UE is at least one UE in the UE group, and the first UE can be a representative of the UE group; and the second UE can be all or part of the UE in the UE group, that is, it has random access to the requesting UE, therefore, the first UE may be included in the second UE.

It should be noted that the first UE may be at least one of the following:

Comprised of at least one UE; or,

At least one UE determined according to preset rules; or,

At least one UE notified by the eNB.

Moreover, the preamble and/or the time domain resource and/or frequency domain resource may be preset, or determined by the group identifier of the UE group, or notified by the eNB.

Optionally, the first UE and/or the second UE in the UE group monitors the RAR corresponding to the preamble sent by the eNB, which may include:

The first UE and/or the second UE schedules the cyclic redundancy check of downlink control information (DCI, Downlink Control Information) of the RAR

according to the preset wireless network temporary identifier RA-RNTI corresponding to the preamble Code (CRC, Cyclic Redundancy Check) for descrambling, and receive the RAR; wherein, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant; and,

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant contained in the RAR; specifically, the first UE and/or the second UE may determine the TC-RNTI and/or uplink grant allocated to the first UE and/or the second UE according to a preset rule according to its own identity.

Optionally, the first UE and/or the second UE in the UE group monitors the RAR corresponding to the preamble sent by the eNB, which may include:

The first UE and/or the second UE determine their respective corresponding RA-RNTIs according to their respective identities and/or preambles, and unscramble the CRC of the DCI that schedules the RAR according to the respective corresponding RA-RNTIs, and receives the RAR corresponding to itself. The RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE or second UE.

For example, after the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, this embodiment may further include: the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself.

Further, after the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself, this embodiment may further include: the first UE and/or the second UE receives the message 4 sent by the eNB.

It should be noted that receiving the message 4 sent by the eNB by the first UE and/or the second UE includes: scheduling the CRC of the DCI of the message 4 using the TC-RNTI allocated to the first UE and/or the second UE Do scrambling.

Specifically, the message 4 may include at least one set of radio resources, and the first UE and/or the second UE determines the radio resources allocated to itself according to the at least one set of radio resources included in the message 4; in detail,

the UE may also determine the radio resource allocated to itself from message 4 according to its own identity according to a preset rule.

Specifically, the message 4 may also include a set of radio resources allocated to the corresponding first UE or second UE.

Optionally, after the first UE and/or the second UE receive the message 4 sent by the eNB, this embodiment may further include: the first UE and/or the second UE send to the eNB for notifying the eNB with an indication signal of successful access by the first UE and/or the second UE; wherein, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

Optionally, after the first UE and/or the second UE receive the message 4 sent by the eNB, this embodiment may further include: the first UE and/or the second UE receive the message sent by the eNB indicating that the first UE and/or a second UE re-initiate random access indication information.

For example, before the first UE in the UE group sends a preamble on a time-frequency resource, this embodiment may further include:

The first UE and/or the second UE receives the DCI or paging message sent by the eNB or

Radio resource control RRC signaling;

Or, the first UE receives random access request information sent by the second UE.

Further, the first UE and/or the second UE receive the DCI or paging message or RRC signaling sent by the eNB, including at least one of the following:

The DCI, or the CRC of the DCI that schedules the paging message or the RRC message, is scrambled using the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

Further, the first UE receives the random access request information sent by the second UE, including:

The first UE counts the received random access requests of the second UE in the group;

When the count reaches a preset threshold, the first UE sends a preamble on a time-frequency resource.

For example, the first UE in the UE group sends a preamble on a time-frequency resource, which may specifically include: the first UE periodically sends a preamble on a frequency domain resource.

It should be noted that, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In addition, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

Further, the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset UE corresponding to the number.

This embodiment provides a random access method. The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource, and then the first UE and/or the second UE in the UE group monitor the random access response RAR corresponding to the preamble sent by the eNB, and complete uplink authorization and resource allocation, so that a group of UEs only need to occupy one PRACH resource (including time domain resources, frequency domain resources and preamble) in a random access. In this way, PRACH resources can be greatly saved to meet the needs of a huge number of machine communications.

Embodiment 2

Referring to FIG. 2 , it shows a flow of a random access method provided by an embodiment of this invention. The method can be applied to the eNB side, and the method can include:

S201: The eNB receives a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

S202: The eNB sends a random access response RAR corresponding to the preamble.

Optionally, the RAR may include at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR may be used for the first UE and/or the second UE to determine the TC-RNTI and/or allocated to itself from the at least one TC-RNTI and/or uplink grant according to its own identity and according to preset rules Uplink Authorization.

Optionally, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE.

It should be noted that the first UE described in S201 to S202 above is at least one UE in the UE group, and the first UE can be a representative of the UE group; and the second UE can be all or part of UEs in the UE group, that is, UEs with a random access request, therefore, the first UE may be included in the second UE.

Further, after the eNB sends the RAR corresponding to the preamble, this embodiment may further include: the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

Moreover, after the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself, this embodiment may further include:

The eNB sends a message 4 to the first UE and/or the second UE。

It should be noted that the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

Specifically, the message 4 may include at least one set of radio resources, and the first UE and/or the second UE determines the radio resources allocated to itself according to the at least one set of radio resources included in the message 4 .

Alternatively, the message 4 may also include a set of radio resources allocated to the corresponding first UE or second UE.

Further, after the eNB sends the message 4 to the first UE and/or the second UE, this embodiment may further include: the eNB receives the message sent by the first UE and/or the second UE for sending the message to the eNB informing

the first UE and/or the second UE of an indication signal of successful access; wherein the indication signal is a scheduling request SR or an acknowledgment ACK signal.

Alternatively, after the eNB sends message 4 to the first UE and/or the second UE, this embodiment may further include: the eNB sends to the first UE and/or the second UE a message indicating that the first UE and the /or the second UE re-initiates the random access indication information.

For example, before the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, this embodiment may further include:

The eNB sends DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

Further, the DCI or paging message or RRC signaling includes at least one of the following:

The DCI, or the CRC that schedules the DCI of the paging message or RRC message, uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

Specifically, the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, specifically including:

The eNB periodically receives a preamble sent by the first UE on a frequency domain resource. It should be noted that the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In addition, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

This embodiment provides a random access method such that after receiving the preamble sent by the first UE in the UE group on a time-frequency resource, the eNB sends the random access response RAR corresponding to the preamble, so that the UE completes the uplink authorization and resource allocation, so that

a group of UEs only need to occupy one PRACH resource (including time-domain resources, frequency-domain resources and preamble) in a random access. In this way, PRACH resources can be greatly saved to meet the requirements of a huge number of machine communications need.

Embodiment 3

Based on the same technical concept of the above two embodiments, this embodiment introduces the technical solutions of the above two embodiments in detail through the following four specific examples. It should be noted that the following four examples are only used to implement this invention Those with technical qualifications can combine the technical solutions of these four specific examples as needed without any creative work, and this embodiment of this invention will not repeat them here.

In the following example, multiple (two or more) UEs form a UE group, a group of UEs has a group ID as the group identifier, and each UE has its own ID number within the group, that is, its own identification information. Groups can be formed in one of the following ways:

(1) For a fixed UE installed by an operator or a UE that is relatively close and fixed and has the same service (such as a vehicle, the same compartment of a train or subway), the operator will operate, manage and maintain (OAM, Operation Administration and Maintenance) in the background to configure these UEs as a group;

(2) The network side detects the TA values of all connected terminals, and if the TA values of some terminals remain the same for a period of time, configures these terminals as a group;

(3) Using a positioning system, configure a group of UEs with relatively close positioning distances.

(4) In the case that UEs can communicate with each other, for example, using the discovery technology in D2D, UEs spontaneously form a group. The UE spontaneously forms a group, which is similar to "discovery" in the existing D2D technology. (It can only be used when UEs in the group can communicate).

Example 1

Example 1 provides a non-contention-based random access method, referring to Figure 3, this example includes the following steps:

Step 301: When the UE is in the connected state, the eNB assigns a group identifier or group ID to the UE group, that is, a group Radio Network Temporary Identifier (RNTI, Radio Network Temporary Identifier).

Step 302: eNB notifies UE group to complete uplink synchronization;

The eNB notifies the group of UEs to perform random access to complete uplink synchronization, and the notification signaling may be physical layer signaling or high layer signaling.

The physical layer signaling may be a DCI, and the cyclic redundancy check (CRC, Cyclic Redundancy Check) code uses the group RNTI for scrambling or masking; the method of scrambling or masking can be the way of doing XOR bit by bit, for example, the group RNTI is 16 bits, and the CRC is also 16 bits, XOR is performed between the bits corresponding to the two, and for example, the group RNTI is "0000H010000HH", and the CRC is "1111001111110011", then after scrambling the CRC with this group of RNTI, "1111111011111100" is obtained. Correspondingly, the UE that has received the scrambled CRC performs bit-wise XOR of the scrambled CRC with the group RNTI to obtain the CRC before scrambling;

The high-level signaling may also be RRC signaling, and the high-level signaling may be public information sent to the UE group, or RRC signaling sent to a UE, and the RRC signaling is used to notify the UE For group access, for example, a bit indication is used in the RRC signaling to notify the UE of group access.

Specifically, the notification signaling (DCI or RRC signaling) may only include preamble-related information, for example, include a preamble index information, so that after receiving the notification signaling, the preamble to be sent can be determined according to the preamble-related information, and the time-frequency resource for sending the preamble can be preset, for example, a fixed time-frequency resource preset by the UE group, or a time-frequency resource agreed in advance between the UE group and the eNB; alternatively, the notification signaling may further include time-domain resource information, that is, sending subframe information, which is used to instruct UEs in the UE group to send the preamble on the subframe, so that the notification is received after the signaling, the frequency domain information for sending the preamble may be preset, for example, a fixed frequency domain resource preset by the UE group, or a frequency domain resource agreed in advance between the UE group and the

eNB; alternatively, the notification signaling includes preamble related information and a frequency domain resource information, so that after receiving the notification signaling, the subframe information for sending the preamble can be preset, for example, preset by the UE group A fixed time domain resource, or a time domain resource agreed in advance between the UE group and the eNB; alternatively, the notification signaling may include preamble related information and time-frequency resource information (including time-domain resource information and frequency-domain resource information, and the time-domain resource information is subframe information); alternatively, the notification signaling may not include preamble-related information, time-domain resource information, and frequency-domain resource information, and one or more UEs in the UE group receiving the notification signaling directly send the preamble agreed with the eNB to the eNB through the time-frequency domain resource agreed in advance.

Step 303: One or more UEs in the UE group send a preamble to the eNB on behalf of the UEs in the group.

After receiving the above notification signaling, the UEs in the UE group send a corresponding (notified by eNB, or preset or agreed) preamble on the corresponding (notified by eNB, or preset or agreed) time-frequency resources;

Specifically, the UE sending the preamble is the first UE, which can be one of the following:

(1) One or more fixed UEs;

For example, pre-designate the UE whose number is 0 to send the preamble, or pre-designate the UE with an even number in the UE group to send the preamble, or designate all UEs to send the preamble.

(2) One or part of UEs determined according to preset rules;

For example, the UE sending the preamble is determined according to the number of the UE sending the preamble and the subframe number of the subframe of the received physical layer signaling or high-level signaling; for example, if the received subframe is an odd number, the odd numbered UE sends a preamble, and if an even-numbered subframe is received, the UE with an even number sends a preamble.

(3) One or more UEs specified in the notification signaling sent by the eNB;

In this case, the physical layer signaling or high layer signaling also needs to include the number information of the UE that initiates the random access.

After the UE sends the preamble, all UEs monitor the RAR, and the CRC of the PDCCH that schedules the RAR is scrambled or masked with the RA-RNTI, so the RA-RNTI can be preset, for example, it is bound to the sending time of the preamble and the frequency domain resources sent (in FDD, just the sending time):

RA-RNTI= 1 + t id+10*f _id

When the time-frequency resources are fixed, the RA-RNTI is also fixed. In this case, all UEs monitor the PDCCH scrambled by the RA-RNTI to obtain the RAR.

Alternatively, the time-frequency resource may not be fixed, for example, the frequency domain resource may be fixed, but the time domain resource may not be fixed. This situation may only occur when there is only one UE that sends the preamble. At this time, the UE that sends the preamble monitors the PDCCH scrambled by the RA-RNTI obtained by calculating the transmitted time-frequency resources, and other UEs need to monitor multiple PDCCHs scrambled by the RA-RNTI obtained by calculating all possible time-frequency resources.

After the UE monitors the PDCCH scrambled by the RA-RNTI, it receives the PDSCH scheduled by it, and then obtains the TA information.

The random access in the prior technique is independently completed by each UE, however, in this example, a group of UEs only occupy one PRACH resource (including time domain resources, frequency domain resources and preamble) in one random access, thus greatly saving PRACH resources.

Example 2

A method for triggering a UE group access by sending a paging message by an eNB is provided, see FIG. 4, the example includes the following steps:

Step 401: the eNB sends a paging message to the UE group;

Specifically, the paging message is used to wake up all or part of UEs in the idle state in the UE group to perform random access.

The paging message includes at least one of the following:

(1) Group ID. The group ID may be included in the paging message, or the CRC of the PDCCH scheduling the paging message may be scrambled by using the group ID.

(2) The number of the UE that initiates random access, that is, UE-ID.

(3) The preamble ID can also be preset without notification.

(4) Time domain and/or frequency domain resources may also be preset without notification, or time domain resources are preset, and frequency domain resources are notified, or frequency domain resources are preset, and time domain resources are notified.

(5) The number (UE-ID) of some UEs in the group, this information will only be included when some UEs are awakened to perform random access.

When the above paging message does not include the number of the UE initiating random access, that is, UE-ID, the UE initiating random access may be determined in the following manner:

a、 One or more UEs in the specified UE group initiate random access, for example, the UE with a predefined number 0 sends a preamble, or the UE with a predefined even number sends a preamble, or all UEs.

b、 One or more UEs determined according to a certain rule to initiate random access, for example, determine the one that initiates

random access according to the corresponding relationship between the number of the UE that sent the preamble and the subframe that received the physical layer signaling or high-level signaling or multiple UEs; for example, if an odd-numbered subframe is received, the odd-numbered UE sends a preamble, and if it is an even-numbered subframe, the even-numbered UE sends a preamble;

It should be noted that the one or more UEs that initiate the random access determined in the above manner may be the same as or different from the UEs that the eNB requires to wake up, and such differences include: some or all of them are different.

Step 402: After receiving the paging message, UEs in the UE group perform random access; specifically, random access can be achieved in the following three ways:

Method 1:

Step 1: The one or more UEs that initiate random access send a preamble on the time-frequency resource.

Step 2: After receiving the preamble, eNB sends a RAR, which carries TA and at least one of the following information:

(1) TC-RNTI information;

Specifically, the TC-RNTI information may include M TC-RNTIs, where M is the number of UEs in the group, or the number of UEs that need to be woken up, or a preset value; the M TCs - RNTI can be in the form of an absolute value, that is, a 16-bit C-RNTI, or an absolute value of one C-RNTI and a relative value of M-l C-RNTIs relative to the absolute value, all UEs or some UEs in the group that need to be woken up correspond to different TC-RNTIs according to preset rules, for example, corresponding to UE-ID in order from small to large, or randomly corresponding; or,

The TC-RNTI information may be a TC-RNTI, and all UEs or some UEs in the group correspond to TC-RNTI, TC-RNTI+1, TC-RNTI+2, and TC-RNTI+…，M-l according to preset rules, for example, according to the UE-IDs corresponding in ascending order, or randomly.

(2) Uplink authorization (UL grant, UpLink grant) information;

For example, the grant information may be M independent UL grant information, or one UL grant information including M scheduling information; all UEs or some UEs in the group correspond to different UL grant information according to preset rules; for example, corresponding to UE-ID in ascending order, or randomly; or,

The UL grant information may be a UL grant, and all UEs or some UEs in the group that need to be awakened correspond to the UL grant assigned to them according to preset rules; for example, assuming that the resources in the UL grant are allocated as physical resource bearers (PRB, Physical Resource Bearer) #0-3, each UE determines the resources allocated to the UE according to its own number, for example, UE #1 corresponds to PRB #4-7, or corresponds randomly, and other UE information, such as modulation and coding strategy (MCS, Modulation and Coding Scheme), etc. are the same as those in the UL grant。

Alternatively, in step 2, the eNB may also send M RARs.

Wherein, each RAR uses a different RA-RNTI for scrambling. The UE determines an RA-RNTI to unscramble the CRC of the DCI according to its own number (UE-ID) and preset rules, and receives the corresponding RAR 0 For example, the RA-RNTI of the UE whose UE-ID is UE 0 is determined according to the time-frequency resource for sending the preamble, and UE 1, UE 2 to UE n respectively correspond to RA-RNTI+1, RA-RNTI+2 to RA-RNTI+n in turn;

Alternatively, UEs with different numbers may also correspond to RA-RNTI+1, the RA-RNTI+2, ... any one of RA-RNTI+n.

Step 3: All or some UEs in the group (all or some UEs refer to all or some UEs that the eNB requires to be woken up) respectively send Msg 3 on resources corresponding to their own UL grant.

Step 4: For the Msg 3 sent in Step 3, the eNB sends Msg 4 respectively.

It should be noted that the reception of RAR is more important in this method; in order to avoid the UE missing RAR detection, the RAR can be resent within a window。

In the case that some UEs fail to receive the RAR, the eNB may resend the paging message to notify these UEs to access.

Method 2:

Step 1: The one or more UEs that initiate random access send a preamble on the time-frequency resource.

Step 2: After receiving the preamble, eNB sends RAR, which carries a TA information, a TC-RNTI and a UL grant in the RAR.

Step 3: All or some UEs in the group (all or some UEs refer to all or some UEs that the eNB requires to wake up) monitor the RAR to obtain TA and TC-RNTI.

Step 4: One or more UEs send Msg 3, where the one or more UEs may be the one or more UEs that sent the preamble in step 1 or a preset UE among the multiple UEs (for example, the UEID with the smallest value), the sent Msg 3 carries a group ID or a preset value, and the preset value is commonly known by UEs in the group.

Step 5: The eNB sends Msg 4, which carries the group ID. Msg 4 is scrambled with the above-mentioned TC-RNTI. The Msg 4 may also include M-1 C-RNTIs, or may not include them. For the case where M-1 C-RNTIs are included in Msg4, all or some UEs in the group (all or some UEs refer to all or some UEs that the eNB requires to wake up) can choose a TC-RNTI as its own C-RNTI according to its own group number; for example, the UE numbered UE 5 corresponds to the fifth TC-RNTI; or, the UE can also randomly select a TC-RNTI as its own C-RNTI; if Msg 4 does not contain a TC-RNTI, all UEs in the group or some UEs can calculate a C-RNTI according to the preset formula according to their own group numbers as their own C-RNTI. For example, if the number is UE 5, then add 5 to the TC-RNTI of

the CRC of the DCI corresponding to the scrambling scheduling Msg 4; or, the UE may also randomly select one from the TC-RNTI to the TC-RNTI+M-I. Further, the Msg 4 may also include one or M pieces of radio resource configuration information, such as CQI feedback resources, SR resources and so on.

For the case where Msg 4 includes M radio resource configuration information, all UEs in the group or some UEs can select a set of radio resource configuration information as their own radio resource configuration according to their own group numbers. The selection method here can be the same as that of the above TC - RNTI or the selection can be done in a similar manner. For the case where Msg 4 includes 1 radio resource configuration information, all or some UEs in the group can obtain their own radio resource configuration according to their own group numbers according to the preset formula. For example, if the radio resource configuration includes SR configuration, the number A UE may consider its own SR configuration as the SR resource 5; or, a random selection method may be used to determine SR configurations corresponding to different UEs.

In this way, the reception of RAR and Msg 4 is more important. In order to prevent the UE from missing RAR Msg 4, the RAR and Msg 4 can be sent repeatedly within a window.

Method 3

Step 1: The one or more UEs send a preamble on the time-frequency resource.

Step 2: The eNB sends RAR, which carries a TA information, M TC-RNTIs and a UL grant.

All UEs in the group or some UEs (only wake up some UEs for random access) monitor RAR to obtain TA and TC-RNTI.

In the first step, the one or more UEs that send the preamble or a preset UE among the multiple UEs (such as the one with the smallest UE ID) sends Msg 3, carrying a group ID or a preset value.

Step 3: The eNB sends a Msg 4, which carries the group ID or the preset value, and the UE monitors the Msg 4.

Specifically, the eNB can send a Msg 4, which can be obtained by scrambling the TC-RNTI in Msg 3, and contains one or M sets of radio resources (it can also continue to carry multiple TC. RNTI).

The UE determines the C-RNTI and radio resources allocated to itself in a manner similar to that in mode 2a; or,

The eNB sends multiple Msg 4, and the multiple Msg 4 are respectively scrambled with M TC-RNTIs, and the UE selects a TC-RNTI according to its own number or at random, and receives the TC-RNTI scrambled Msg4 scheduled by the DCI.

In the case that some UEs fail to receive the RAR, the eNB may re-page these UEs for access.

Example 3

Example 3 provides a method for a group of UEs to compete for access, and the example includes the following steps:

Step 501: One or more UEs in the UE group periodically send a preamble to the eNB on a time-frequency domain resource, thereby initiating random access to the eNB; the UE sending the preamble may be one of the following: (1) Fixed one or more UEs;

For example, pre-designate the UE whose number is 0 to send the preamble, or pre-designate the UE with an even number in the UE group to send the preamble, or designate all UEs to send the preamble.

(2) One or part of UEs determined according to preset rules;

For example, the UE sending the preamble is determined according to the number of the UE sending the preamble and the subframe number of the subframe of the received physical layer signaling or high-layer signaling; For example, if an odd-numbered subframe is received, the odd-numbered UE sends a preamble, and if an even-numbered subframe is received, the even-numbered UE sends a preamble.

The sending period and the offset of the subframe for sending the preamble can be set in advance according to actual needs, and the set sending period and the offset of the subframe for sending the preamble are known to all UEs in the group.

There may be two situations when initiating random access: one situation is that the services of the UEs in the group are the same, and the whole group must access each access; another situation is that only some UEs in the group need to access each access.

In the latter case, the number of UEs accessed may be random.

Specifically, random access can be implemented in the following three ways:

Method 1:

Step 1: The one or more UEs that initiate random access send a preset preamble on a preset time-frequency resource. The preamble resource has a corresponding relationship with the group ID.

Step 2: After the eNB receives the preamble, the eNB learns that the UE is accessing on behalf of a group of UEs through the PRACH resource (time-frequency resource information or preamble information) sent by the UE; after that, the eNB sends a RAR, which carries TA, and at least one of the following information:

(1) TC-RNTI information;

Specifically, the TC-RNTI information may include M TC-RNTIs, where M is the number of UEs in the group, or the number of UEs that need to initiate random access, or a preset value; Before this step, there is a one-to-one correspondence between the preamble sent by the UE and the time-frequency resources used for sending the preamble and the UE group, and if the eNB knows the information of the UE group in advance, such as the number of UEs in the UE group, then the eNB can determine the UE group that initiates random access through the received preamble and time-frequency resource information, thereby determining the information of the UE group, and thus knowing the number M of UEs of the group of UEs, or M can also be a preset value; In addition, when the UE sends the preamble, it can also carry the number M of UEs in the group, or the number M of UEs in the UE group that need to initiate random access, or carry a preset value M; the M TC-RNTI may be in the form of an absolute value, that is, a 16-bit C-RNTI; or it may be an absolute value of one C-RNTI and a relative value of M-1 C-RNTIs relative to the absolute value. In this way, after receiving the TC-RNTI information, all UEs or some UEs in the UE group that need to initiate random access determine their own TC-RNTI according to preset rules, for example, according to the order of UE-ID from small to large corresponding to different TC-RNTIs, or randomly corresponding to TC-RNTIs; or,

… ,The TC-RNTI information may be a TC-RNTI, and all UEs or some UEs in the group correspond to TC-RNTI, TC-RNTI+1, TC-RNTI+2, and TC-RNTI+M-I

according to preset rules, for example, according to the UE-IDs correspond in ascending order, or randomly.

(2) Uplink authorization (UL grant, UpLink grant) information;

For example, the UL grant information may be M independent UL grant information, or one UL grant information including M scheduling information; all UEs or some UEs in the group correspond to different UL grant information according to preset rules; For example, corresponding to UE-ID in ascending order, or randomly; or,

The UL grant information may be a UL grant, and all UEs or some UEs in the group that need to perform random access are allocated to their own UL grants according to preset rules; for example, assuming that the resource allocation in the UL grant is Physical resource bearer (PRB, Physical Resource Bearer) 0-3, each UE determines the resources allocated to the UE according to its own number, for example, UE 1 corresponds to PRB 4-7, or corresponds randomly, and other UE information, such as modulation and coding strategies (MCS, Modulation and Coding Scheme), etc. are the same as those in UL grant.

Or, in step 2, eNB can also send M RARs。

Wherein, each RAR uses a different RA-RNTI for scrambling. The UE determines an RA-RNTI to unscramble the CRC of the DCI according to its own number (UE-ID) and preset rules, and receives the corresponding RAR 0 For example, the RA-RNTI of the UE whose UE-ID is UE #0 is determined according to the time-frequency resource for sending the preamble, and UE #1, UE #2 to UE#n respectively correspond to RA-RNTI+1, RA-RNTI+2 to RA-RNTI+n in turn; Alternatively, UEs with different numbers may also correspond to RA-RNTI +1, any of the RA-RNTI+2, and RA-RNTI+n.

Step 3: All UEs or some UEs in the UE group ((E) that need to perform random access respectively send Msg 3 on resources corresponding to their own UL grants.

Step 4: The eNB sends Msg 4 respectively according to the received Msg 3, and the number of the Msg 4 sent is the same as the number of the Msg 3 received by the eNB.

In this mode, the reception of the RAR is more important. In order to prevent the UE from missing the RAR detection, it may be considered to repeatedly send the RAR within a window.

If the access fails, the group of UEs can re-initiate access, or access according to the existing method, that is, a single UE initiates random access.

Method 2:

Step 1: The one or more UEs that initiate random access send a preset preamble on a preset time-frequency resource. The preamble resource has a corresponding relationship with the group ID.

Step 2: After the eNB receives the preamble, the eNB learns that the UE is accessing on behalf of a group of UEs through the PRACH resource (time-frequency resource information or preamble information) sent by the UE; after that, the eNB sends a RAR, which carries TA , TC-RNTI and other information 。

Step 3: All UEs in the UE group or some UEs (UEs requiring random access) monitor the RAR to obtain TA and TC-RNTI.

Step 4: One or more UEs send Msg 3, where the one or more UEs can be the one or more UEs that sent the preamble in step 1 or a preset UE among the multiple UEs (for example, the UEID with the smallest value), and the sent Msg 3 carries a group ID.

Step 5: The eNB sends Msg 4, which carries the group ID. The Msg 4 is scrambled by the TC-RNTI. The Msg 4 may also include M-1 C-RNTIs, or may not include them. Further, the Msg 4 may also include one or M pieces of radio resource configuration information, such as CQI feedback resources, SR resources, etc. The UE can determine the C-RNTI allocated to itself and the radio resource configuration information in a manner similar to the manner 2 in the second example.

In this method, the reception of RAR and Msg 4 is more important. In order to prevent the UE from missing detection of RAR and Msg 4, it may be considered to repeatedly send RAR and Msg 4 within a window.

Method 3:

Step 1: The one or more UEs send a preset preamble on a preset time-frequency resource. The preamble resource has a corresponding relationship with the group ID.

Step 2: The eNB learns through the PRACH resource (time-frequency resource information or preamble information) sent by the UE that the UE accesses on behalf of a group of UEs; after that, the eNB sends a RAR, which carries TA, M TC-RNTI and other information.

Step 3: All UEs or some UEs in the group (all UEs or some UEs refer to UEs that need to perform random access) monitor RAR to obtain TA and TC-RNTI.

Step 4: The one or more UEs that sent the preamble in step 1 or a preset UE among the multiple UEs (for example, the one with the smallest UEID) sends a Msg 3, the Msg 3 carries a group ID, and the Msg 3 is scrambled with a TC-RNTI, and the TC-RNTI may be the first TC-RNTI among the TC-RNTIs obtained in step 3.

Step 5: eNB sends Msg 4, and all UEs or some UEs in the group (all UEs or some UEs refer to UEs that need to perform random access) monitor Msg4. Msg 4 may be one of the following:

a. A Msg 4 obtained by scrambling the TC-RNTI in Msg 3, the Msg 4 may carry a group ID, and may also include one or M sets of radio resources, or it may also continue to carry multiple of the M TC-RNTIs in step 2. Further, the Msg 4 may also include one or M pieces of radio resource configuration information, such as CQI feedback resources, SR resources and so on. The UE that receives the Msg 4 may determine the C-RNTI allocated to itself and the radio resource configuration information in a manner similar to the method 2 in Example 2.

b. The monitored Msg 4 can be multiple Msg 4, and the multiple Msg 4 are respectively scrambled with M TC-RNTIs. Msg 4 can carry group ID. Msg 4 supports Hybrid Automatic Repeat reQuest (HARQ, Hybrid Automatic Repeat reQuest), so, in this case, each UE can feed back its corresponding Msg 4 and send an ACK confirmation message, which can avoid waste of resources. In this case, if the eNB does not receive the ACK sent by the UE, it considers that this set of resources is not used by the UE.

In the above three ways, if the UE fails to access, the group of UEs can re-initiate random access, or implement the access of corresponding UEs in the existing way, that is, a single UE initiates random access alone.

Furthermore, if two UEs select the same radio resource (including C-RNTI, wireless air interface resources, etc.), the uplink data sent by them will always collide, resulting in a failure to send. If the eNB finds that these UEs always fail to transmit, they can send indication signaling to make them re-access.

If the number of UEs that correctly receive Msg4 is less than the number of radio resources allocated by the eNB, there will be waste. The OUE can send a message to indicate that it occupies a certain set of resources. If the eNB does not receive the information for a certain set of resources, the eNB considers that the

set of resources is not occupied by the UE. For example, a time window is defined. Within this time window, the UE sends an indication message indicating that it occupies the set of resources (TC-RNTI, radio resource). The indication information can be SR, ACK, etc. If the eNB does not receive the information indicated, the eNB considers this set of resources to be wasted resources and it can be allocated to other UEs.

Example 4

Example 4 provides a method for a group of UEs to compete for access. In this example, the UEs in the UE group can communicate with each other. Specifically, the UEs in the group can use short-distance communication methods such as WIFI and D2D to realize interaction.

In this example, when members in the group need to initiate random access, they first report to the first UE (hereinafter referring to as the first UE as the group leader), and the group leader can perform access according to a certain period, such as once every 100mS, If all UEs within 100 mS have no random access request, no access is initiated; if one or more UEs have random access requests, the group leader initiates random access; or, the group leader initiates random access when the accumulated random access requests reach a certain number. The group leader can be preset, or be fixed as a UE with a certain ID number, such as a UE with an ID number of 0, or determine a UE in the UE group as the group leader according to a certain rule; or,

When UEs of the same service type may be divided into a group, and these UEs will initiate random access at a fixed time, then the group leader will initiate random access instead of the whole group of UEs at a fixed time.

The process in which the group leader performs random access on behalf of the entire group of UEs or some UEs is given below in modes 1 to 3.

Method 1:

Step 1: The group leader sends a preamble on the designated time-frequency resource;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE, and sends RAR, which carries TA, TC-RNTI and other information。

Step 3: The group leader sends Msg 3, and Msg 3 carries the number M of UEs in the group that need random access;

Step 4: The eNB sends Msg 4, Msg 4 is scrambled with TC-RNTI, Msg 4 contains M-1 C-RNTI values, or M-1 different values of TC-RNTI, or may not be included; further, the Msg 4 may also include one set or M sets of radio resource configuration information, such as CQI feedback resources, SR resources, and the like.

Step 5: The group leader notifies the UEs with random access needs of these information, which may be notified by broadcast or unicast, which is not limited here.

Method 2:

Step 1: The group leader sends a preamble on a certain time-frequency resource, the PRACH resource corresponds to the number M of UEs that need to perform random access, or the eNB knows the number of random access requests;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE sending the preamble, and sends RAR, which carries information such as TA and a TC-RNTI.

Step 3: The group leader sends Msg 3;

Step 4: The eNB sends Msg 4, Msg 4 is scrambled with TC-RNTI, Msg 4 contains M-1 C-RNTI values, or M-1 difference values with TC-RNTI, or may not include, the remaining TC-RNTI values allocated RNTI is obtained according to preset rules, such as TC-RNTI, TC-RNTI+1,..., TC-RNTI+M-1 and so on, the Msg 4 may also include one or M sets of radio resource configuration information, such as CQI feedback resources, SR resources, etc., if it is a set of radio resource configuration information, the rest of the allocated radio resources Obtained according to preset rules.If it is a set of radio resource configuration information, the rest of the allocated radio resources are obtained according to preset rules.

When the group leader notifies the UEs with scheduling requests of these information, it may use broadcast or unicast, which is not limited here.

Method 3:

Step 1: The group leader sends a preamble on a certain time-frequency resource, the PRACH resource corresponds to the number M of UEs that need random access, or the number of random access requests known by the eNB;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE, and sends RAR, which carries information such as TA and M TC-RNTIs.

Step 3: UE: Send Msg 3, and the Msg 3 uses one of the M TC-RNTIs for scrambling.

Step 4: eNB sends Msg 4, Msg 4 is scrambled with TC-RNTI in Msg 3, and Msg 4 includes 1 or M sets of radio resources (M TC-RNTIs can also be carried continuously).

Method 4:

In this method, the group members know the PRACH resources (including time-frequency resources and preamble) sent by the group leader through short-distance communication, so as to know the RA-RNTI.

The process of achieving random access includes the following steps:

Step 1: The group leader UE sends a preamble on a certain time-frequency resource, and the PRACH resource corresponds to the number M of UEs that need to perform random access;

Step 2: The eNB learns that the UE is the group leader through the PRACH resource (time-frequency resource information or preamble information) sent by the UE, and sends RAR, which carries TA, TC-RNTI information and UL grant information. This is similar to Method 1 in Example 2.

Step 3: UEs with access requests in the group send Msg 3 on the resources corresponding to their corresponding UL grants;

Step 4: The eNB sends Msg4 respectively according to the received Msg 3, and the number of the Msg 4 sent is the same as the number of the Msg 3 received by the eNB.

In this example, in order to prevent the UE from missing the RAR detection, the eNB can repeatedly send the RAR within a window.

Method 5:

In this method, the group members know the PRACH resources (including time-frequency resources and preamble) sent by the group leader through short-distance communication, so as to know the RA-RNTI.

The random access procedure includes the following steps:

Step 1: The group leader sends a preamble on a certain time-frequency resource;

Step 2: The eNB learns that the UE sending the PRACH resource is the group leader through the received PRACH resource (time-frequency resource information or preamble information), and sends RAR, which carries information such as TA and TC-RNTI.

Step 3: All UEs or UEs in the group that have access requests monitor the RAR to obtain TA and TC-RNTI.

Step 4: After listening to the RAR, the group leader UE sends Msg 3, carrying the group ID or a preset value, and the number M of UEs in the group that need to perform random access. The group ID or a preset value may be notified by the group leader, notified by the network side, or preset.

Step 5: eNB sends Msg 4, carrying the group ID or preset value in the previous step, Msg 4 is scrambled with TC-RNTI, Msg can also include M-1 C-RNTI values, and one or M sets of radio resource configuration information. All UEs/UEs with access requests in the group listen to Msg 4 scrambled by TC-RNTI, and obtain their own C-RNTI and radio resource configuration information according to preset rules.

Before this method is implemented, the group member UE should know the PRACH resource (time frequency, preamble) sent by the group leader UE, so as to know that the reception of RAR and Msg 4 in RA-RNTI 0 is more important in this method. In order to avoid UE missing RAR and Msg 4, it may be considered to send RAR and Msg 4 repeatedly within a window.

Method 6:

The group member UE knows the PRACH resource (including time-frequency resource and preamble) sent by the group leader UE, so as to know the RA-RNTI.

The random access procedure in this example includes the following steps:

Step 1: The UE sends a preamble on a certain time-frequency resource, and the PRACH resource corresponds to the number M of UEs that need to perform random access, or the number of random access requests known by the eNB;

Step 2: The eNB learns that the UE is the group leader through the received PRACH resources (time-frequency resource information or preamble information), and sends RAR, which carries information such as TA and TC-RNTI. Step 3: UEs with access requests in the group monitor RAR and get TA and TC-RNTI. Step 4: The group leader sends Msg 3, carrying an ID known to all UEs in the group;

Step 5: After receiving Msg 3, eNB sends Msg 4. Msg 4 is scrambled with TC-RNTI. Msg 4 contains M-1 C-RNTI values, or M-1 difference values with TC-RNTI, and includes a set or M sets of radio resources.

Step 6: All UEs in the UE group or UEs in the group with access requests listen to Msg 4 scrambled by the TC-RNTI, and obtain their own C-RNTI and radio resource configuration information according to preset rules or randomly.

Method 7:

The group member UE knows the PRACH resource (including time-frequency resource and preamble) sent by the group leader UE, so as to know the RA-RNTI.

The random access process in this mode includes the following steps:

Step 1: The UE sends a preamble on a certain time-frequency resource, and the PRACH resource corresponds to the number M of UEs that need to perform random access, or the number of random access requests known by the eNB;

Step 2: The eNB learns that the UE sending the PRACH resource is the group leader through the received PRACH resource (time-frequency resource information or preamble information), and sends RAR, which carries information such as TA and multiple TC-RNTIs.

Step 3: The group leader uses a TC-RNTI to send Msg 3, carrying the group ID or a preset value.

Step 4: After receiving Msg 3, eNB sends Msg 4. Msg 4 can be a message scrambled with the TC-RNTI in Msg 3. The Msg 4 contains one or M sets of radio resources (it can also continue to carry multiple TC -RNTI). All UEs/UEs with access requests in the group listen to Msg 4 scrambled by TC-RNTI, and obtain their own C-RNTI and radio resource configuration automatically according to preset rules. 。

Alternatively, the eNB may also send multiple Msg 4s, which are respectively scrambled with multiple TC-RNTIs. All UEs or UEs in the group that need random access determine their corresponding C-RNTI according to preset rules or randomly, and receive Msg 4 corresponding to the C-RNTI.

If two UEs select the same radio resources (including C-RNTI, radio interface resources, etc.), the uplink data they send will always collide, resulting in transmission failure. If the eNB finds that these UEs always fail to transmit, it can send an indication signal order to reconnect it.

If the number of UEs that correctly receive Msg 4 is less than the number of radio resources allocated by the eNB, there will be waste. The OUE can send a

message to indicate that it occupies a certain set of resources. If the eNB does not receive the information for a certain set of resources, the eNB considers that the set of resources is not occupied by the UE. For example, define a time window. Within this time window, the UE should send an indication message indicating that it occupies the set of resources (TC-RNTI, radio resource). The indication information can be SR, ACK, etc. If the eNB does not receive the indication that this information is used, the eNB considers this set of resources to be wasted resources and it can be allocated to other UEs.

Embodiment 4

Based on the same technical concept as the above-mentioned embodiments, see FIG. 5, which shows that an embodiment of this invention provides a user equipment UE50, which may include: a sending unit 501 and a monitoring unit 502; wherein,

The sending unit 501 is configured to send a preamble to the evolved base station eNB on a time-frequency resource;

The monitoring unit 502 is configured to monitor the random access response RAR corresponding to the preamble sent by the eNB。

For example, referring to FIG. 6, the monitoring unit 502 includes: a first descrambling subunit 5021A, a first receiving subunit 5022A, and an allocation subunit 5023A, wherein,

The first descrambling subunit 5021A is configured to unscramble the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset wireless network temporary identifier RA-RNTI corresponding to the preamble;

The first receiving subunit 5022A is configured to receive the RAR, where the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant;

The allocating subunit 5023A is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

Further, the allocating subunit 5023A is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to a preset rule according to the UE's own identity.

For example, referring to FIG. 7, the monitoring unit 502 includes: a determining subunit 5021B, a second descrambling subunit 5022B, and a second receiving subunit 5023B, wherein,

The determining subunit 5021B is configured to determine the RA-RNTI corresponding to each of the UEs according to their respective identities and/or preambles;

The second descrambling subunit 5022B is configured to unscramble the CRC of the DCI that schedules the RAR according to the RA-RNTI corresponding to each of the UEs;

The second receiving subunit 5023B is configured to receive the RAR corresponding to the UE itself, and the RAR includes a TC-RNTI and/or an uplink grant allocated to the UE.

In the above scheme, the sending unit 501 is further configured to send the message 3 according to the uplink grant allocated to the UE itself.

In the above scheme, referring to FIG. 6 and FIG. 7, the UE further includes a receiving unit 503 configured to receive the message 4 sent by the eNB.

Further, the message 4 includes:

The CRC of the DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

Further, the message 4 includes at least one set of radio resources for the UE to determine to allocate to itself.

Further, the message 4 includes: a set of radio resources allocated to the corresponding UE.

For example, the sending unit 501 is further configured to send to the eNB an indication signal for notifying the eNB that the UE has successfully accessed.

Further, the indication signal is a scheduling request SR or an acknowledgment ACK signal.

In the above scheme, the receiving unit 503 is further configured to receive instruction information sent by the eNB for instructing the UE to re-initiate random access.

For example, the receiving unit 503 is further configured to receive DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, receiving the random access request sent by the second UE from 。

Further, the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

For example, the sending unit 501 is configured to periodically send a Preamble on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests, or the number of UEs included in the UE group, or a preset number of UEs.

In the above scheme, the preamble and/or time domain resources and/or frequency domain resources correspond to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset number of UEs.

Embodiment 5

Based on the same technical concept as the previous embodiments, see FIG. 8, which shows that an embodiment of this invention provides an evolved base station eNB 80, which may include: a receiving unit 801 and a sending unit 802, wherein,

The receiving unit 801 is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein, the first UE has at least one UE in the UE group; the sending Unit 802, configured to send a random access response RAR corresponding to the preamble。

For example, the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used for the first UE and or the second UE to determine the TC-RNTI and/or uplink allocated to itself from the at least one TC-RNTI and/or uplink grant according to

its own identity and according to preset rules authorization, the second UE is all or part of the UE group.

For example, the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is all or part of UEs in the UE group.

Further, the receiving unit 801 is further configured to receive the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

Further, the sending unit 802 is further configured to send message 4 to the first UE and/or the second UE.

Further, the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

Optionally, the message 4 includes at least one set of radio resources for the first UE and/or the second UE to determine to allocate to itself.

Optionally, the message 4 includes: a set of radio corresponding the first UE or the second UE.

For example, the receiving unit 801 is further configured to receive a message sent by the first UE and/or the second UE for notifying the eNB that the first UE and/or the second UE have successfully accessed indication signal; The indication signal is a scheduling request SR or an acknowledgment ACK signal.

For example, the sending unit 802 is further configured to send indication information for instructing the first UE and/or the second UE to reinitiate random access to the first UE and/or the second UE.

For example, the sending unit 802 is further configured to send DCI or paging message or radio resource control RRC signaling to the first UE and/or the second UE.

Further, the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or, the DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

For example, the receiving unit 801 is specifically configured to: periodically receive a preamble sent by the first UE on a frequency domain resource.

In the above scheme, the message 3 and the message 4 include the group identifier of the UE group or a preset field.

In the above scheme, the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

In addition, based on the same technical concept as the above embodiments, an embodiment of this invention also provides a random access system, the system including a user equipment UE and an evolved base station eNB; wherein,

The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group;

The eNB is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

And, send the RAR corresponding to the preamble。

Embodiment 6

An embodiment of the present invention also provides a computer-readable storage medium, storing computer-executable instructions, and implementation of the above random access method when the computer-executable instructions are executed.

Those with technical qualifications can understand that all or part of the steps in the above embodiments can be implemented using a computer program flow, the computer program can be stored in a computer-readable storage medium, and

the computer program can be run on a corresponding hardware platform (such as system, equipment, apparatus, component, processor, etc.), and when executed, includes one or a combination of the steps of the method embodiments.

Optionally, all or part of the steps in the above embodiments can also be realized using integrated circuits, and these steps can be fabricated into individual integrated circuit modules, or multiple modules or steps can be incorporated into a single integrated circuit module.

The devices/functional modules/functional units in the above embodiments can be realized by general-purpose computing devices, and they can be concentrated on a single computing device, or distributed on a network composed of multiple computing devices.

When the devices/functional modules/functional units in the above embodiments are realized in the form of software functional modules and sold or used as independent products, they can be stored in a computer-readable storage medium. The computer-readable storage medium mentioned above may be a read-only memory, a magnetic disk or an optical disk, and the like.

Those with technical qualifications can understand that the technical solution of this application can be modified or equivalently replaced without departing from the spirit and scope of the technical solution of the present application. The protection scope of the present application shall be determined by the scope defined in the claims.

Those with technical qualifications should understand that the embodiments of this invention may be provided as methods, systems, or computer program products. Accordingly, this invention can take the form of a hardware embodiment, a software embodiment, or an embodiment combining software and hardware aspects. Furthermore, this invention may take the form of a computer program product embodied on one or more computer-usable storage media (including but not limited to disk storage and optical storage, etc.) having computer-usable program code embodied therein.

This invention is described with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It should be understood that each procedure and/or block in the flowchart and/or block diagram, and a combination of procedures and/or blocks in the flowchart and/or block diagram can be realized by computer program instructions. These computer program instructions may be

provided to a general purpose computer, special purpose computer, embedded processor, or processor of other programmable data processing equipment to produce a machine such that the instructions executed by the processor of the computer or other programmable data processing equipment produce an apparatus for realizing the functions specified in one or more procedures of the flowchart and/or one or more blocks of the block diagram.

These computer program instructions may also be stored in a computer-readable memory capable of directing a computer or other programmable data processing apparatus to operate in a specific manner, such that the instructions stored in the computer-readable memory produce an article of manufacture comprising instruction means for implementing the functions specified in one or more of the flow charts and/or one or more blocks of the block diagram.。

These computer program instructions may also be loaded onto a computer or other programmable data processing device, causing a series of operational steps to be performed on the computer or other programmable device to produce a computer-implemented process; the instructions executed on the computer or other programmable devices thus provide steps for realizing the functions specified in one or more procedures of the flowchart and/or one or more blocks of the block diagram.

The above descriptions are only preferred embodiments of this invention, and are not intended to limit the protection scope of this invention.

Industrial Applicability

According to a method, device and system for random access provided by the embodiments of the present invention, one or more UEs in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource to instruct the eNB to perform UE random access processing of some or all UEs in the group. In this way, a group of UEs only need to occupy one PRACH resource (including time-domain resources, frequency-domain resources and preamble) in one random access, so that the PRACH resources can be greatly saved and meet the needs of a huge number of machine communications.

Claims

1. A random access method, characterized in that the method comprises:

The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group.

2、 The method according to claim 1, wherein the first UE is at least one of the following:

Comprised of at least one UE; or,

At least one UE determined according to preset rules; or at least one UE notified by the eNB.

3、 The method according to claim 1, wherein the preamble and/or the time domain resources and/or frequency domain resources are preset, or determined by the group identifier of the UE group, or are notified by the above eNB.

4、 The method according to claim 1, wherein the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, comprising:

The first UE and/or the second UE unscrambles the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset radio network temporary identifier RA-RNTI corresponding to the preamble, and receives the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization;

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

5、 The method according to claim 4, wherein, the first UE and/or the second UE according to at least one TC-RNTI included in the RAR And/or at least one uplink grant determines the TC-RNTI and/or uplink grant allocated to itself, specifically including:

The first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to the first UE and/or the second UE according to a preset rule according to its own identity.

6、 The method according to claim 1, wherein the first UE and/or the second UE monitors the RAR corresponding to the preamble sent by the eNB, comprising:

The first UE and/or the second UE determine their respective corresponding RA-RNTIs according to their respective identities and/or preambles, and unscramble the CRC for scheduling the DCI of the RAR according to the respective corresponding RA-RNTIs, And receive the RAR corresponding to itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE or second UE.

7、 The method according to claim 4, wherein after the first UE and/or the second UE monitor the RAR corresponding to the preamble sent by the eNB, the method further comprises: the first UE and /or the second UE sends message 3 according to the uplink grant allocated to itself.

8、 The method according to claim 7, wherein after the first UE and/or the second UE sends the message 3 according to the uplink grant allocated to itself, it further includes:

The first UE and/or the second UE receives message 4 sent by the eNB.

9. The method according to claim 8, wherein the receiving of the message 4 sent by the eNB by the first UE and/or the second UE includes:

The CRC of the DCI scheduling the message 4 is scrambled using the TC-RNTI allocated to the first UE and/or the second UE.

10. The method according to claim 9, wherein the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determine the radio resources allocated to itself according to the at least one set of radio resources included in the message 4 .

11. The method according to claim 10, wherein the first UE and/or the second UE determines radio resources allocated to itself according to at least one set of radio resources included in the message 4, further comprising:

The UE also determines radio resources allocated to itself according to its own identity according to a preset rule.

12、 The method according to claim 9, wherein the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

13、 The method according to claim 8, wherein after the first UE and/or the second UE receives the message 4 sent by the eNB, further comprising: the first UE and/or the second UE sending the eNB an indication signal for notifying the eNB of successful access of the first UE and/or the second UE.

14、 The method according to claim 13, wherein the indication signal is a scheduling request (SR) or an acknowledgment (ACK) signal.

15. The method according to claim 8, characterized in that after the first UE and/or the second UE receive the message 4 sent by the eNB, further comprising:

The first UE and/or the second UE receives instruction information sent by the eNB for instructing the first UE and/or the second UE to re-initiate random access.

16、 The method according to claim 1, wherein before the first UE in the UE group sends a preamble on a time-frequency resource, further comprising:

The first UE and/or the second UE receives DCI or paging message or radio resource control RRC signaling sent by the eNB;

Or, the first UE receives random access request information sent by the second UE.

17、 The method according to claim 16, wherein the first UE and/or the second UE receive the DCI or paging message or RRC signaling sent by the eNB, including at least one of the following:

The DCI, or the CRC that schedules the DCI of the paging message or RRC message, uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identity of the first UE and/or the second UE, or

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

18. The method according to claim 16, wherein the first UE receives the random access request information sent by the second UE, comprising:

The first UE counts the received random access requests of the second UE in the group;

When the count reaches a preset threshold, the first UE sends a preamble on a time-frequency resource.

19、 The method according to claim 1, wherein the first UE in the UE group sends a preamble on a time-frequency resource, specifically comprising:

The first UE periodically sends a preamble on a frequency domain resource.

20、 The method according to claim 8, wherein the message 3 and the message 4 include a group identifier of the UE group or a preset field.

21. The method according to claim 7, wherein the message 3 includes the number of UEs with random access requests in the UE group or the number of UEs included in the UE group or a preset number of UEs.

22、 The method according to claim 3, wherein the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs in the UE group corresponds to the number of UEs included or a preset number of UEs.

23、 A random access method, characterized in that the method comprises:

The evolved base station eNB receives a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein, the first UE is at least one UE in the UE group;

The eNB sends the random access response RAR corresponding to the preamble。

24、 The method according to claim 23, wherein the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used for the first UE and/or the second UE determines the TC-RNTI and/or uplink grant allocated to itself from the at least one TC-RNTI and/or uplink grant according to the preset allocation rule according to its own identity, and the second UE is the entire UE group or part of the UEs in the UE.

25、 The method according to claim 23, wherein the RAR includes a TC-RNTI and/or an uplink grant assigned to the corresponding first UE/or second UE, and the second UE is the all or part of UEs in the UE group.

26、 The method according to claim 24, wherein after the eNB sends the RAR corresponding to the preamble, the method further comprises:

The eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

27、 The method according to claim 26, wherein after the eNB receives the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself, the method further comprises:

The eNB sends message 4 to the first UE and/or the second UE.

28、 The method according to claim 27, wherein the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

29、 The method according to claim 28, wherein the message 4 includes at least one set of radio resources, and the first UE and/or the second UE determine allocation according to the at least one set of radio resources included in the message 4 to its own radio resources.

30、 The method according to claim 28, wherein the message 4 includes:

A set of radio resources allocated to the corresponding first UE or second UE.

31、 The method according to claim 27, wherein after the eNB sends message 4 to the first UE and/or the second UE, the method further comprises:

The eNB receives an indication signal sent by the first UE and/or the second UE for notifying the eNB that the first UE and/or the second UE have been successfully accessed; the indication signal is a scheduling request SR or acknowledge ACK signal.

32、 The method according to claim 27, wherein after the eNB sends message 4 to the first UE and/or the second UE, the method further comprises:

The eNB sends to the first UE and/or the second UE a message indicating that the first UE and/or

The second UE re-initiates the random access indication information.

33、 The method according to claim 23, wherein before the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, the method further comprises:

The eNB sends DCI or a paging message or radio resource control RRC signaling to the first UE and/or the second UE.

34、 The method according to claim 33, wherein the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC of the DCI that schedules the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message contains the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identity of the first UE and/or the second UE, or

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

35、 The method according to claim 23, wherein the eNB receives the preamble sent by the first UE in the UE group on a time-frequency resource, specifically comprising:

The eNB periodically receives a preamble sent by the first UE on a frequency domain resource.

36. The method according to claim 24, wherein the message 3 and message 4 contain the group identifier of the UE group or a preset field.

37、 The method according to claim 23, wherein the message 3 includes the number of UEs in the UE group that have random access requests or the number of UEs included in the UE group.

38、 A user equipment UE, characterized in that the UE includes: a sending unit and a monitoring unit; wherein,

The sending unit is configured to send a preamble to the evolved base station eNB on a time-frequency resource;

The monitoring unit is configured to monitor the random access response RAR corresponding to the preamble sent by the eNB。

39、 The UE according to claim 38, wherein the monitoring unit includes: a first descrambling subunit, a first receiving subunit, and an allocating subunit, wherein,

The first descrambling subunit is configured to unscramble the cyclic redundancy check code CRC of the downlink control information DCI scheduling the RAR according to the preset wireless network temporary identifier RA-RNTI corresponding to the preamble;

The first receiving subunit is configured to receive the RAR; the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink grant;

The allocating subunit is configured to determine the TC-RNTI and/or uplink grant allocated to the UE itself according to at least one TC-RNTI and/or at least one uplink grant included in the RAR.

40. The UE according to claim 39, wherein the allocating subunit is configured to determine the TC-RNTI and/or uplink RNTI allocated to the UE according to a preset rule according to the identity of the UE itself authorized.

41. The UE according to claim 38, wherein the monitoring unit comprises: a determining subunit, a second descrambling subunit and a second receiving subunit, wherein,

The determining subunit is configured to determine the RA-RNTI corresponding to each of the UEs according to their respective identities and/or preambles;

The second descrambling subunit is configured to unscramble the CRC of the DCI scheduling the 20 RARs according to the respective RA-RNTIs corresponding to the UEs;

The second receiving subunit is configured to receive a RAR corresponding to the UE itself, where the RAR includes a TC-RNTI and/or an uplink grant allocated to the UE.

42. The UE according to claim 39, wherein the sending unit is further configured to send the message 3 according to the uplink grant allocated to the UE itself.

43. The UE according to claim 39, wherein the UE further comprises a receiving unit configured to receive the message 4 sent by the eNB.

44. The UE according to claim 43, wherein the message 4 includes:

The CRC of the DCI of the scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

45. The UE according to claim 44, wherein the message 4 includes at least one set of radio resources for the UE to determine to allocate to itself.

46、 The UE according to claim 44, wherein the message 4 includes: a set of radio resources allocated to the corresponding UE.

47、 The UE according to claim 43, wherein the sending unit is further configured to send an indication signal for notifying the eNB that the UE has successfully accessed to the eNB.

48、 The UE according to claim 47, wherein the indication signal is a scheduling request (SR) or an acknowledgment (ACK) signal.

49、 The UE according to claim 43, wherein the receiving unit is further configured to receive indication information sent by the eNB for instructing the UE to re-initiate random access.

50. The UE according to claim 38, characterized in that, the UE further comprises a receiving unit configured to receive DCI or paging message or radio resource control RRC signaling sent by the eNB; or, receive the random access request information sent by the second UE.

51. The UE according to claim 50, wherein the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identifier of the first UE and/or the second UE, or the DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or preamble frequency domain resources.

52. The UE according to claim 38, wherein the sending unit is configured to periodically send a preamble on a frequency domain resource.

53. The UE according to claim 43, wherein the message 3 and the message 4 contain the group identifier of the UE group or a preset field.

54. The UE according to claim 42, wherein the message 3 includes the number of UEs in the UE group having random access requests or the number of UEs included in the UE group or a preset number of UEs.

55. The UE according to claim 38, wherein the preamble and/or time domain resources and/or frequency domain resources are related to the number of UEs with random access requests in the UE group or the number of UEs included in the UE group corresponding to the number of UEs or a preset number of UEs.

56、 An evolved base station eNB, characterized in that the eNB includes: a receiving unit and a sending unit, wherein,

The receiving unit is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource; wherein the first UE is at least one UE in the UE group; the sending unit is used to send a random access response RAR corresponding to the preamble.

57、 The eNB according to claim 56, wherein the RAR includes at least one temporary cell radio network temporary identifier TC-RNTI and/or at least one uplink authorization; the RAR is used by the first UE and/or the second UE to determine the TC-RNTI and/or uplink grant assigned to itself from the at least one TC-RNTI and/or uplink grant according to its own identity according to preset rules, and the second UE is all or part of the UE.

58、 The eNB according to claim 56, wherein the RAR includes a TC-RNTI and/or an uplink grant allocated to the corresponding first UE/or second UE, and the second UE is the all or part of UEs in the UE group.

59、 The eNB according to claim 57, wherein the receiving unit is further configured to receive the message 3 sent by the first UE and/or the second UE according to the uplink grant allocated to itself.

60、 The eNB according to claim 59, wherein the sending unit is further configured to send message 4 to the first UE and/or the second UE.

61. The eNB according to claim 59, wherein the message 4 includes: the cyclic redundancy check code CRC of the downlink control information DCI of the

scheduling message 4 is scrambled by using the TC-RNTI allocated to the first UE and/or the second UE.

62. The eNB according to claim 61, wherein the message 4 includes at least one set of radio resources for the first UE and/or the second UE to determine to allocate to itself.

63. The eNB according to claim 61, wherein the message 4 includes: a set of radio resources allocated to the corresponding first UE or second UE.

64、 The eNB according to claim 60, wherein the receiving unit is further configured to receive a message sent by the first UE and/or the second UE for notifying the eNB of the first UE and/or an indication signal of successful access by the second UE; the indication signal is a scheduling request SR or an acknowledgment ACK signal.

65、 The eNB according to claim 60, wherein the sending unit is further configured to send to the first UE and/or the second UE a message for instructing the first UE and/or the second UE to re-initiate random access indication information.

66、 The eNB according to claim 56, wherein the sending unit is further configured to send DCI or a paging message or radio resource control (RRC) signaling to the first UE and/or the second UE.

67、 The method according to claim 66, wherein the DCI or paging message or RRC signaling includes at least one of the following:

The DCI or the CRC that schedules the DCI of the paging message or RRC message uses the group identifier of the UE group to perform scrambling; or,

The DCI or the paging message or the RRC message includes the group identifier of the UE group; or,

The DCI or the paging message or the RRC message includes the identity of the first UE and/or the second UE; or,

The DCI or the paging message or the RRC message includes the Preamble identifier and/or the time domain resource of the Preamble and/or the frequency domain resource of the preamble.

68. The method according to claim 56, wherein the receiving unit is specifically configured to: periodically receive a preamble sent by the first UE on a frequency domain resource.

69、 The eNB according to claim 57, wherein the message 3 and the message 4 include the group identifier of the UE group or a preset field.

70、 The eNB according to claim 56, wherein the message 3 includes the number of UEs in the UE group having random access requests or the number of UEs included in the UE group.

71、 A random access system, characterized in that the system includes user equipment UE and evolved base station eNB; wherein,

The first UE in the user equipment UE group sends a preamble to the evolved base station eNB on a time-frequency resource;

The first UE and/or the second UE in the UE group monitors the random access response RAR corresponding to the preamble sent by the eNB; wherein the first UE is at least one in the UE group UE, the second UE is all or part of UEs in the UE group;

The eNB is configured to receive a preamble sent by a first UE in a user equipment UE group on a time-frequency resource;

And, send the RAR corresponding to the preamble.

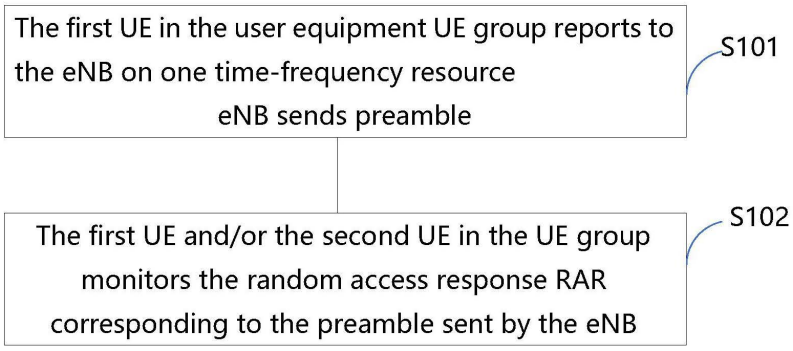


Figure 1

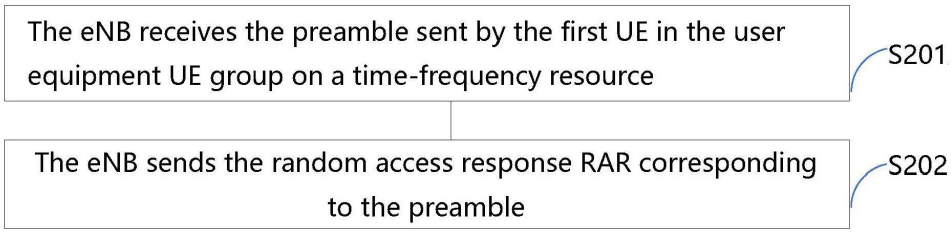


Figure 2

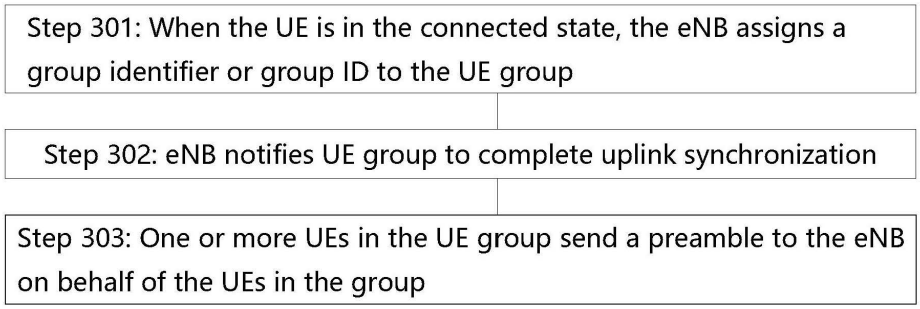


Figure 3

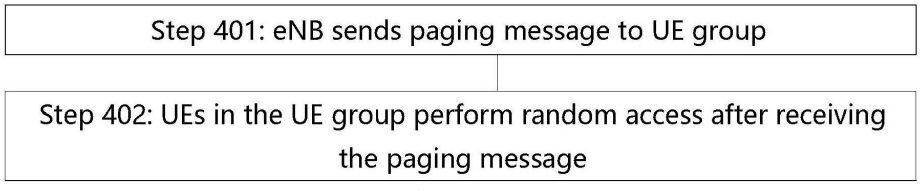


Figure 4

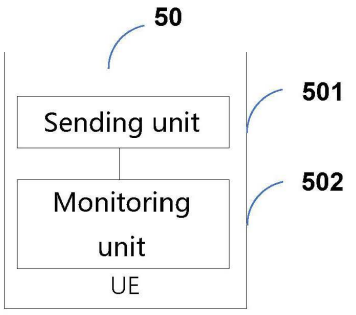


Figure 5

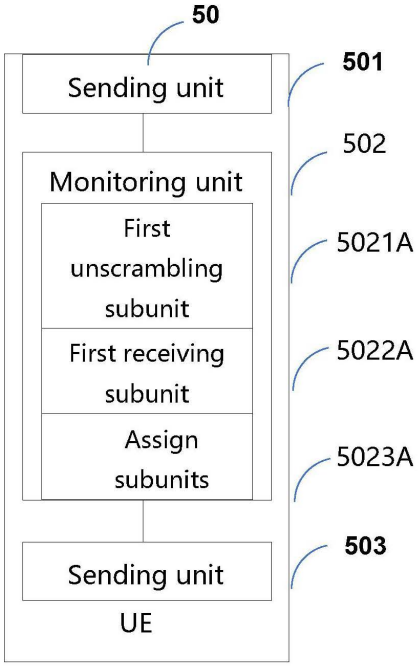


Figure 6

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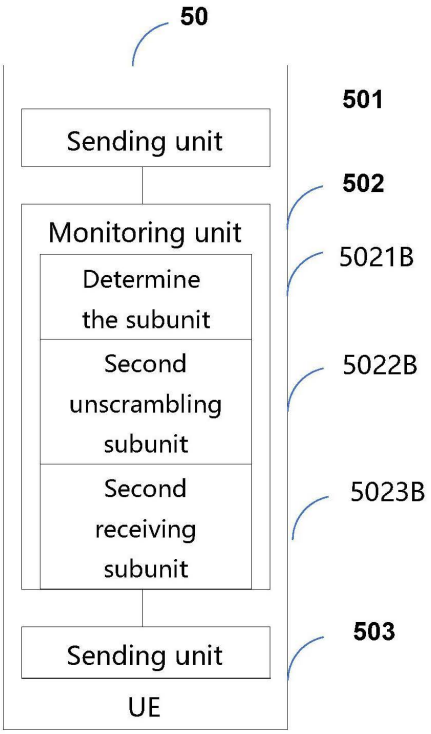


Figure 7

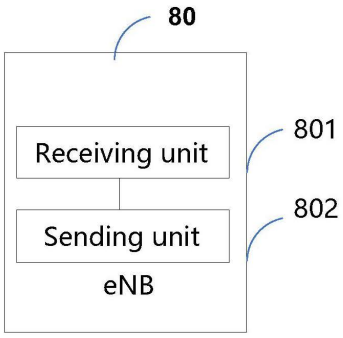


Figure 8

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/082087

A. CLASSIFICATION OF SUBJECT MATTER

H04W 74/08 (2009.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W; H04Q; H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, EPODOC, WPI, GOOGLE, 3GPP: RAR, MTC, M2M, UE, PRACH, random w access, RA, preamble, machine+ 4w communicat+, group+, represent+, master, sav+, resource+, terminal, device, transit, monitor, prefix code

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102378302 A (HUAWEI TECHNOLOGIES CO., LTD.) 14 March 2012 (14.03.2012) claims 1 to 25, description, paragraphs [0008] to [0010], [0106] to [0136], and figures 6, 8 to 11	1-71
X	WO 2014096766 A1 (SONY CORPORATION et al.) 26 June 2014 (26.06.2014) description, page 20, line 8 to page 24, line 10, and figures 5 and 6	1-71
X	CN 103141147 A (SONY CORPORATION) 05 June 2013 (05.06.2013) claims 1 to 11, description, paragraphs [0096] to [0105], [0137] to [0171]	1-71
X	CN 102917433 A (INNOFIDEI TECHNOLOGY CO., LTD.) 06 February 2013 (06.02.2013) claims 1 to 11, description, paragraphs [0006] to [0020]	1-71
A	US 2013114494 A1 (LG ELECTRONICS INC.) 09 May 2013 (09.05.2013) the whole document	1-71

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2016	26 July 2016
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer LIU, Shan Telephone No. (86-10) 62413248

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2016/082087

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 102378302 A	14 March 2012	AU 2011260987 A1	21 March 2013
		US 2013155894 A1	20 June 2013
		WO 2011150766 A1	08 December 2011
WO 2014096766 A1	26 June 2014	CN 104885541 A	02 September 2015
		US 2015271791 A1	24 September 2015
		KR 20150096667 A	25 August 2015
		GB 2509071 A	25 June 2014
		EP 2936902 A1	28 October 2015
		JP 2016509768 A	31 March 2016
CN 103141147 A	05 June 2013	JP 2012085011 A	26 April 2012
		WO 2012046507 A1	12 April 2012
		US 2013155994 A1	20 June 2013
CN 102917433 A	06 February 2013	None	
US 2013114494 A1	09 May 2013	WO 2011093663 A2	04 August 2011
		KR 20110088452 A	03 August 2011

Form PCT/ISA /210 (patent family annex) (July 2009)

EXHIBIT 4

IN THE CLAIMS:

Please amend claims 1, 3-5, 8-11, 13, 15-20, 22, and 38 and cancel claim 7 and 21 as follows:

1. (Currently Amended) A random access method, comprising:

sending, by a first User Equipment (UE) in a UE group, a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource; ~~and~~

monitoring, by at least one of the first UE ~~and/~~or a second UE in the UE group, a Random Access Response (RAR) corresponding to the preamble and sent by the eNB, wherein the first UE is at least one UE in the UE group, and the second UE is all or some UEs in the UE group; and

after monitoring, by at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB:

sending, by at least one of the first UE or the second UE, a message 3 according to a Uplink (UL) grant allocated thereto, wherein the message 3 comprises a number of UEs having random access requests in the UE group or a number of UEs contained in the UE group or a pre-set UE number.

2. (Original) The method according to claim 1, wherein the first UE is at least one of the following:

at least one fixed UE; or,

at least one UE determined according to a pre-set rule; or,

at least one UE notified by the eNB.

3. (Currently Amended) The method according to claim 1, wherein at least one of the preamble ~~and/or,~~ the time domain resource ~~and/~~or the frequency domain resource ~~are/~~is pre-set, or determined by a group Identifier (ID) of the UE group, or notified by the eNB.

4. (Currently Amended) The method according to claim 1, wherein monitoring, by at least one of the first UE ~~and/~~or the second UE, the RAR corresponding to the preamble and sent by the eNB comprises:

descrambling, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, a Cyclic Redundancy Check (CRC) of Downlink Control Information (DCI) for scheduling the RAR according to a pre-set Random Access Radio Network Temporary Identity (RA-RNTI) or an RA-RNTI corresponding to the preamble, and receiving the RAR, the RAR comprising at least one of at least one Temporary Cell Radio Network Temporary Identity (TC-RNTI) ~~and/~~or at least one Uplink (UL) grant; and

determining, by at least one of the first UE ~~and/~~or the second UE, at least one of a TC-RNTI ~~and/~~or UL grant allocated thereto according to at least one of at least one TC-RNTI ~~and/~~or at least one UL grant contained in the RAR; or

monitoring, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB comprises:

determining, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, corresponding RA-RNTIs according to at least one of respective IDs ~~and/~~or preambles, descrambling a CRC of DCI for scheduling the RAR according to the corresponding RA-RNTIs, and receiving corresponding RARs, the RAR comprising at least one of a TC-RNTI ~~and/~~or a UL grant allocated to the first UE or second UE.

5. (Currently Amended) The method according to claim 4, wherein determining, by at least one of the first UE ~~and/~~or the second UE, at least one of the TC-RNTI ~~and/~~or the UL grant allocated thereto according to at least one of at least one TC-RNTI ~~and/~~or at least one UL grant contained in the RAR comprises:

determining, by at least one of the first UE ~~and/~~or the second UE, at least one of a TC-RNTI ~~and/~~or a UL grant allocated thereto according to at least one of an ID of the first UE ~~and/~~or the second UE in accordance with a pre-set rule.

6. – 7. (Cancelled)

8. (Currently Amended) The method according to claim [[7]]1, further comprising: after sending, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, the ~~a~~ message 3 according to the UL grant allocated thereto,

receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the

second UE, a message 4 sent by the eNB.

9. (Currently Amended) The method according to claim 8, wherein receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, the message 4 sent by the eNB comprises:

scrambling a CRC of DCI for scheduling the message 4 by using a ~~the~~ TC-RNTI allocated to ~~the first UE and/or the second UE~~at least one of the first UE or the second UE.

10. (Currently Amended) The method according to claim 9, wherein the message 4 comprises at least one set of radio resources, radio resources allocated to ~~the first UE and/or the second UE~~at least one of the first UE or the second UE are determined by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE according to at least one set of radio resources in the message 4; or

the message 4 comprises a set of radio resources allocated to the first UE or second UE.

11. (Currently Amended) The method according to claim 10, wherein the radio resources allocated to ~~the first UE and/or the second UE~~at least one of the first UE or the second UE are further determined by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE according to an ID of ~~the first UE and/or the second UE~~at least one of the first UE or the second UE in accordance with a pre-set rule.

12. (Cancelled)

13. (Currently Amended) The method according to claim 8, further comprising: after receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, the message 4 sent by the eNB,

sending, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, an indicating signal for notifying the eNB of a successful access of ~~the first UE and/or the second UE~~at least one of the first UE or the second UE to the eNB,

wherein the indicating signal is a Scheduling Request (SR) or an

Acknowledgement (ACK) signal.

14. (Cancelled)

15. (Currently Amended) The method according to claim 8, further comprising: after receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, ~~the a~~ message 4 sent by the eNB,

receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, indicating information, sent by the eNB, for indicating re-initiation of a random access of ~~the first UE and/or the second UE~~at least one of the first UE or the second UE.

16. (Currently Amended) The method according to claim 1, further comprising: before sending, by the first UE in the UE group, the preamble over the time-frequency resource,

receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, Downlink Control Information (DCI) or a paging message or a Radio Resource Control (RRC) message sent by the eNB; or,

receiving, by the first UE, random access request information sent by the second UE.

17. (Currently Amended) The method according to claim 16, wherein receiving, by ~~the first UE and/or the second UE~~at least one of the first UE or the second UE, the DCI or the ~~a~~ paging message or the ~~an~~ RRC message sent by the eNB comprises at least one of the following:

the DCI or a CRC of DCI for scheduling the paging message or the RRC message is scrambled by using a group ID of the UE group;

the DCI or the paging message or the RRC message comprises a group ID of the UE group;

the DCI or the paging message or the RRC message comprises an ID of ~~the first UE and/or the second UE~~at least one of the first UE or the second UE; or ~~and~~

the DCI or the paging message or the RRC message comprises at least one of an ID of the ~~a~~ preamble, the ~~and/or a~~ time domain resource of the ~~a~~ preamble ~~and~~/or the ~~a~~ frequency domain resource of the ~~a~~ preamble.

18. (Currently Amended) The method according to claim 16, further comprising: after receiving, by the first UE, the random access request information sent by the second UE,

counting, by the first UE, received random access requests of the second UE in the UE group; and

when a count reaches a pre-set threshold, sending, by the first UE, the ~~a~~ preamble over the ~~a~~ time-frequency resource.

19. (Currently Amended) The method according to claim 1, wherein sending, by the first UE in the UE group, the preamble over the time-frequency resource comprises:

periodically sending, by the first UE, the preamble over the ~~a~~ frequency domain resource.

20. (Currently Amended) The method according to claim 8, wherein the message 3 and the message 4 comprise a ~~the~~ group ID of the UE group or a pre-set field.

21. (Cancelled)

22. (Currently Amended) The method according to claim 3, wherein at least one of the preamble, ~~and/or~~ the time domain resource ~~and/~~or the frequency domain resource correspond~~(s)~~ to the number of UEs having random access requests in the UE group or the number of UEs contained in the UE group or the pre-set UE number.

23. – 37. (Cancelled)

38. (Currently Amended) A User Equipment (UE), comprising: a sending unit and a monitoring unit,

wherein the sending unit is configured to: send a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource; ~~and~~

the monitoring unit is configured to: monitor a Random Access Response (RAR) corresponding to the preamble and sent by the eNB; and

the sending unit is further configured to: send a message 3 according to a Uplink (UL) grant allocated to the UE, wherein the message 3 comprises a number of UEs having random access requests in a UE group or a number of UEs contained in the UE group or a pre-set UE number.

39. – 71. (Cancelled)

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EXHIBIT 5

EXHIBIT C1

Patent Number: US 10,448,430

Patent Title: Group based random access method device and system

Filing Date: 2016-05-13

Publication Date: 2019-10-15

Claim 1: A random access method, comprising:

sending, by a first User Equipment (UE) in a UE group, a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource;

monitoring, by at least one of the first UE or a second UE in the UE group, a Random Access Response (RAR) corresponding to the preamble and sent by the eNB, wherein the first UE is at least one UE in the UE group, and the second UE is all or some UEs in the UE group; and

after monitoring, by at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB:

sending, by at least one of the first UE or the second UE, a message 3 according to a Uplink (UL) grant allocated thereto, wherein the message 3 comprises a number of UEs having random access requests in the UE group or a number of UEs contained in the UE group or a pre-set UE number.

Accused Product: Samsung Galaxy A13 5G Smartphone

References Used:

Samsung Galaxy A13 5G Highlights

Samsung Galaxy A13 5G Models

Samsung Galaxy A13 5G Compare

Buy Samsung Galaxy A13 5G (Unlocked)

3GPP TS 38.213 version 16.5.0 Release 16 (5G; NR; Physical layer procedures for control)

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3GPP TS 38.300 version 16.5.0 Release 16 (5G; NR; NR and NG-RAN Overall description; Stage-2)

3GPP TS 38.321 version 16.4.0 Release 16 (5G; NR; Medium Access Control (MAC) protocol specification)

Reference Links:

https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA

https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models

https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare

https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/

https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf

https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf

https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf

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INFRINGEMENT OF THE PATENT US 10,448,430 BY SAMSUNG GALAXY A13 5G SMARTPHONE DEVICE

Overview

Plaintiff accuses the making, using, selling, offering for sale and/or importation of Defendant Samsung (fka SAMSUNG ELECTRONICS CO., LTD.) and Defendant's parents, affiliates, subsidiaries ("Samsung" or "Defendant") accused system and method, including without limitation the products implementing 3GPP 5th generation telecommunications technology standard (5G) features (Galaxy A13 5G Smartphone) and all other substantially similar products (the "Accused Device(s)") of directly infringing U.S. Patent No. (the "'430 Patent"). The term "Accused Device(s)" includes the associated computer hardware and internal semiconductors, software and data, and processes and methods related thereto. The foregoing infringing products includes operating characteristics that infringe upon the claims of the '430 Patent which teaches a random-access method intended to save PRACH resources and meet requirements for a huge number of machine communications. The technical solution of the '430 Patent enables a group of UEs to only occupy a PRACH resource (including a time domain resource, a frequency domain resource and a preamble) in a random access, so that PRACH resources can be greatly saved, thereby meeting requirements for a huge number of machine communications.

Plaintiff further accuses Samsung of indirectly infringing the '430 Patent by providing its customers and others the Accused Devices to utilize in an infringing manner. Samsung intends to cause infringement by its customers and users as Samsung instructs the users to use the Accused Device in an infringing manner for example, by providing features like HyperFast downloads, lag-free gaming and streaming, HD video calling, etc. Samsung further instructs users to operate the Accused Device in an infringing manner, for example, by providing instructions on using 5G enabled features like HyperFast downloads, lag-free gaming and streaming, HD video calling, etc. Samsung also provides support services for the Accused Device, including providing instructions, configurations, guides, online materials and technical support.

The asserted claims include elements that are implemented, at least in part, by proprietary electronics, firmware and software in the Accused Device. The precise designs, processes, and algorithms used in them are held secret, at least in part, and are not publicly available in their entirety. An inspection of the Accused Device, and an analysis of Samsung's documentation and/or source code may be necessary to fully and accurately describe all infringing features and functionality of the Accused Device and, accordingly, Plaintiff reserves the right to supplement these contentions once such information is made available to Plaintiff. Furthermore, Plaintiff reserves the right to revise these contentions, including as discovery in the case progresses, in view of the Court's final claim construction in this action and in connection with the provision of its expert reports.

10,448,430 Claim 1	Evidence
1. A random access method, comprising:	This is the preamble of the claim and is not limiting. This element, if construed as a limitation, is present literally and under the doctrine of equivalents in the Accused Device. The Accused Device is a smartphone device comprising Octa-Core processor, PLS TFT LCD display, high resolution front and rear cameras, 4GB RAM with 64GB internal storage and 5000mAh battery. The Accused Device is configured to support features like Side Sensor Fingerprint, expandable memory etc.

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The Accused Device is available in different models varying based on Cell Phone Carrier, Internal Memory and Color. The various models available for the Accused Device are A136UZKDXAA, SM-A136ULGDXAA, SM-A136UZKAATT, SM-A136ULGAATT, SM-A136UZKAXAU, and SM-A136UZKAUSC.



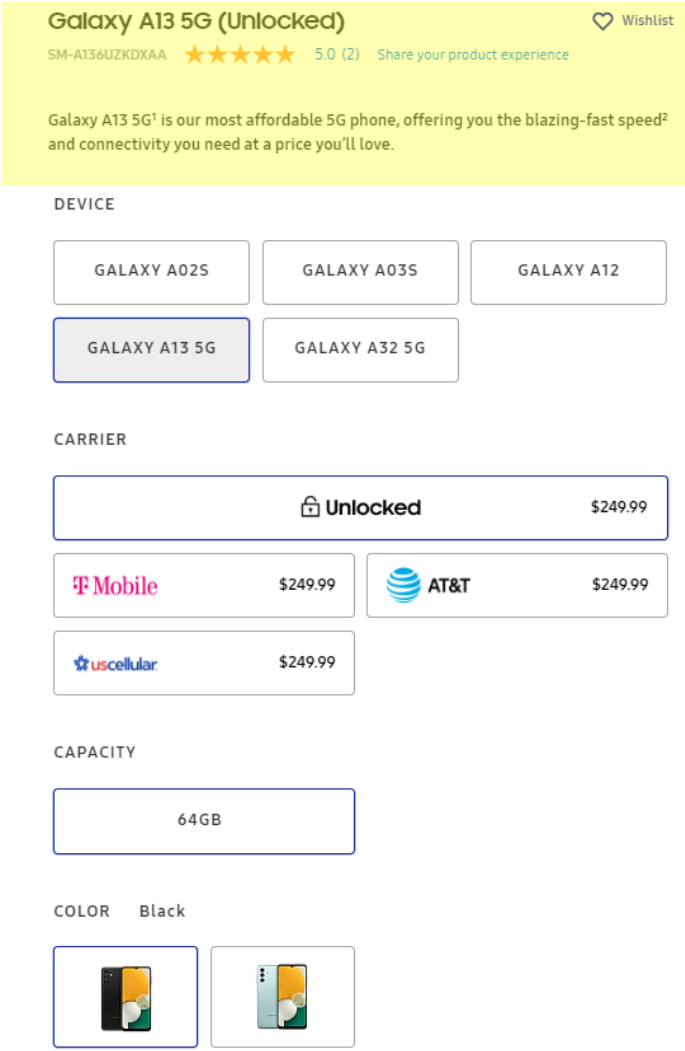
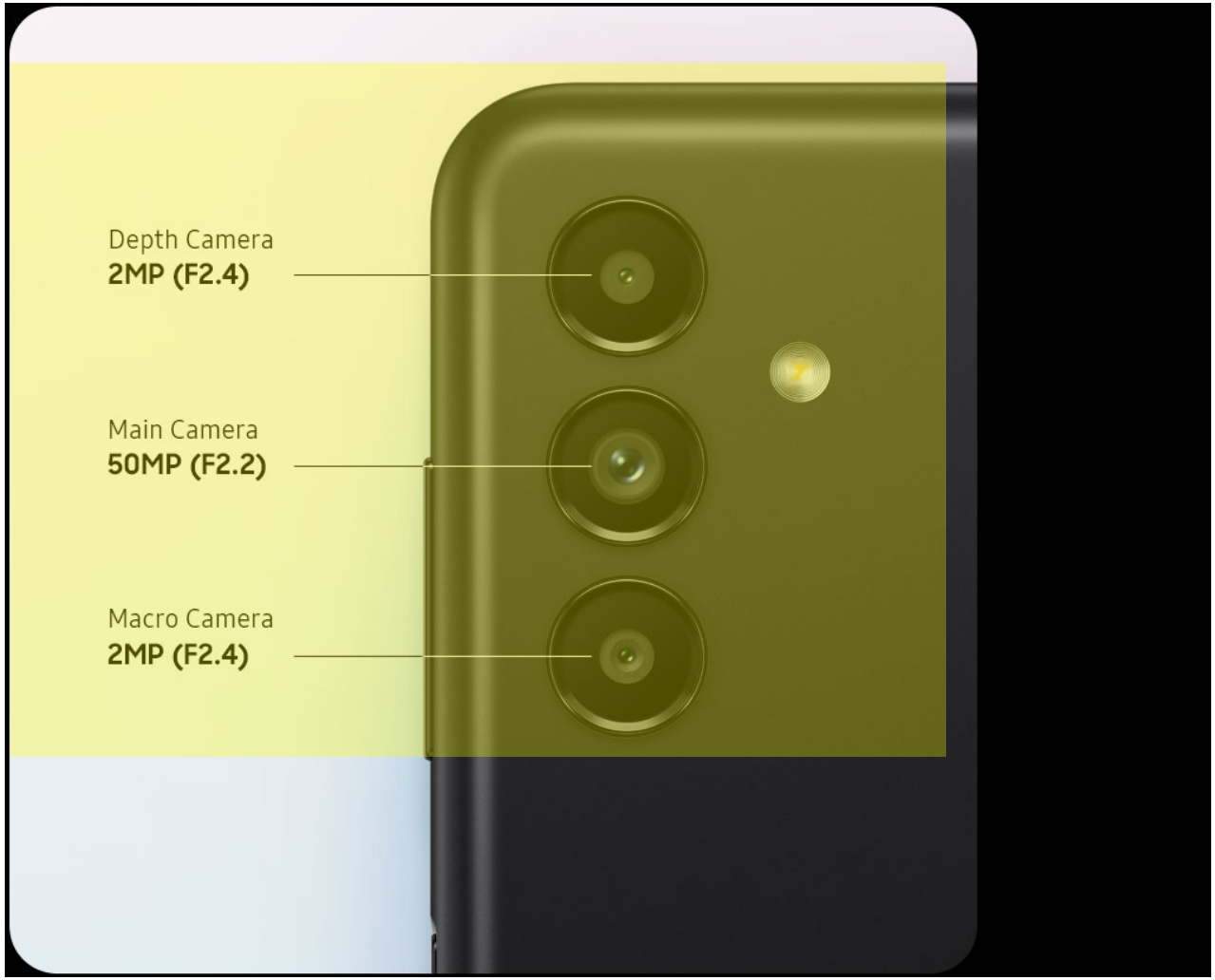
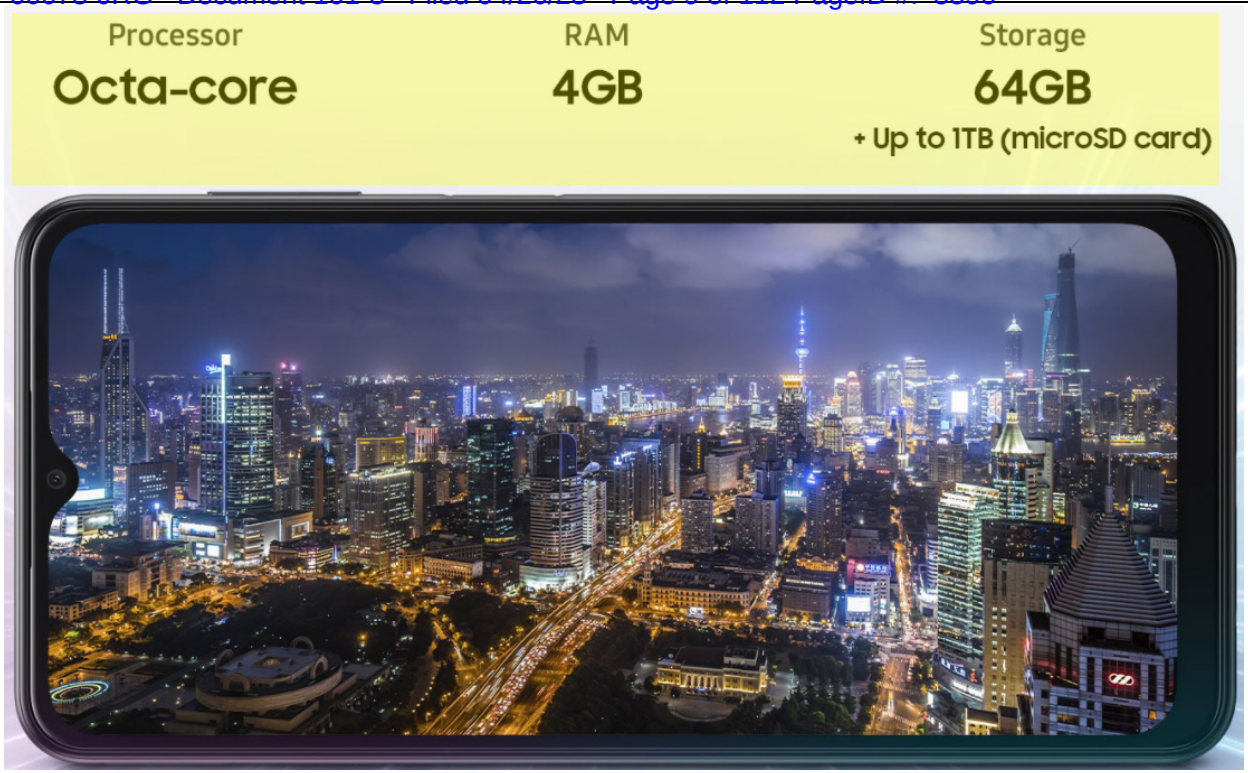


	Image of the Accused Device Galaxy A13 5G Smartphone SM-A136UZKDXAA (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).  Screenshot showing Image of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).

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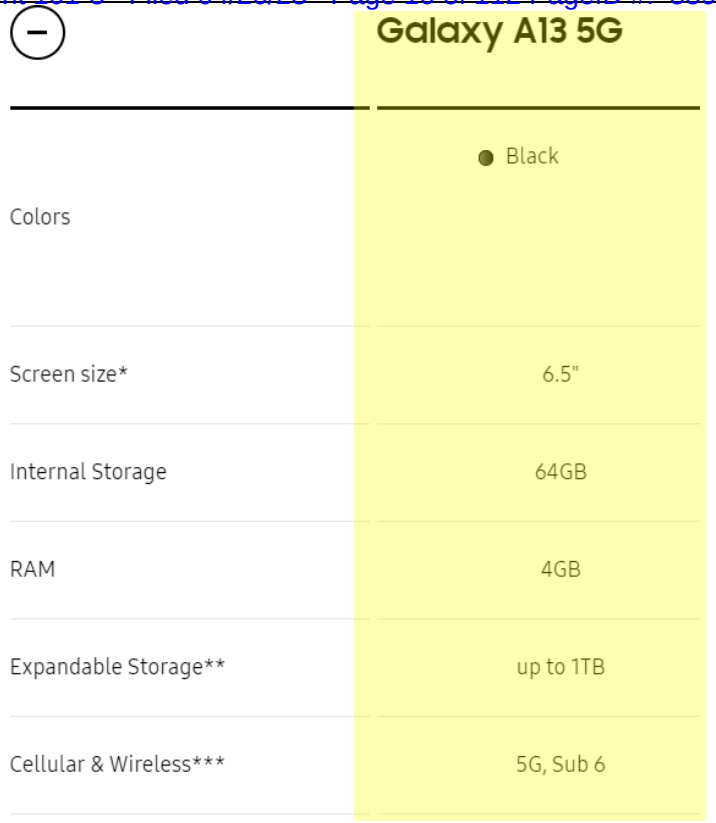


Screenshot showing camera of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

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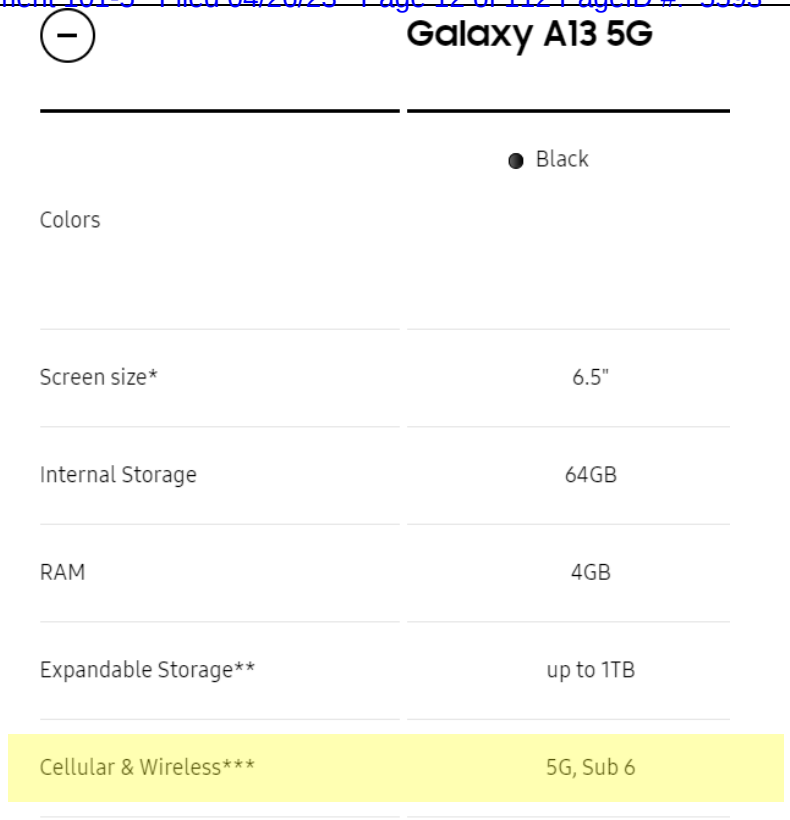


	Galaxy A13 5G
Colors	Black
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Display type	Flat
Fingerprint Sensor	Side Fingerprint Sensor
Front Camera	5MP Selfie Camera
Rear Camera	50MP Main Camera 2MP Macro Camera 2MP Depth Camera
Battery Capacity****	5000mAh (typical)

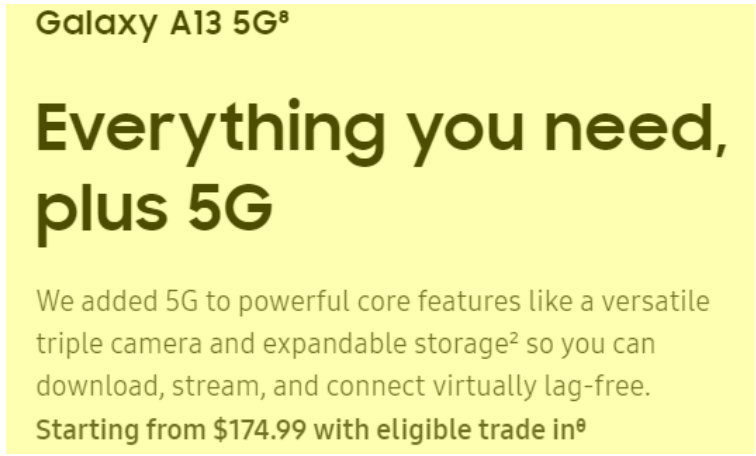
Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).

The Accused Device can be configured as a mobile terminal to support 5G telecommunications standard for providing services like blazing-fast speed, and virtually lag-free download and stream.

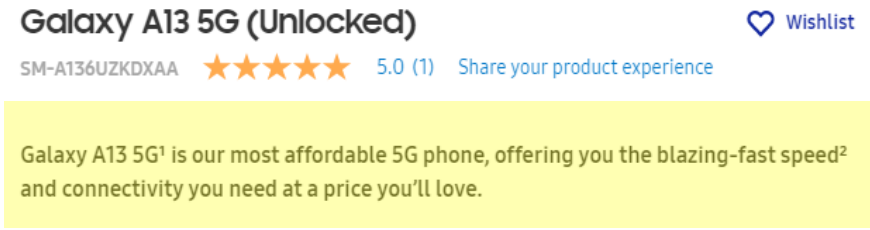


	Galaxy A13 5G
	● Black
Colors	
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).





Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 38.213 version 16.5.0 Release 16 (5G; NR; Physical layer procedures for control), 3GPP TS 38.300 version 16.5.0 Release 16 (5G; NR; NR and NG-RAN Overall description; Stage-2) and 3GPP TS 38.321 version 16.4.0 Release 16 (5G; NR; Medium Access Control (MAC) protocol specification).

ETSI TS 138 213 V16.5.0 (2021-04)



5G;
NR;
Physical layer procedures for control
(3GPP TS 38.213 version 16.5.0 Release 16)

1 Scope

The present document specifies and establishes the characteristics of the physical layer procedures for control operations in 5G-NR.

Screenshot showing the scope of standard 3GPP TS 38.213 version 16.5.0 Release 16 supported by the Accused Device (available on page 7 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).



	1 Scope The present document provides an overview and overall description of the NG-RAN and focuses on the radio interface protocol architecture of NR connected to 5GC (E-UTRA connected to 5GC is covered in the 36 series). Details of the radio interface protocols are specified in companion specifications of the 38 series. Screenshot showing the scope of standard 3GPP TS 38.300 version 16.5.0 Release 16 supported by the Accused Device (available on page 11 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

ETSI TS 138 321 V16.4.0 (2021-04)



5G;
NR;
Medium Access Control (MAC) protocol specification
(3GPP TS 38.321 version 16.4.0 Release 16)

1 Scope

The present document specifies the NR MAC protocol.

Screenshot showing the scope of standard 3GPP TS 38.321 version 16.4.0 Release 16 supported by the Accused Device (available on page 9 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

Upon information and belief, the Accused Device is configured to perform the random access procedure. The random access procedure is triggered by a number of events.

5.1 Random Access procedure

5.1.1 Random Access procedure initialization

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 17 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

9.2.6 Random Access Procedure

The random access procedure is triggered by a number of events:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- DL or UL data arrival during RRC_CONNECTED when UL synchronisation status is "non-synchronised";
- UL data arrival during RRC_CONNECTED when there are no PUCCH resources for SR available;
- SR failure;
- Request by RRC upon synchronous reconfiguration (e.g. handover);
- Transition from RRC_INACTIVE;
- To establish time alignment for a secondary TAG;
- Request for Other SI (see clause 7.3);
- Beam failure recovery;
- Consistent UL LBT failure on SpCell.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Accused Device is configured to support Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

Screenshot showing Type-1 L1 Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 41 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

Upon information and belief, the Accused Device is also configured to support 4-step RA type with MSG1. The RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA).

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	Two types of random access procedure are supported: 4-step RA type with MSG1 and 2-step RA type with MSGA. Both types of RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA) as shown on Figure 9.2.6-1 below. The UE selects the type of random access at initiation of the random access procedure based on network configuration: - when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type; - when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type; - when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type. Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
1a. sending, by a first User Equipment (UE) in a UE group, a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource;	The Accused Device is configured as a first User Equipment (UE) in a UE group and can send a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource. Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 38.213 version 16.5.0 Release 16 (5G; NR; Physical layer procedures for control), 3GPP TS 38.300 version 16.5.0 Release 16 (5G; NR; NR and NG-RAN Overall description; Stage-2) and 3GPP TS 38.321 version 16.4.0 Release 16 (5G; NR; Medium Access Control (MAC) protocol specification). The Accused Device is configured to select the type of random access at the initiation of the random access procedure based on the network configuration and sends a random access preamble to an evolved Node B (eNB). Upon information and belief, the Accused Device is also configured to select the 4-step RA type with MSG1. The MSG1 of the 4-step RA type consists of a preamble on PRACH wherein PRACH is a time-frequency resource.

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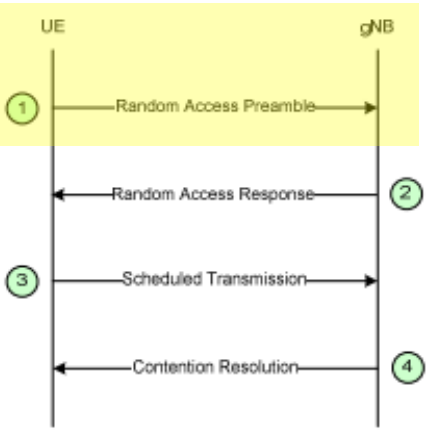
Two types of random access procedure are supported: 4-step RA type with MSG1 and 2-step RA type with MSGA. Both types of RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA) as shown on Figure 9.2.6-1 below.

The UE selects the type of random access at initiation of the random access procedure based on network configuration:

- when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type;
- when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type;
- when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type.

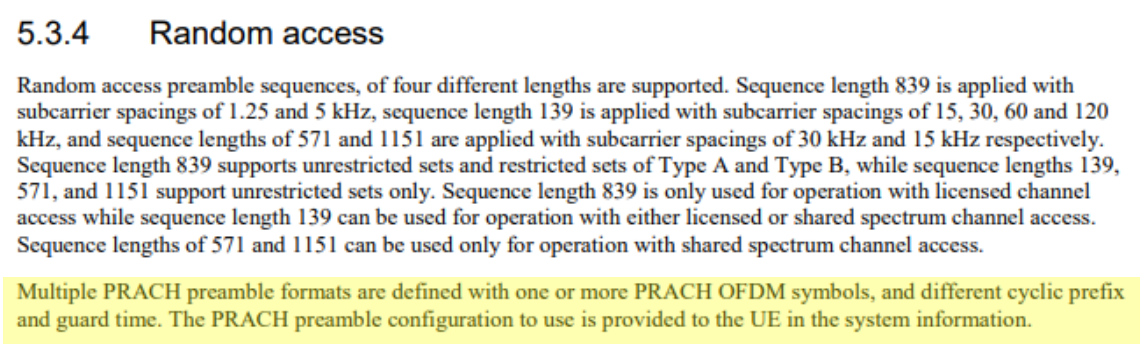
The network does not configure CFRA resources for 4-step and 2-step RA types at the same time for a Bandwidth Part (BWP). CFRA with 2-step RA type is only supported for handover.

The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.



(a) CBRA with 4-step RA type

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).



5.3.4 Random access

Random access preamble sequences, of four different lengths are supported. Sequence length 839 is applied with subcarrier spacings of 1.25 and 5 kHz, sequence length 139 is applied with subcarrier spacings of 15, 30, 60 and 120 kHz, and sequence lengths of 571 and 1151 are applied with subcarrier spacings of 30 kHz and 15 kHz respectively. Sequence length 839 supports unrestricted sets and restricted sets of Type A and Type B, while sequence lengths 139, 571, and 1151 support unrestricted sets only. Sequence length 839 is only used for operation with licensed channel access while sequence length 139 can be used for operation with either licensed or shared spectrum channel access. Sequence lengths of 571 and 1151 can be used only for operation with shared spectrum channel access.

Multiple PRACH preamble formats are defined with one or more PRACH OFDM symbols, and different cyclic prefix and guard time. The PRACH preamble configuration to use is provided to the UE in the system information.

Screenshot showing PRACH resource from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 34 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Accused Device configured as the User Equipment (UE) transmits the Random Access Preamble with the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted. The RA-RNTI associated with the PRACH resource comprises a time domain resource and a frequency domain resource.

5.1.3 Random Access Preamble transmission

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE_TRANSMISSION_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE_POWER_RAMPING_COUNTER* by 1.

1> select the value of *DELTA_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE_RECEIVED_TARGET_POWER* to *preambleReceivedTargetPower* + *DELTA_PREAMBLE* + (*PREAMBLE_POWER_RAMPING_COUNTER* – 1) × *PREAMBLE_POWER_RAMPING_STEP* + *POWER_OFFSET_2STEP_RA*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE_INDEX*, and *PREAMBLE_RECEIVED_TARGET_POWER*.

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + s\_id + 14 \times t\_id + 14 \times 80 \times f\_id + 14 \times 80 \times 8 \times ul\_carrier\_id$$

where s_id is the index of the first OFDM symbol of the PRACH occasion ($0 \le s\_id < 14$), t_id is the index of the first slot of the PRACH occasion in a system frame ($0 \le t\_id < 80$), where the subcarrier spacing to determine t_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f_id is the index of the PRACH occasion in the frequency domain ($0 \le f\_id < 8$), and ul_carrier_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

Screenshot showing Random Access Preamble transmission by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on pages 27 and 28 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

During the random access procedure, the following identities are also used:

- RA-RNTI: identification of the Random Access Response in the downlink;

Screenshot showing definition of RA-RNTI supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the UE receives a preamble index, a preamble SCS, PPRACH,target , a corresponding RA-RNTI, and a PRACH resource (time resources and frequency resources) from the higher layers (eNB). The PRACH resources are used for the transmission of preamble over a time-frequency resource.

8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

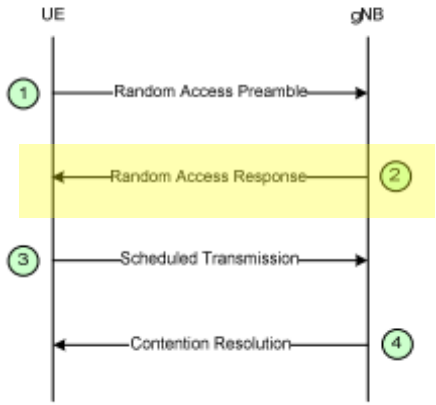
From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

8.1 Random access preamble

Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following:

- A configuration for PRACH transmission [4, TS 38.211].
- A preamble index, a preamble SCS, $P_{\text{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

	A PRACH is transmitted using the selected PRACH format with transmission power $P_{PRACH,b,f,c}(i)$, as described in Clause 7.4, on the indicated PRACH resource. For Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*. Screenshot showing the transmission of random access preamble (Msg1) in a PRACH from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 41 and 42 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
1b. monitoring, by at least one of the first UE or a second UE in the UE group, a Random Access Response (RAR) corresponding to the preamble and sent by the eNB, wherein the first UE is at least one UE in the UE group, and the second UE is all or some UEs in the UE group; and	The Accused Device can be configured as the first UE or a second UE in the UE group. The Accused Device is configured to monitor a Random Access Response (RAR) corresponding to the preamble and sent by the eNB, wherein the first UE is at least one UE in the UE group, and the second UE is all or some UEs in the UE group. Upon information and belief, the Accused Device is configured to monitor a Random Access Response (RAR) corresponding to the preamble from the eNB. For contention-based random access (CBRA), the UE receives a Random Access Response (RAR) from the eNB. The UE monitors the physical downlink channel PDCCH for Random Access Response (RAR) while the ra-ResponseWindow is running. The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.



(a) CBRA with 4-step RA type

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

5.1.4 Random Access Response reception

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

Screenshot showing Random Access Response reception by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.2 Random access response - Type-1 random access procedure

In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in Clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set as defined in Clause 10.1. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*.

If the UE detects the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI and LSBs of a SFN field in the DCI format 1_0, if included and applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity

(RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer.

Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 46 and 47 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

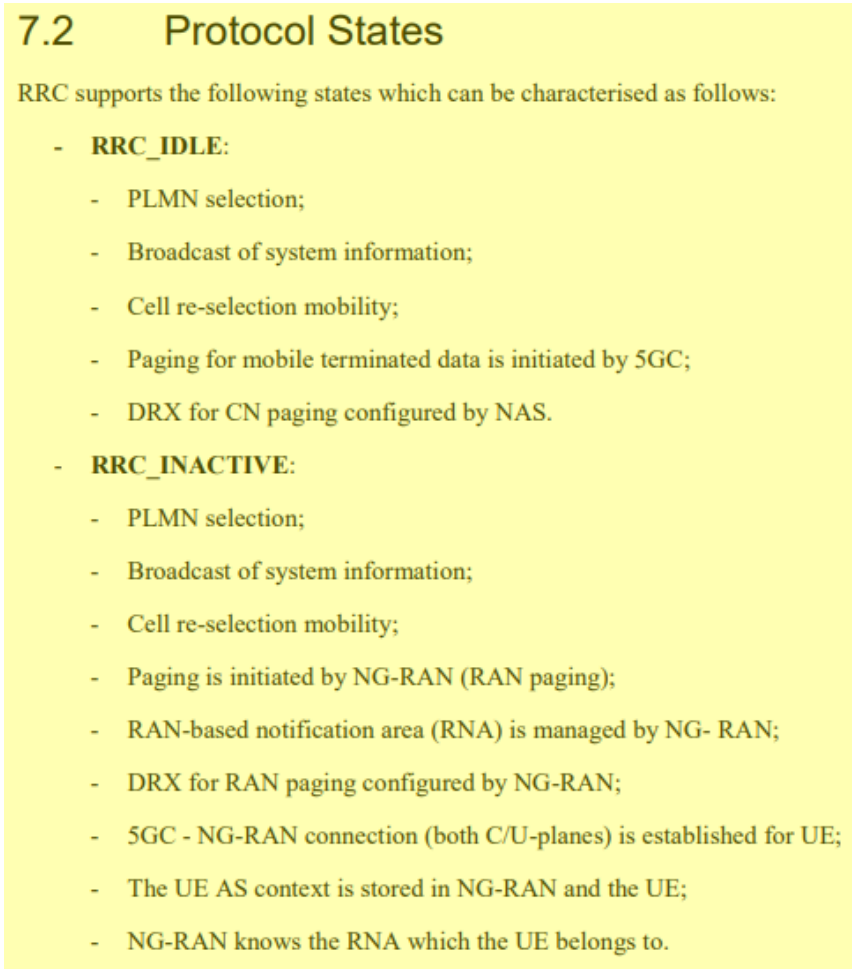
Upon information and belief, the UE initiating the random access procedure may be UEs in RRC-IDLE and RRC-INACTIVE protocol states (UE group). The random access procedure is triggered by a number of events.

7.3.2 Scheduling

The MIB is mapped on the BCCH and carried on BCH while all other SI messages are mapped on the BCCH, where they are dynamically carried on DL-SCH. The scheduling of SI messages part of Other SI is indicated by *SIB1*.

For UEs in RRC_IDLE and RRC_INACTIVE, a request for Other SI triggers a random access procedure (see clause 9.2.6) where MSG3 includes the SI request message unless the requested SI is associated to a subset of the PRACH resources, in which case MSG1 is used for indication of the requested Other SI. When MSG1 is used, the minimum granularity of the request is one SI message (i.e. a set of SIBs), one RACH preamble and/or PRACH resource can be used to request multiple SI messages and the gNB acknowledges the request in MSG2. When MSG 3 is used, the gNB acknowledges the request in MSG4.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 54 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

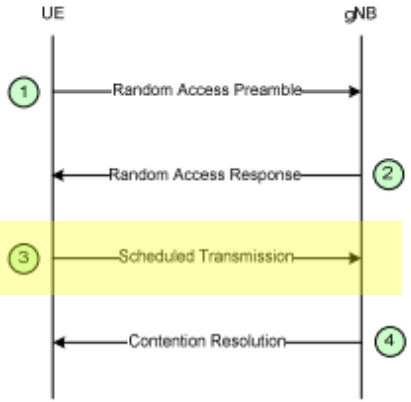


7.2 Protocol States

RRC supports the following states which can be characterised as follows:

- **RRC_IDLE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging for mobile terminated data is initiated by 5GC;
  - DRX for CN paging configured by NAS.
- **RRC_INACTIVE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging is initiated by NG-RAN (RAN paging);
  - RAN-based notification area (RNA) is managed by NG- RAN;
  - DRX for RAN paging configured by NG-RAN;
  - 5GC - NG-RAN connection (both C/U-planes) is established for UE;
  - The UE AS context is stored in NG-RAN and the UE;
  - NG-RAN knows the RNA which the UE belongs to.

Screenshot showing Protocol States supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 52 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

	To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
1c. after monitoring, by at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB: sending, by at least one of the first UE or the second UE, a message 3 according to a Uplink (UL) grant allocated thereto, wherein the message 3 comprises a number of UEs having random access requests in the UE group or a number of UEs contained in the UE group or a pre-set UE number.	The Accused Device can be configured as the first UE or a second UE in the UE group. The Accused Device is configured for, after monitoring the RAR corresponding to the preamble and sent by the eNB, sending a message 3 according to a Uplink (UL) grant allocated thereto, wherein the message 3 comprises a number of UEs having random access requests in the UE group or a number of UEs contained in the UE group or a pre-set UE number. Upon information and belief, for contention-based random access (CBRA), the Accused Device is configured to send a Msg3 using the UL grant scheduled in the response. The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.  **(a) CBRA with 4-step RA type**

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Msg3 comprises a C-RNTI field which is a unique UE identification used as an identifier of the RRC Connection and for scheduling. The C-RNTI MAC CE field contains the C-RNTI of the MAC entity (User Equipment).

Upon information and belief, the C-RNTI MAC CE field comprises a pre-set UE number.

Msg3: Message transmitted on UL-SCH containing a C-RNTI MAC CE or CCCH SDU, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a Random Access procedure.

Screenshot showing Msg3 definition from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

Screenshot showing Msg3 transmission with C-RNTI from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

Screenshot showing Msg3 transmission according to a Uplink (UL) grant from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 42 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

6.1.3.2 C-RNTI MAC CE

The C-RNTI MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.

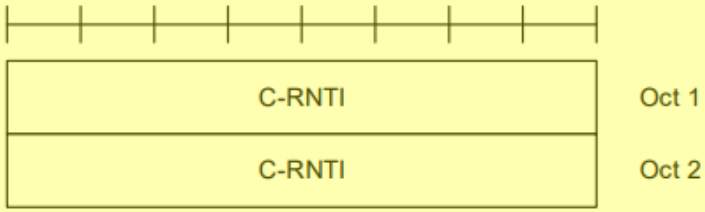


Figure 6.1.3.2-1: C-RNTI MAC CE

Screenshot showing C-RNTI MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.1 UE Identities

In this clause, the identities used by NR connected to 5GC are listed. For scheduling at cell level, the following identities are used:

- C-RNTI: unique UE identification used as an identifier of the RRC Connection and for scheduling;

Screenshot showing C-RNTI from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

8.3 PUSCH scheduled by RAR UL grant

An active UL BWP, as described in Clause 12 and in [4, TS 38.211], for a PUSCH transmission scheduled by a RAR UL grant is indicated by higher layers.

	A UE transmits a transport block in a PUSCH scheduled by a RAR UL grant in a corresponding RAR message using redundancy version number 0. If a TC-RNTI is provided by higher layers, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by TC-RNTI. Otherwise, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by C-RNTI. Msg3 PUSCH retransmissions, if any, of the transport block, are scheduled by a DCI format 0_0 with CRC scrambled by a TC-RNTI provided in the corresponding RAR message [11, TS 38.321]. The UE always transmits the PUSCH scheduled by a RAR UL grant without repetitions. Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 49 and 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 2	**Evidence**
2. The method according to claim 1, wherein the first UE is at least one of the following: at least one fixed UE; or, at least one UE determined according to a pre-set rule; or, at least one UE notified by the eNB.	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is a UE configured to perform random access procedure. The random access procedure is initiated by the MAC entity (UE) itself on receiving of a PDCCH order from the eNB, or is triggered by a number of events. PDCCH Order is a mechanism by which eNB force UE to initiate PRACH. The UE selects the type of random access at initiation of the random access procedure based on network configuration. 5.1 Random Access procedure 5.1.1 Random Access procedure initialization The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000. Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 17 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

7.3.2 Scheduling

The MIB is mapped on the BCCH and carried on BCH while all other SI messages are mapped on the BCCH, where they are dynamically carried on DL-SCH. The scheduling of SI messages part of Other SI is indicated by *SIB1*.

For UEs in RRC_IDLE and RRC_INACTIVE, a request for Other SI triggers a random access procedure (see clause 9.2.6) where MSG3 includes the SI request message unless the requested SI is associated to a subset of the PRACH resources, in which case MSG1 is used for indication of the requested Other SI. When MSG1 is used, the minimum granularity of the request is one SI message (i.e. a set of SIBs), one RACH preamble and/or PRACH resource can be used to request multiple SI messages and the gNB acknowledges the request in MSG2. When MSG 3 is used, the gNB acknowledges the request in MSG4.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 54 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

9.2.6 Random Access Procedure

The random access procedure is triggered by a number of events:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- DL or UL data arrival during RRC_CONNECTED when UL synchronisation status is "non-synchronised";
- UL data arrival during RRC_CONNECTED when there are no PUCCH resources for SR available;
- SR failure;
- Request by RRC upon synchronous reconfiguration (e.g. handover);
- Transition from RRC_INACTIVE;
- To establish time alignment for a secondary TAG;
- Request for Other SI (see clause 7.3);
- Beam failure recovery;
- Consistent UL LBT failure on SpCell.

Two types of random access procedure are supported: 4-step RA type with MSG1 and 2-step RA type with MSGA. Both types of RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA) as shown on Figure 9.2.6-1 below.

The UE selects the type of random access at initiation of the random access procedure based on network configuration:

- when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type;
- when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type;
- when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

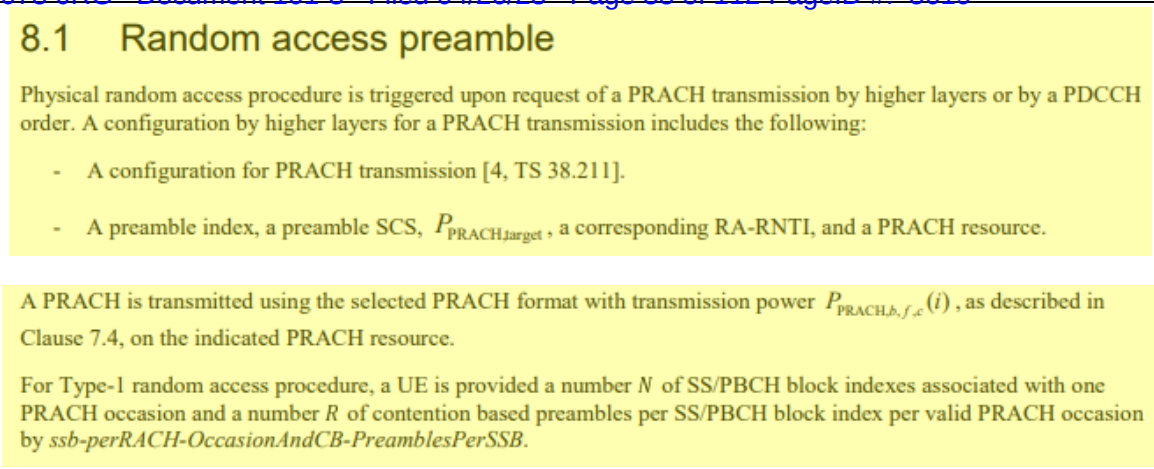
Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

If a random access procedure is initiated by a PDCCH order to the UE, a PRACH transmission is with a same SCS as a PRACH transmission initiated by higher layers.

	Screenshot showing Type-1 L1 Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 41 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 3	**Evidence**
3. The method according to claim 1, wherein at least one of the preamble, the time domain resource or the frequency domain resource is pre-set, or determined by a group Identifier (ID) of the UE group, or notified by the eNB.	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein at least one of the preamble, the time domain resource or the frequency domain resource is pre-set, or determined by a group Identifier (ID) of the UE group, or notified by the eNB. Upon information and belief, the UE receives a preamble index, a preamble SCS, $P_{PRACH,target}$, a corresponding RA-RNTI, and a PRACH resource (time resources and frequency resources) from the higher layers (eNB). **8 Random access procedure** Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements. Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A. Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers: - Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission). - Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)). From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.



8.1 Random access preamble

Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following:

- A configuration for PRACH transmission [4, TS 38.211].
- A preamble index, a preamble SCS, $P_{\text{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

A PRACH is transmitted using the selected PRACH format with transmission power $P_{\text{PRACH},b,f,c}(i)$, as described in Clause 7.4, on the indicated PRACH resource.

For Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

Screenshot showing the transmission of random access preamble (Msg1) in a PRACH from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 41 and 42 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).

10,448,430 Claim 4	Evidence
4. The method according to claim 3, wherein at least one of the preamble, the time domain resource or the frequency domain resource corresponds to the number of UEs having random access requests in the UE group or the number of UEs contained in the UE group or the pre-set UE number.	Every claim limitation of claim 3 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein at least one of the preamble, the time domain resource or the frequency domain resource corresponds to the number of UEs having random access requests in the UE group or the number of UEs contained in the UE group or the pre-set UE number. Upon information and belief, the Accused Device configured as the User Equipment (UE) transmits the Random Access Preamble with the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted. The RA-RNTI associated with the PRACH resource comprises a time domain resource and a frequency domain resource.

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5.1.3 Random Access Preamble transmission

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE_TRANSMISSION_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE_POWER_RAMPING_COUNTER* by 1.

1> select the value of *DELTA_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE_RECEIVED_TARGET_POWER* to *preambleReceivedTargetPower* + *DELTA_PREAMBLE* + (*PREAMBLE_POWER_RAMPING_COUNTER* – 1) × *PREAMBLE_POWER_RAMPING_STEP* + *POWER_OFFSET_2STEP_RA*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE_INDEX*, and *PREAMBLE_RECEIVED_TARGET_POWER*.

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + s\_id + 14 \times t\_id + 14 \times 80 \times f\_id + 14 \times 80 \times 8 \times ul\_carrier\_id$$

where s_id is the index of the first OFDM symbol of the PRACH occasion ($0 \le s\_id < 14$), t_id is the index of the first slot of the PRACH occasion in a system frame ($0 \le t\_id < 80$), where the subcarrier spacing to determine t_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f_id is the index of the PRACH occasion in the frequency domain ($0 \le f\_id < 8$), and ul_carrier_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

Screenshot showing Random Access Preamble transmission by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on pages 27 and 28 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

During the random access procedure, the following identities are also used:

- RA-RNTI: identification of the Random Access Response in the downlink;

Screenshot showing definition of RA-RNTI supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

The UE receives a preamble index, a preamble SCS, PPRACH,target , a corresponding RA-RNTI, and a PRACH resource (time resources and frequency resources) from the higher layers (eNB). The PRACH resources are used for the transmission of preamble over a time-frequency resource.

Upon information and belief, the preamble, the time resource and the frequency resource correspond to the UE receiving the PDCCH order from eNB.

8 Random access procedure

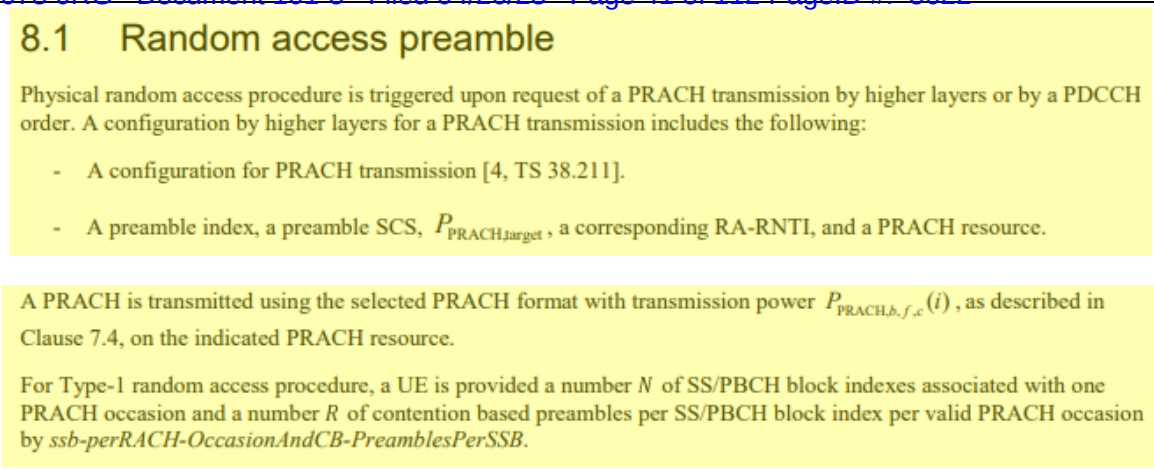
Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.



8.1 Random access preamble

Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following:

- A configuration for PRACH transmission [4, TS 38.211].
- A preamble index, a preamble SCS, $P_{\text{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

A PRACH is transmitted using the selected PRACH format with transmission power $P_{\text{PRACH},b,f,c}(i)$, as described in Clause 7.4, on the indicated PRACH resource.

For Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

Screenshot showing the transmission of random access preamble (Msg1) in a PRACH from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 41 and 42 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

10,448,430 Claim 5	Evidence
5. The method according to claim 1, wherein monitoring, by at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB comprises: descrambling, by at least one of the first UE or the second UE, a Cyclic Redundancy Check (CRC) of Downlink Control Information (DCI) for scheduling the RAR according to a pre-set Random	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein monitoring, by at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB comprises descrambling, by at least one of the first UE or the second UE, a Cyclic Redundancy Check (CRC) of Downlink Control Information (DCI) for scheduling the RAR according to a pre-set Random Access Radio Network Temporary Identity (RA-RNTI) or an RA-RNTI corresponding to the preamble, and receiving the RAR, the RAR comprising at least one of at least one Temporary Cell Radio Network Temporary Identity (TC-RNTI) or at least one Uplink (UL) grant.

Access Radio Network Temporary Identity (RA-RNTI) or an RA-RNTI corresponding to the preamble, and receiving the RAR, the RAR comprising at least one of at least one Temporary Cell Radio Network Temporary Identity (TC-RNTI) or at least one Uplink (UL) grant; and	8.2 Random access response - Type-1 random access procedure In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in Clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set as defined in Clause 10.1. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*. If the UE detects the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI and LSBs of a SFN field in the DCI format 1_0, if included and applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity (RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer. Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 46 and 47 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).
5a. determining, by at least one of the first UE or the second UE, at least one of a TC-RNTI or UL grant allocated thereto according to at least one of at least one TC-RNTI or at least one UL grant contained in the RAR; or monitoring, by at least one of the first UE or the second UE, the RAR corresponding to the preamble and sent by the eNB comprises: determining, by at least one of the first UE or the second UE, corresponding RA-RNTIs according to at least one of respective IDs or preambles,	The Accused Device is configured for determining at least one of a TC-RNTI or UL grant allocated thereto according to at least one of at least one TC-RNTI or at least one UL grant contained in the RAR.

descrambling a CRC of DCI for scheduling the RAR according to the corresponding RA-RNTIs, and receiving corresponding RARs, the RAR comprising at least one of a TC-RNTI or a UL grant allocated to the first UE or second UE.

5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

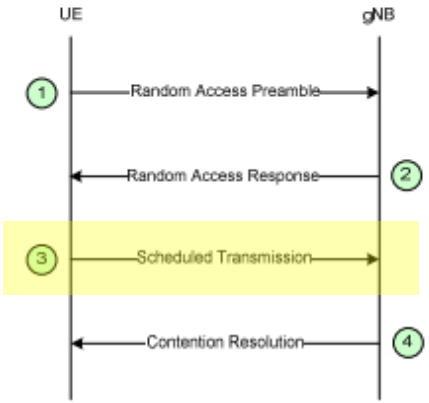
Screenshot showing Uplink (UL) grant reception from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 42 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.3 PUSCH scheduled by RAR UL grant

An active UL BWP, as described in Clause 12 and in [4, TS 38.211], for a PUSCH transmission scheduled by a RAR UL grant is indicated by higher layers.

	A UE transmits a transport block in a PUSCH scheduled by a RAR UL grant in a corresponding RAR message using redundancy version number 0. If a TC-RNTI is provided by higher layers, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by TC-RNTI. Otherwise, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by C-RNTI. Msg3 PUSCH retransmissions, if any, of the transport block, are scheduled by a DCI format 0_0 with CRC scrambled by a TC-RNTI provided in the corresponding RAR message [11, TS 38.321]. The UE always transmits the PUSCH scheduled by a RAR UL grant without repetitions. Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 49 and 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).
10,448,430 Claim 6	**Evidence**
6. The method according to claim 5, wherein determining, by at least one of the first UE or the second UE, at least one of the TC-RNTI or the UL grant allocated thereto according to at least one of at least one TC-RNTI or at least one UL grant contained in the RAR comprises: determining, by at least one of the first UE or the second UE, at least one of a TC-RNTI or a UL grant allocated thereto according to at least one of an ID of the first UE or the second UE in accordance with a pre-set rule.	Every claim limitation of claim 5 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein determining, by at least one of the first UE or the second UE, at least one of the TC-RNTI or the UL grant allocated thereto according to at least one of at least one TC-RNTI or at least one UL grant contained in the RAR comprises determining, by at least one of the first UE or the second UE, at least one of a TC-RNTI or a UL grant allocated thereto according to at least one of an ID of the first UE or the second UE in accordance with a pre-set rule. Upon information and belief, for contention-based random access (CBRA), the Accused Device is configured to send a Msg3 using the UL grant scheduled in the response. The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.

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(a) CBRA with 4-step RA type

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Msg3 comprises a C-RNTI field which is a unique UE identification used as an identifier of the RRC Connection and for scheduling. The C-RNTI MAC CE field contains the C-RNTI of the MAC entity (User Equipment).

Upon information and belief, the C-RNTI MAC CE field comprises a pre-set UE number.

Msg3: Message transmitted on UL-SCH containing a C-RNTI MAC CE or CCCH SDU, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a Random Access procedure.

Screenshot showing Msg3 definition from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

Screenshot showing Msg3 transmission with C-RNTI from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

Screenshot showing Msg3 transmission according to a Uplink (UL) grant from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 42 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

6.1.3.2 C-RNTI MAC CE

The C-RNTI MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.

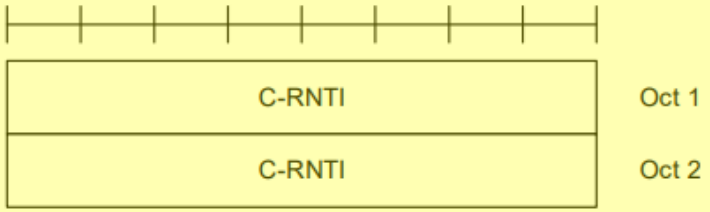


Figure 6.1.3.2-1: C-RNTI MAC CE

Screenshot showing C-RNTI MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.1 UE Identities

In this clause, the identities used by NR connected to 5GC are listed. For scheduling at cell level, the following identities are used:

- C-RNTI: unique UE identification used as an identifier of the RRC Connection and for scheduling;

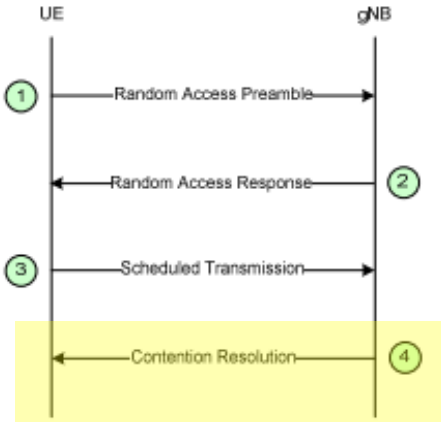
Screenshot showing C-RNTI from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

8.3 PUSCH scheduled by RAR UL grant

An active UL BWP, as described in Clause 12 and in [4, TS 38.211], for a PUSCH transmission scheduled by a RAR UL grant is indicated by higher layers.

	A UE transmits a transport block in a PUSCH scheduled by a RAR UL grant in a corresponding RAR message using redundancy version number 0. If a TC-RNTI is provided by higher layers, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by TC-RNTI. Otherwise, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by C-RNTI. Msg3 PUSCH retransmissions, if any, of the transport block, are scheduled by a DCI format 0_0 with CRC scrambled by a TC-RNTI provided in the corresponding RAR message [11, TS 38.321]. The UE always transmits the PUSCH scheduled by a RAR UL grant without repetitions. Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 49 and 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 7	**Evidence**
7. The method according to claim 1, further comprising: after sending, by at least one of the first UE or the second UE, the message 3 according to the UL grant allocated thereto, receiving, by at least one of the first UE or the second UE, a message 4 sent by the eNB.	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured for after sending, by at least one of the first UE or the second UE, the message 3 according to the UL grant allocated thereto, receiving, by at least one of the first UE or the second UE, a message 4 sent by the eNB. Upon information and belief, for contention-based random access (CBRA), the Accused Device receives a message Msg4 as a contention resolution message. The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.

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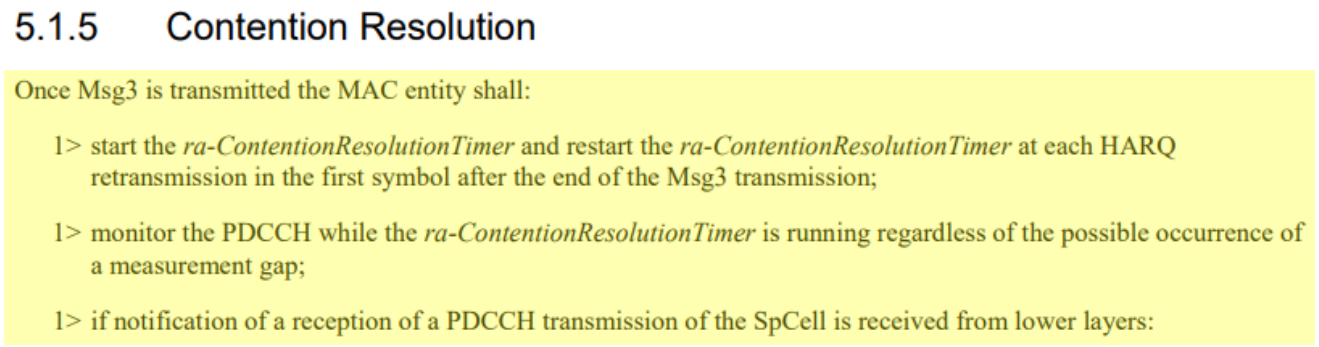


(a) CBRA with 4-step RA type

Screenshot showing Contention Resolution message received by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

Screenshot showing Contention Resolution message received by the Accused Device from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 41 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).



5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

Screenshot showing Contention Resolution from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 35 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

10,448,430 Claim 8	Evidence
8. The method according to claim 7, wherein receiving, by at least one of the first UE or the second UE, the message 4 sent by the eNB comprises: scrambling a CRC of DCI for scheduling the message 4 by using a TC-RNTI allocated to at least one of the first UE or the second UE.	Every claim limitation of claim 7 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein receiving, by at least one of the first UE or the second UE, the message 4 sent by the eNB comprises scrambling a CRC of DCI for scheduling the message 4 by using a TC-RNTI allocated to at least one of the first UE or the second UE.

	8.4 PDSCH with UE contention resolution identity In response to a PUSCH transmission scheduled by a RAR UL grant when a UE has not been provided a C-RNTI, the UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding TC-RNTI scheduling a PDSCH that includes a UE contention resolution identity [11, TS 38.321]. In response to the PDSCH reception with the UE contention resolution identity, the UE transmits HARQ-ACK information in a PUCCH. The PUCCH transmission is within a same active UL BWP as the PUSCH transmission. A minimum time between the last symbol of the PDSCH reception and the first symbol of the corresponding PUCCH transmission with the HARQ-ACK information is equal to $N_{T,1} + 0.5$ msec. $N_{T,1}$ is a time duration of N_1 symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $\mu = 0$, the UE assumes $N_{1,0} = 14$ [6, TS 38.214]. Screenshot showing UE Contention Resolution from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 9	**Evidence**
9. The method according to claim 8, wherein the message 4 comprises at least one set of radio resources, radio resources allocated to at least one of the first UE or the second UE are determined by at least one of the first UE or the second UE according to at least one set of radio resources in the message 4; or the message 4 comprises a set of radio resources allocated to the first UE or second UE.	Every claim limitation of claim 8 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein the message 4 comprises at least one set of radio resources, radio resources allocated to at least one of the first UE or the second UE are determined by at least one of the first UE or the second UE according to at least one set of radio resources in the message 4 or the message 4 comprises a set of radio resources allocated to the first UE or second UE. Upon information and belief, the contention resolution message Msg4 comprises a Physical Downlink Shared Channel (PDSCH) allocated for contention resolution. The contention resolution message Msg4 comprises a UE Contention Resolution Identity identifying the MAC entity (UE).

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8.4 PDSCH with UE contention resolution identity

In response to a PUSCH transmission scheduled by a RAR UL grant when a UE has not been provided a C-RNTI, the UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding TC-RNTI scheduling a PDSCH that includes a UE contention resolution identity [11, TS 38.321]. In response to the PDSCH reception with the UE contention resolution identity, the UE transmits HARQ-ACK information in a PUCCH. The PUCCH transmission is within a same active UL BWP as the PUSCH transmission. A minimum time between the last symbol of the PDSCH reception and the first symbol of the corresponding PUCCH transmission with the HARQ-ACK information is equal to $N_{T,1} + 0.5$ msec. $N_{T,1}$ is a time duration of N_1 symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $\mu = 0$, the UE assumes $N_{1,0} = 14$ [6, TS 38.214].

Screenshot showing UE Contention Resolution from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

6.1.3.3 UE Contention Resolution Identity MAC CE

The UE Contention Resolution Identity MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-1.

It has a fixed 48-bit size and consists of a single field defined as follows (Figure 6.1.3.3-1):

- UE Contention Resolution Identity: This field contains the UL CCCH SDU. If the UL CCCH SDU is longer than 48 bits, this field contains the first 48 bits of the UL CCCH SDU.

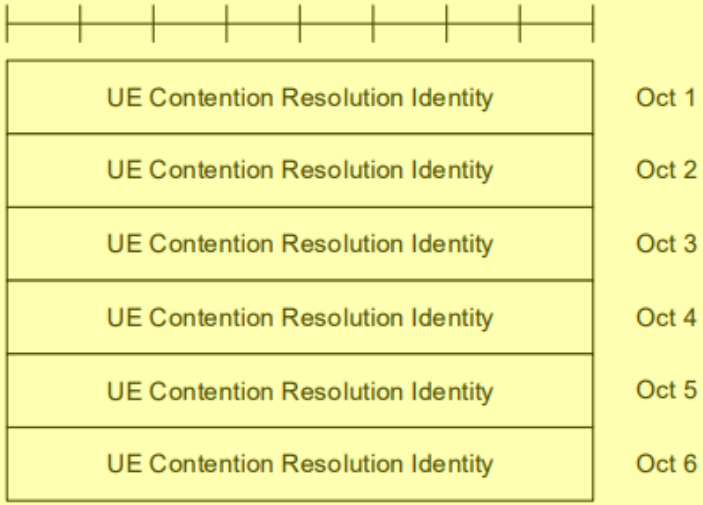


Figure 6.1.3.3-1: UE Contention Resolution Identity MAC CE

Screenshot showing UE Contention Resolution Identity MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

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10,448,430 Claim 10	Evidence
10. The method according to claim 9, wherein the radio resources allocated to at least one of the first UE or the second UE are further determined by at least one of the first UE or the second UE according to an ID of at least one of the first UE or the second UE in accordance with a pre-set rule.	Every claim limitation of claim 9 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein the radio resources allocated to at least one of the first UE or the second UE are further determined by at least one of the first UE or the second UE according to an ID of at least one of the first UE or the second UE in accordance with a pre-set rule. Upon information and belief, the contention resolution message Msg4 comprises a UE Contention Resolution Identity identifying the MAC entity (UE). **8.4 PDSCH with UE contention resolution identity** In response to a PUSCH transmission scheduled by a RAR UL grant when a UE has not been provided a C-RNTI, the UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding TC-RNTI scheduling a PDSCH that includes a UE contention resolution identity [11, TS 38.321]. In response to the PDSCH reception with the UE contention resolution identity, the UE transmits HARQ-ACK information in a PUCCH. The PUCCH transmission is within a same active UL BWP as the PUSCH transmission. A minimum time between the last symbol of the PDSCH reception and the first symbol of the corresponding PUCCH transmission with the HARQ-ACK information is equal to $N_{T,1} + 0.5$ msec. $N_{T,1}$ is a time duration of N_1 symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $\mu = 0$, the UE assumes $N_{1,0} = 14$ [6, TS 38.214]. Screenshot showing UE Contention Resolution from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

6.1.3.3 UE Contention Resolution Identity MAC CE

The UE Contention Resolution Identity MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-1.

It has a fixed 48-bit size and consists of a single field defined as follows (Figure 6.1.3.3-1):

- UE Contention Resolution Identity: This field contains the UL CCCH SDU. If the UL CCCH SDU is longer than 48 bits, this field contains the first 48 bits of the UL CCCH SDU.

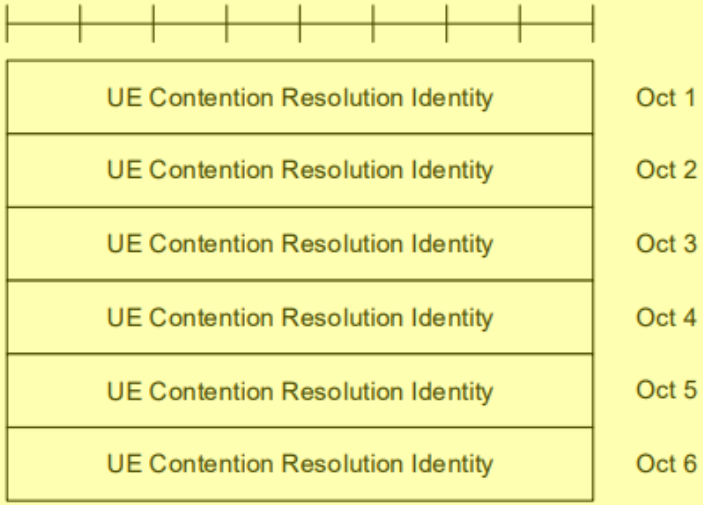


Figure 6.1.3.3-1: UE Contention Resolution Identity MAC CE

Screenshot showing UE Contention Resolution Identity MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

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10,448,430 Claim 11	Evidence
11. The method according to claim 7, further comprising: after receiving, by at least one of the first UE or the second UE, the message 4 sent by the eNB, sending, by at least one of the first UE or the second UE, an indicating signal for notifying the eNB of a successful access of at least one of the first UE or the second UE to the eNB, wherein the indicating signal is a Scheduling Request (SR) or an Acknowledgement (ACK) signal.	Every claim limitation of claim 7 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured such that after receiving, by at least one of the first UE or the second UE, the message 4 sent by the eNB, sending, by at least one of the first UE or the second UE, an indicating signal for notifying the eNB of a successful access of at least one of the first UE or the second UE to the eNB, wherein the indicating signal is a Scheduling Request (SR) or an Acknowledgement (ACK) signal. Upon information and belief, the Accused Device is configured to transmit an HARQ-ACK acknowledgement message to eNB in response to receiving the Physical Downlink Shared Channel (PDSCH) allocated for contention resolution. Further, in case the contention resolution procedure is successful, the UE acknowledge it to the higher layer (eNB). **8.4 PDSCH with UE contention resolution identity** In response to a PUSCH transmission scheduled by a RAR UL grant when a UE has not been provided a C-RNTI, the UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding TC-RNTI scheduling a PDSCH that includes a UE contention resolution identity [11, TS 38.321]. In response to the PDSCH reception with the UE contention resolution identity, the UE transmits HARQ-ACK information in a PUCCH. The PUCCH transmission is within a same active UL BWP as the PUSCH transmission. A minimum time between the last symbol of the PDSCH reception and the first symbol of the corresponding PUCCH transmission with the HARQ-ACK information is equal to $N_{T,1} + 0.5$ msec. $N_{T,1}$ is a time duration of N_1 symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $\mu = 0$, the UE assumes $N_{1,0} = 14$ [6, TS 38.214]. Screenshot showing UE Contention Resolution from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

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2> else if the CCCH SDU was included in Msg3 and the PDCCH transmission is addressed to its *TEMPORARY_C-RNTI*:

3> if the MAC PDU is successfully decoded:

4> stop *ra-ContentionResolutionTimer*;

4> if the MAC PDU contains a UE Contention Resolution Identity MAC CE; and

4> if the UE Contention Resolution Identity in the MAC CE matches the CCCH SDU transmitted in Msg3:

5> consider this Contention Resolution successful and finish the disassembly and demultiplexing of the MAC PDU;

5> if this Random Access procedure was initiated for SI request:

6> indicate the reception of an acknowledgement for SI request to upper layers.

Screenshot showing Contention Resolution from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 35 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

10,448,430 Claim 12	Evidence
12. The method according to claim 7, further comprising: after receiving, by at least one of the first UE or the second UE, the message 4 sent by the eNB, receiving, by at least one of the first UE or the second UE, indicating information, sent by the eNB, for indicating re-initiation of a random access of at	Every claim limitation of claim 7 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured such that after receiving, by at least one of the first UE or the second UE, the message 4 sent by the eNB, receiving, by at least one of the first UE or the second UE, indicating information, sent by the eNB, for indicating re-initiation of a random access of at least one of the first UE or the second UE. Upon information and belief, in case the contention resolution is not successful, the UE receives an indication from the eNB for re-initiation of the random access procedure by going back to Msg1 transmission.

least one of the first UE or the second UE.

The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.

Screenshot showing Random Access Procedure from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

1> if the Contention Resolution is considered not successful:

2> flush the HARQ buffer used for transmission of the MAC PDU in the Msg3 buffer;

2> increment *PREAMBLE_TRANSMISSION_COUNTER* by 1;

2> if *PREAMBLE_TRANSMISSION_COUNTER* = *preambleTransMax* + 1:

3> indicate a Random Access problem to upper layers.

3> if this Random Access procedure was triggered for SI request:

4> consider the Random Access procedure unsuccessfully completed.

2> if the Random Access procedure is not completed:

3> if the *RA_TYPE* is set to *4-stepRA*:

4> select a random backoff time according to a uniform distribution between 0 and the *PREAMBLE_BACKOFF*;

4> if the criteria (as defined in clause 5.1.2) to select contention-free Random Access Resources is met during the backoff time:

5> perform the Random Access Resource selection procedure (see clause 5.1.2);

4> else:

5> perform the Random Access Resource selection procedure (see clause 5.1.2) after the backoff time.

Screenshot showing Contention Resolution from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 36 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

Upon information and belief, in case the random access procedure is not successful, the HARQ operation performs retransmission of the random access resources as indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC.

5.4.2.1 HARQ Entity

The MAC entity includes a HARQ entity for each Serving Cell with configured uplink (including the case when it is configured with *supplementaryUplink*), which maintains a number of parallel HARQ processes.

The number of parallel UL HARQ processes per HARQ entity is specified in TS 38.214 [7].

Each HARQ process supports one TB.

Each HARQ process is associated with a HARQ process identifier. For UL transmission with UL grant in RA Response or for UL transmission for MSGA payload, HARQ process identifier 0 is used.

NOTE: When a single DCI is used to schedule multiple PUSCH, the UE is allowed to map generated TB(s) internally to different HARQ processes in case of LBT failure(s), i.e. UE may transmit a new TB on any HARQ process in the grants that have the same TBS, the same RV and the NDIs indicate new transmission.

The maximum number of transmissions of a TB within a bundle of the dynamic grant or configured grant is given by *REPETITION_NUMBER* as follows:

- For a dynamic grant, *REPETITION_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.1 of TS 38.214 [7];
- For a configured grant, *REPETITION_NUMBER* is set to a value provided by lower layers, as specified in clause 6.1.2.3 of TS 38.214 [7].

If *REPETITION_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION_NUMBER* – 1 HARQ retransmissions follow within the bundle. For both dynamic grant and configured uplink grant, bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle, HARQ retransmissions are triggered without waiting for feedback from previous transmission according to *REPETITION_NUMBER* for a dynamic grant or configured uplink grant unless they are terminated as specified in clause 6.1 of TS 38.214 [7]. Each transmission within a bundle is a separate uplink grant delivered to the HARQ entity.

Screenshot showing HARQ operation from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 45 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

	5.4.2.2 HARQ process Each HARQ process is associated with a HARQ buffer. New transmissions are performed on the resource and with the MCS indicated on PDCCH or indicated in the Random Access Response (i.e. MAC RAR or fallbackRAR), or signalled in RRC or determined as specified in clause 5.1.2a for MSGA payload. Retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH, or on the same resource and with the same MCS as was used for last made transmission attempt within a bundle, or on stored configured uplink grant resources and stored MCS when *cg-RetransmissionTimer* is configured. If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. When *cg-RetransmissionTimer* is configured and the HARQ entity obtains a MAC PDU to transmit and LBT failure indication is received from lower layer, the corresponding HARQ process is considered to be pending. For a configured uplink grant, configured with *cg-RetransmissionTimer*, each associated HARQ process is considered as not pending when: Screenshot showing HARQ process from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 48 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 13	**Evidence**
13. The method according to claim 7, wherein the message 3 and the message 4 comprise a group ID of the UE group or a pre-set field.	Every claim limitation of claim 7 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein the message 3 and the message 4 comprise a group ID of the UE group or a pre-set field. Upon information and belief, the Msg3 comprises a C-RNTI field which is a unique UE identification used as an identifier of the RRC Connection and for scheduling. The C-RNTI MAC CE field contains the C-RNTI of the MAC entity (User Equipment). Upon information and belief, the C-RNTI MAC CE field comprises a pre-set UE number. **Msg3**: Message transmitted on UL-SCH containing a C-RNTI MAC CE or CCCH SDU, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a Random Access procedure.

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Screenshot showing Msg3 definition from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

Screenshot showing Msg3 transmission with C-RNTI from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

Screenshot showing Msg3 transmission according to a Uplink (UL) grant from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 42 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

6.1.3.2 C-RNTI MAC CE

The C-RNTI MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.

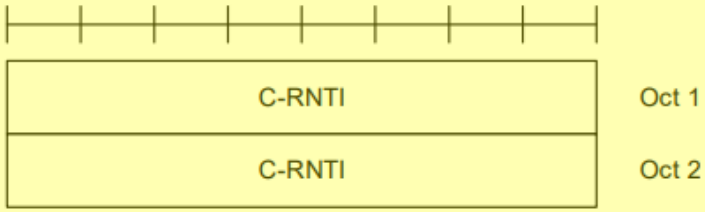


Figure 6.1.3.2-1: C-RNTI MAC CE

Screenshot showing C-RNTI MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.1 UE Identities

In this clause, the identities used by NR connected to 5GC are listed. For scheduling at cell level, the following identities are used:

- C-RNTI: unique UE identification used as an identifier of the RRC Connection and for scheduling;

Screenshot showing C-RNTI from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the contention resolution message Msg4 comprises a Physical Downlink Shared Channel (PDSCH) allocated for contention resolution. The contention resolution message Msg4 comprises a UE Contention Resolution Identity identifying the MAC entity (UE).

8.4 PDSCH with UE contention resolution identity

In response to a PUSCH transmission scheduled by a RAR UL grant when a UE has not been provided a C-RNTI, the UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding TC-RNTI scheduling a PDSCH that includes a UE contention resolution identity [11, TS 38.321]. In response to the PDSCH reception with the UE contention resolution identity, the UE transmits HARQ-ACK information in a PUCCH. The PUCCH transmission is within a same active UL BWP as the PUSCH transmission. A minimum time between the last symbol of the PDSCH reception and the first symbol of the corresponding PUCCH transmission with the HARQ-ACK information is equal to $N_{T,1} + 0.5$ msec. $N_{T,1}$ is a time duration of N_1 symbols corresponding to a PDSCH processing time for UE processing capability 1 when additional PDSCH DM-RS is configured. For $\mu = 0$, the UE assumes $N_{1,0} = 14$ [6, TS 38.214].

Screenshot showing UE Contention Resolution from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

6.1.3.3 UE Contention Resolution Identity MAC CE

The UE Contention Resolution Identity MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-1.

It has a fixed 48-bit size and consists of a single field defined as follows (Figure 6.1.3.3-1):

- UE Contention Resolution Identity: This field contains the UL CCCH SDU. If the UL CCCH SDU is longer than 48 bits, this field contains the first 48 bits of the UL CCCH SDU.

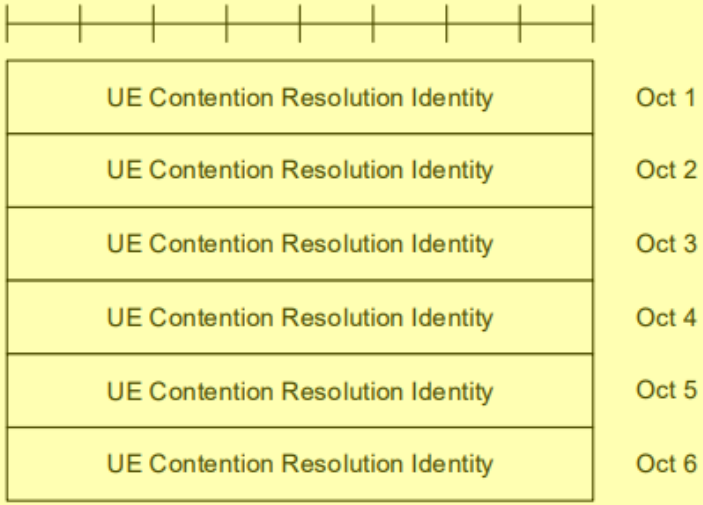


Figure 6.1.3.3-1: UE Contention Resolution Identity MAC CE

Screenshot showing UE Contention Resolution Identity MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

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10,448,430 Claim 14	Evidence
14. The method according to claim 1, further comprising: before sending, by the first UE in the UE group, the preamble over the time-frequency resource, receiving, by at least one of the first UE or the second UE, Downlink Control Information (DCI) or a paging message or a Radio Resource Control (RRC) message sent by the eNB; or, receiving, by the first UE, random access request information sent by the second UE.	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured that before sending, by the first UE in the UE group, the preamble over the time-frequency resource, receiving, by at least one of the first UE or the second UE, Downlink Control Information (DCI) or a paging message or a Radio Resource Control (RRC) message sent by the eNB or receiving, by the first UE, random access request information sent by the second UE. Upon information and belief, the Accused Device is configured to perform the random access procedure. The random access procedure is triggered by RRC for a number of events. 5.1 Random Access procedure 5.1.1 Random Access procedure initialization The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000. Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 17 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

9.2.6 Random Access Procedure

The random access procedure is triggered by a number of events:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- DL or UL data arrival during RRC_CONNECTED when UL synchronisation status is "non-synchronised";
- UL data arrival during RRC_CONNECTED when there are no PUCCH resources for SR available;
- SR failure;
- Request by RRC upon synchronous reconfiguration (e.g. handover);
- Transition from RRC_INACTIVE;
- To establish time alignment for a secondary TAG;
- Request for Other SI (see clause 7.3);
- Beam failure recovery;
- Consistent UL LBT failure on SpCell.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Paging messages allow the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state for initiating random access procedure. Further, Paging messages are also used to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change.

7.3.2 Scheduling

The MIB is mapped on the BCCH and carried on BCH while all other SI messages are mapped on the BCCH, where they are dynamically carried on DL-SCH. The scheduling of SI messages part of Other SI is indicated by *SIB1*.

For UEs in RRC_IDLE and RRC_INACTIVE, a request for Other SI triggers a random access procedure (see clause 9.2.6) where MSG3 includes the SI request message unless the requested SI is associated to a subset of the PRACH resources, in which case MSG1 is used for indication of the requested Other SI. When MSG1 is used, the minimum granularity of the request is one SI message (i.e. a set of SIBs), one RACH preamble and/or PRACH resource can be used to request multiple SI messages and the gNB acknowledges the request in MSG2. When MSG 3 is used, the gNB acknowledges the request in MSG4.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 54 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

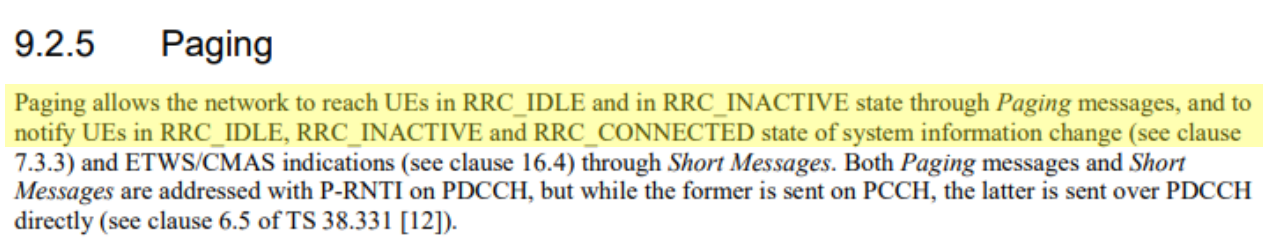
7.2 Protocol States

RRC supports the following states which can be characterised as follows:

- **RRC_IDLE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging for mobile terminated data is initiated by 5GC;
  - DRX for CN paging configured by NAS.
- **RRC_INACTIVE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging is initiated by NG-RAN (RAN paging);
  - RAN-based notification area (RNA) is managed by NG- RAN;
  - DRX for RAN paging configured by NG-RAN;
  - 5GC - NG-RAN connection (both C/U-planes) is established for UE;
  - The UE AS context is stored in NG-RAN and the UE;
  - NG-RAN knows the RNA which the UE belongs to.

Screenshot showing Protocol States supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 52 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

<table>
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9.2.5 Paging

Paging allows the network to reach UEs in RRC_IDLE and in RRC_INACTIVE state through *Paging* messages, and to notify UEs in RRC_IDLE, RRC_INACTIVE and RRC_CONNECTED state of system information change (see clause 7.3.3) and ETWS/CMAS indications (see clause 16.4) through *Short Messages*. Both *Paging* messages and *Short Messages* are addressed with P-RNTI on PDCCH, but while the former is sent on PCCH, the latter is sent over PDCCH directly (see clause 6.5 of TS 38.331 [12]).

Screenshot showing Paging supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 52 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).</td></tr>
<tr><th>10,448,430 Claim 15</th><th>Evidence</th></tr>
<tr><td>15. The method according to claim 14, wherein receiving, by at least one of the first UE or the second UE, the DCI or the paging message or the RRC message sent by the eNB comprises at least one of the following:
the DCI or a CRC of DCI for scheduling the paging message or the RRC message is scrambled by using a group ID of the UE group;
the DCI or the paging message or the RRC message comprises a group ID of the UE group;
the DCI or the paging message or the RRC message comprises an ID of at least one of the first UE or the second UE; or</td><td>Every claim limitation of claim 14 is present in the Accused Device as described above and incorporated herein by reference.

The Accused Device is configured such that wherein receiving, by at least one of the first UE or the second UE, the DCI or the paging message or the RRC message sent by the eNB comprises the DCI or the paging message or the RRC message comprises at least one of an ID of the preamble, the time domain resource of the preamble or the frequency domain resource of the preamble.</td></tr>
</table>

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the DCI or the paging message or the RRC message comprises at least one of an ID of the preamble, the time domain resource of the preamble or the frequency domain resource of the preamble.	8.2 Random access response - Type-1 random access procedure In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in Clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set as defined in Clause 10.1. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*. If the UE detects the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI and LSBs of a SFN field in the DCI format 1_0, if included and applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity (RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer. Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 46 and 47 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). Upon information and belief, the UE receives a preamble index, a preamble SCS, PPRACH,target , a corresponding RA-RNTI, and a PRACH resource (time resources and frequency resources) from the higher layers (eNB). The PRACH resources are used for the transmission of preamble over a time-frequency resource.

8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

8.1 Random access preamble

Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following:

- A configuration for PRACH transmission [4, TS 38.211].
- A preamble index, a preamble SCS, $P_{\text{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

A PRACH is transmitted using the selected PRACH format with transmission power $P_{\text{PRACH},b,f,c}(i)$, as described in Clause 7.4, on the indicated PRACH resource.

For Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

	Screenshot showing the transmission of random access preamble (Msg1) in a PRACH from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 41 and 42 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 17	**Evidence**
17. The method according to claim 1, wherein sending, by the first UE in the UE group, the preamble over the time-frequency resource comprises: periodically sending, by the first UE, the preamble over the frequency domain resource.	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. The Accused Device is configured wherein sending, by the first UE in the UE group, the preamble over the time-frequency resource comprises periodically sending, by the first UE, the preamble over the frequency domain resource. Upon information and belief, the UE tranmits the preamble firstly in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions and then in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot. 8.1 Random access preamble Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following: - A configuration for PRACH transmission [4, TS 38.211]. - A preamble index, a preamble SCS, $P_{\text{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource.

A PRACH is transmitted using the selected PRACH format with transmission power $P_{\text{PRACH},b,f,c}(i)$, as described in Clause 7.4, on the indicated PRACH resource.

For Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

For Type-2 random access procedure with common configuration of PRACH occasions with Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* and a number Q of contention based preambles per SS/PBCH block index per valid PRACH occasion by *msgA-CB-PreamblesPerSSB-PerSharedRO*. The PRACH transmission can be on a subset of PRACH occasions associated with a same SS/PBCH block index within an SSB-RO mapping cycle for a UE provided with a PRACH mask index by *msgA-SSB-SharedRO-MaskIndex* according to [11, TS 38.321].

For Type-2 random access procedure with separate configuration of PRACH occasions with Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB* when provided; otherwise, by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*.

For Type-1 random access procedure, or for Type-2 random access procedure with separate configuration of PRACH occasions from Type 1 random access procedure, if $N < 1$, one SS/PBCH block index is mapped to $1/N$ consecutive valid PRACH occasions and R contention based preambles with consecutive indexes associated with the SS/PBCH block index per valid PRACH occasion start from preamble index 0. If $N \geq 1$, R contention based preambles with consecutive indexes associated with SS/PBCH block index n, $0 \leq n \leq N-1$, per valid PRACH occasion start from preamble index $n \cdot N^{\text{total}}_{\text{preamble}}/N$ where $N^{\text{total}}_{\text{preamble}}$ is provided by *totalNumberOfRA-Preambles* for Type-1 random access procedure, or by *msgA-TotalNumberOfRA-Preambles* for Type-2 random access procedure with separate configuration of PRACH occasions from a Type 1 random access procedure, and is an integer multiple of N.

SS/PBCH block indexes provided by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon* are mapped to valid PRACH occasions in the following order where the parameters are described in [4, TS 38.211].

- First, in increasing order of preamble indexes within a single PRACH occasion
- Second, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions
- Third, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot
- Fourth, in increasing order of indexes for PRACH slots

An association period, starting from frame 0, for mapping SS/PBCH block indexes to PRACH occasions is the smallest value in the set determined by the PRACH configuration period according Table 8.1-1 such that N_{Tx}^{SSB} SS/PBCH block indexes are mapped at least once to the PRACH occasions within the association period, where a UE obtains N_{Tx}^{SSB} from the value of *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*. If after an integer number of SS/PBCH block indexes to PRACH occasions mapping cycles within the association period there is a set of PRACH occasions or PRACH preambles that are not mapped to N_{Tx}^{SSB} SS/PBCH block indexes, no SS/PBCH block indexes are mapped to the set of PRACH occasions or PRACH preambles. An association pattern period includes one or more association periods and is determined so that a pattern between PRACH occasions and SS/PBCH block indexes repeats at most every 160 msec. PRACH occasions not associated with SS/PBCH block indexes after an integer number of association periods, if any, are not used for PRACH transmissions.

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The PRACH occasions are mapped consecutively per corresponding SS/PBCH block index. The indexing of the PRACH occasion indicated by the mask index value is reset per mapping cycle of consecutive PRACH occasions per SS/PBCH block index. The UE selects for a PRACH transmission the PRACH occasion indicated by PRACH mask index value for the indicated SS/PBCH block index in the first available mapping cycle.

For the indicated preamble index, the ordering of the PRACH occasions is

- First, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions
- Second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot
- Third, in increasing order of indexes for PRACH slots

For a PRACH transmission triggered upon request by higher layers, a value of *ra-OccasionList* [12, TS 38.331], if *csirs-ResourceList* is provided, indicates a list of PRACH occasions for the PRACH transmission where the PRACH occasions are associated with the selected CSI-RS index indicated by *csi-RS*. The indexing of the PRACH occasions indicated by *ra-OccasionList* is reset per association pattern period.

Table 8.1-1: Mapping between PRACH configuration period and SS/PBCH block to PRACH occasion association period

PRACH configuration period (msec)	Association period (number of PRACH configuration periods)
10	{1, 2, 4, 8, 16}
20	{1, 2, 4, 8}
40	{1, 2, 4}
80	{1, 2}
160	{1}

Screenshot showing the transmission of random access preamble (Msg1) from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 41-43 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

Upon information and belief, the Accused Device configured as the User Equipment (UE) transmits the Random Access Preamble with the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted. The RA-RNTI associated with the PRACH resource comprises a time domain resource and a frequency domain resource.

5.1.3 Random Access Preamble transmission

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE_TRANSMISSION_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE_POWER_RAMPING_COUNTER* by 1.

1> select the value of *DELTA_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE_RECEIVED_TARGET_POWER* to *preambleReceivedTargetPower* + *DELTA_PREAMBLE* + (*PREAMBLE_POWER_RAMPING_COUNTER* – 1) × *PREAMBLE_POWER_RAMPING_STEP* + *POWER_OFFSET_2STEP_RA*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE_INDEX*, and *PREAMBLE_RECEIVED_TARGET_POWER*.

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + s\_id + 14 \times t\_id + 14 \times 80 \times f\_id + 14 \times 80 \times 8 \times ul\_carrier\_id$$

where s_id is the index of the first OFDM symbol of the PRACH occasion ($0 \le s\_id < 14$), t_id is the index of the first slot of the PRACH occasion in a system frame ($0 \le t\_id < 80$), where the subcarrier spacing to determine t_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f_id is the index of the PRACH occasion in the frequency domain ($0 \le f\_id < 8$), and ul_carrier_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

Screenshot showing Random Access Preamble transmission by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on pages 27 and 28 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

	To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
10,448,430 Claim 18	**Evidence**
18. A User Equipment (UE), comprising: a sending unit and a monitoring unit,	This is the preamble of the claim and is not limiting. This element, if construed as a limitation, is present literally and under the doctrine of equivalents in the Accused Device. The Accused Device is a smartphone device comprising Octa-Core processor, PLS TFT LCD display, high resolution front and rear cameras, 4GB RAM with 64GB internal storage and 5000mAh battery. The Accused Device is configured to support features like Side Sensor Fingerprint, expandable memory etc. The Accused Device is available in different models varying based on Cell Phone Carrier, Internal Memory and Color. The various models available for the Accused Device are A136UZKDXAA, SM-A136ULGDXAA, SM-A136UZKAATT, SM-A136ULGAATT, SM-A136UZKAXAU, and SM-A136UZKAUSC.

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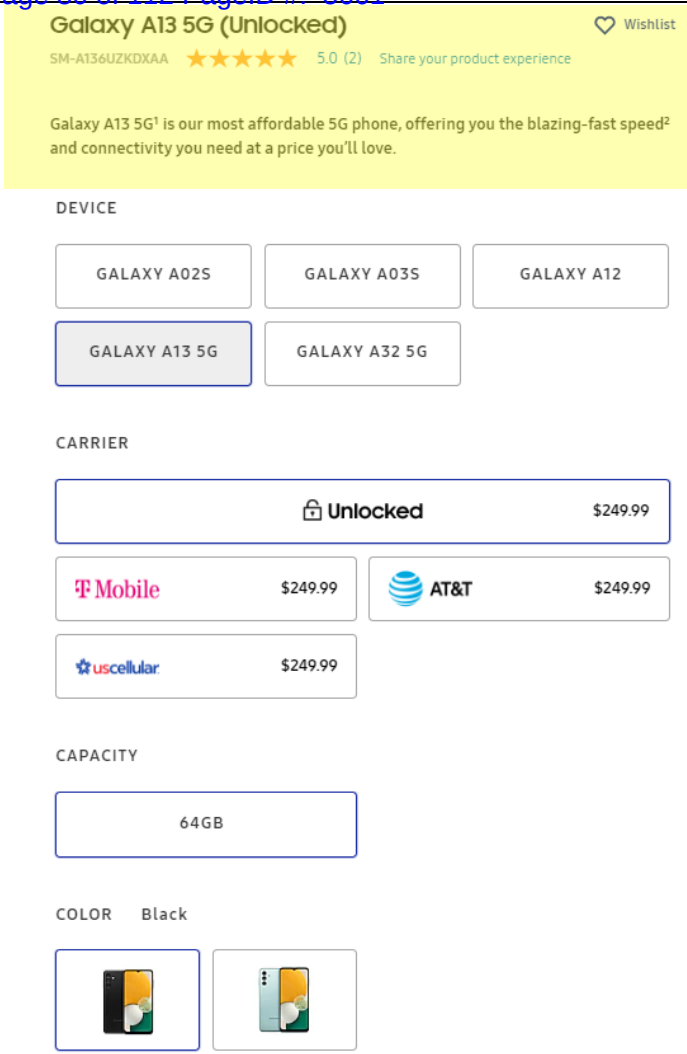
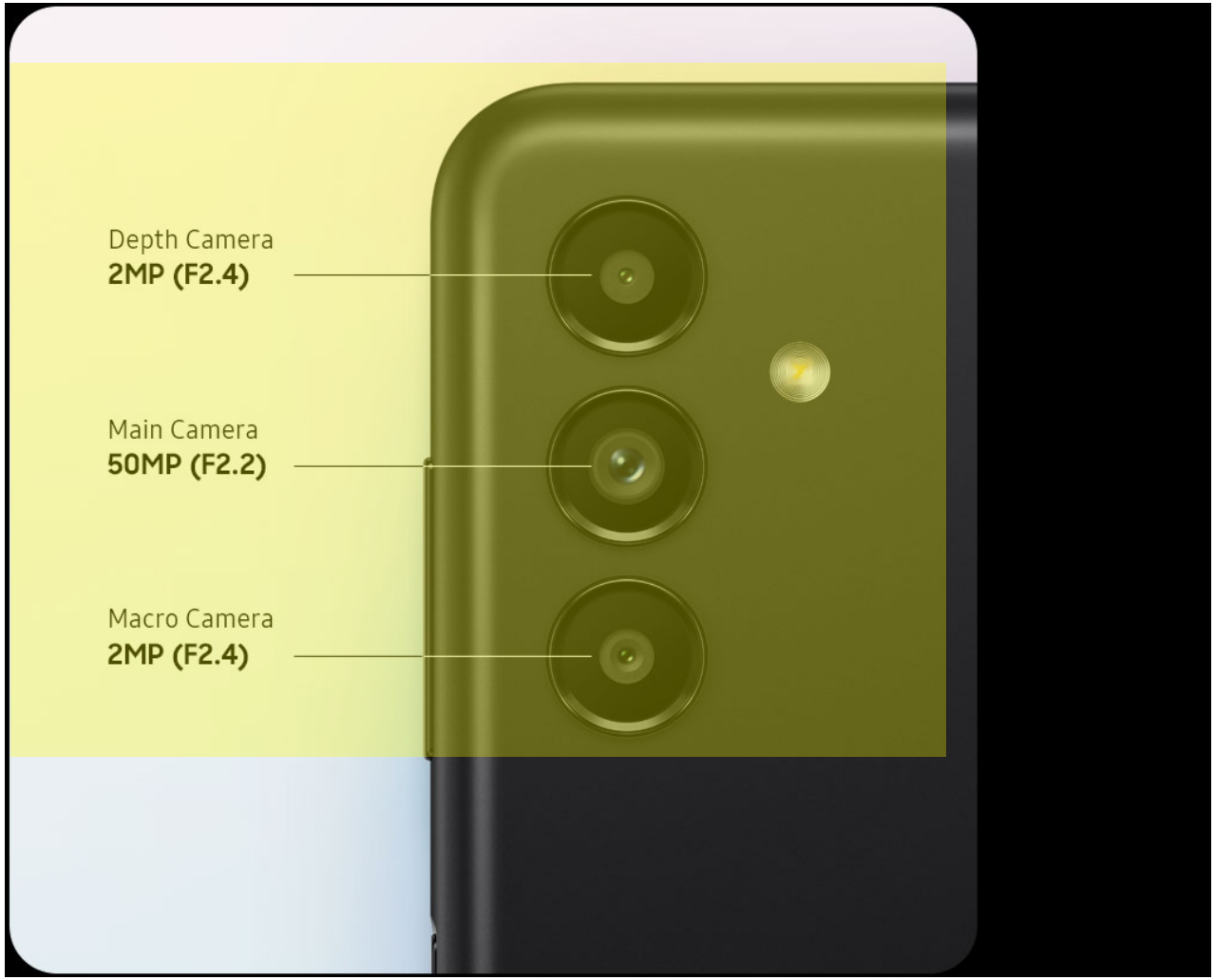


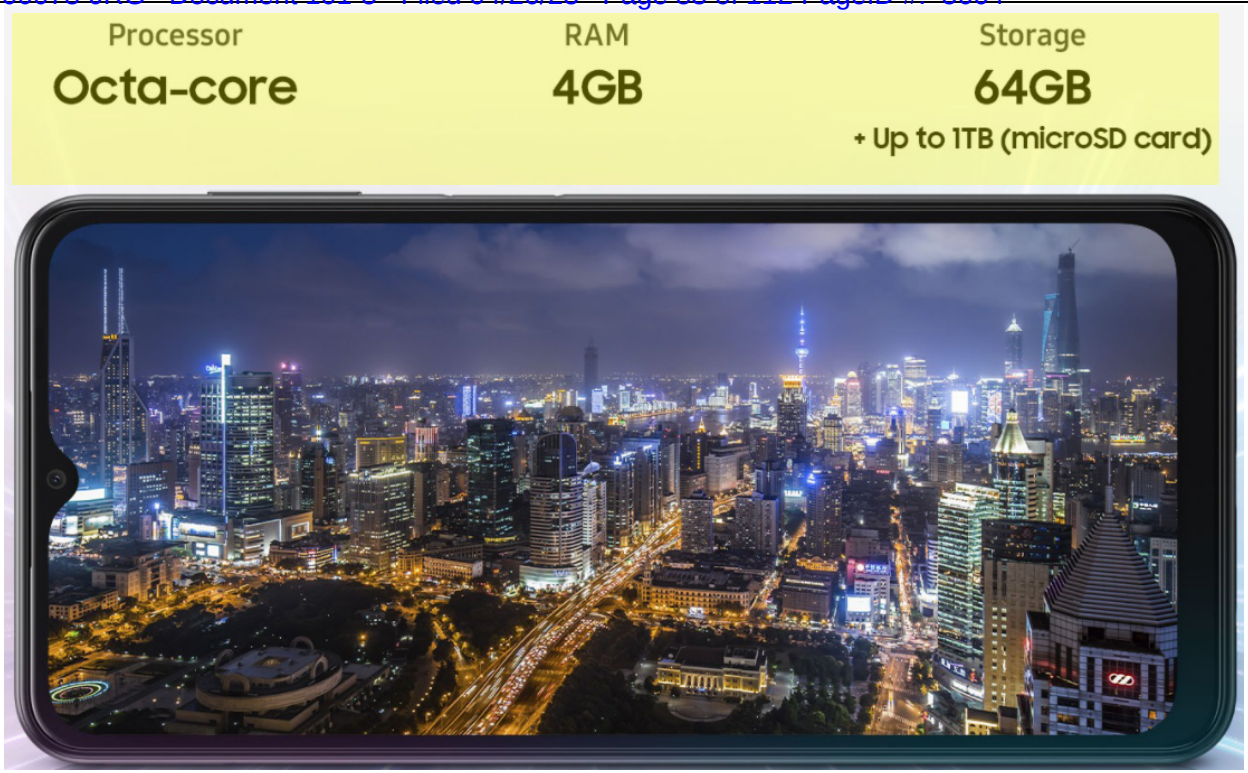
Image of the Accused Device Galaxy A13 5G Smartphone SM-A136UZKDXAA (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



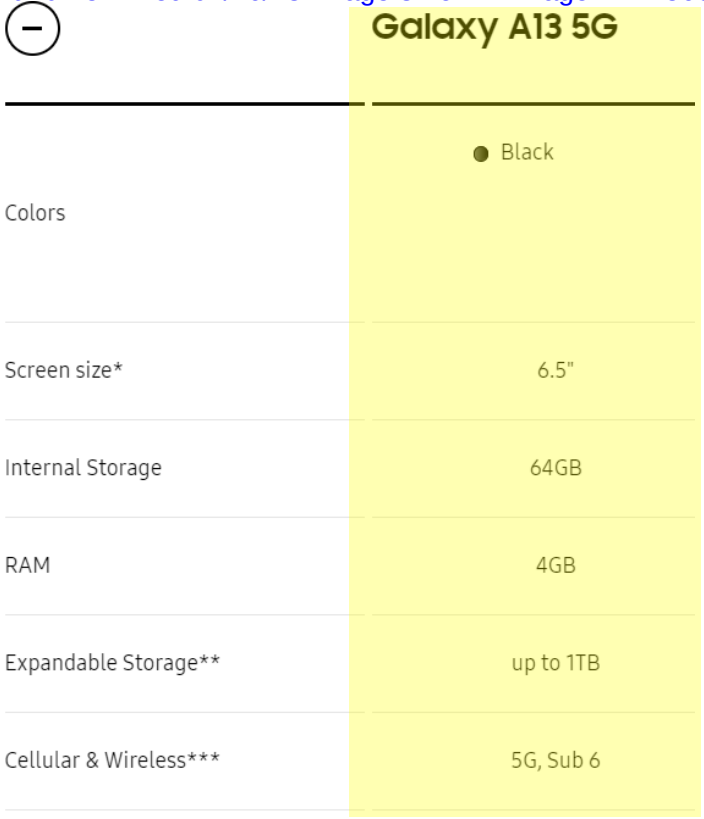
Screenshot showing Image of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).



Screenshot showing camera of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

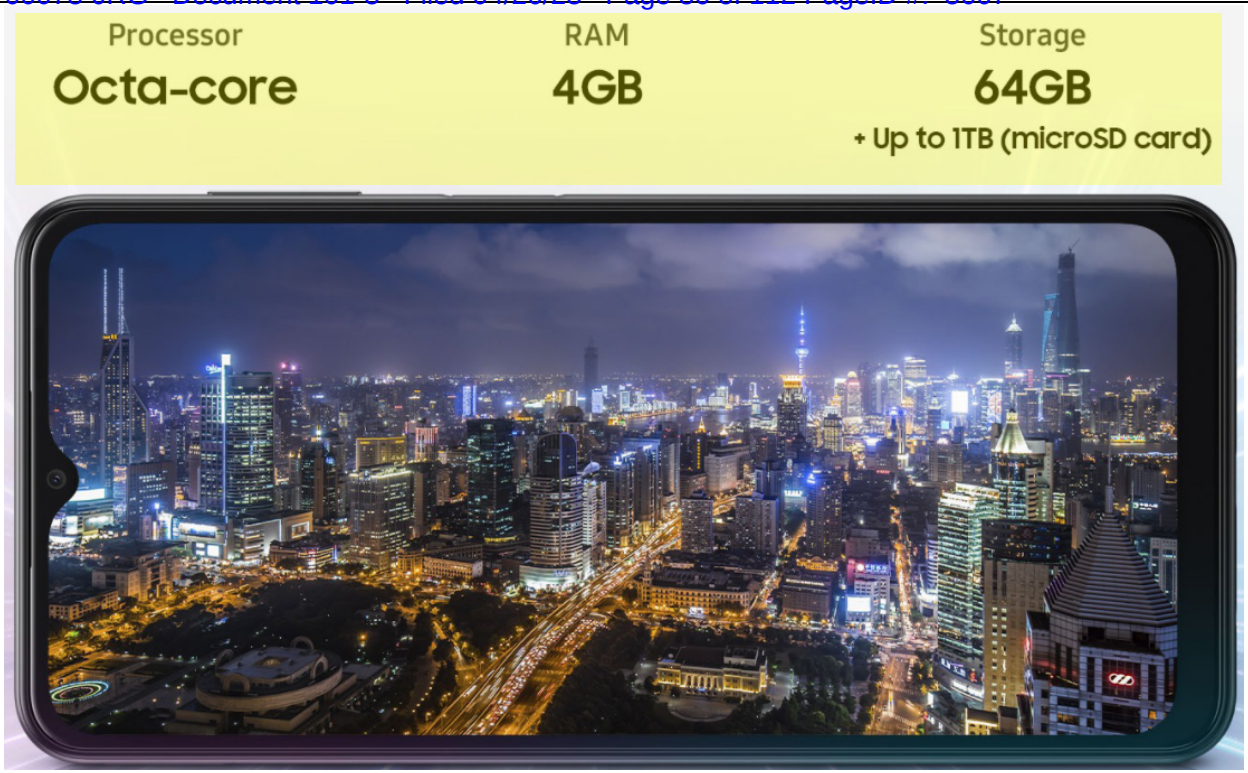


	Galaxy A13 5G
Colors	Black
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

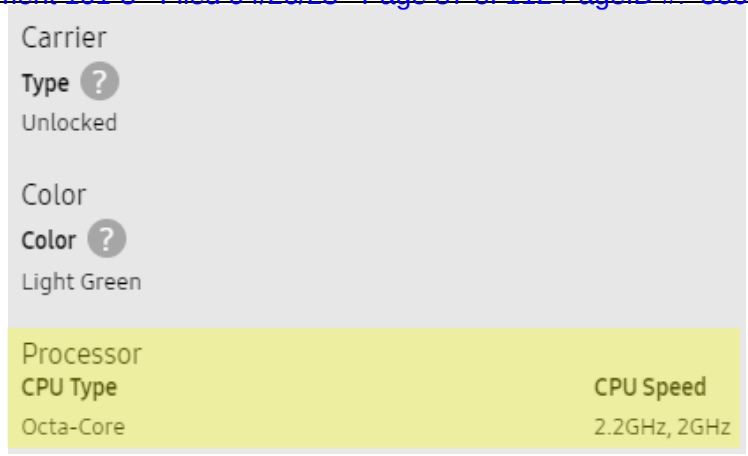
Display type	Flat
Fingerprint Sensor	Side Fingerprint Sensor
Front Camera	5MP Selfie Camera
Rear Camera	50MP Main Camera 2MP Macro Camera 2MP Depth Camera
Battery Capacity****	5000mAh (typical)

Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).

Upon information and belief, the Accused Device comprises a sending unit and a monitoring unit for supporting various network and connectivity. The Accused Device comprises a processor configured for monitoring and processing the network signals.



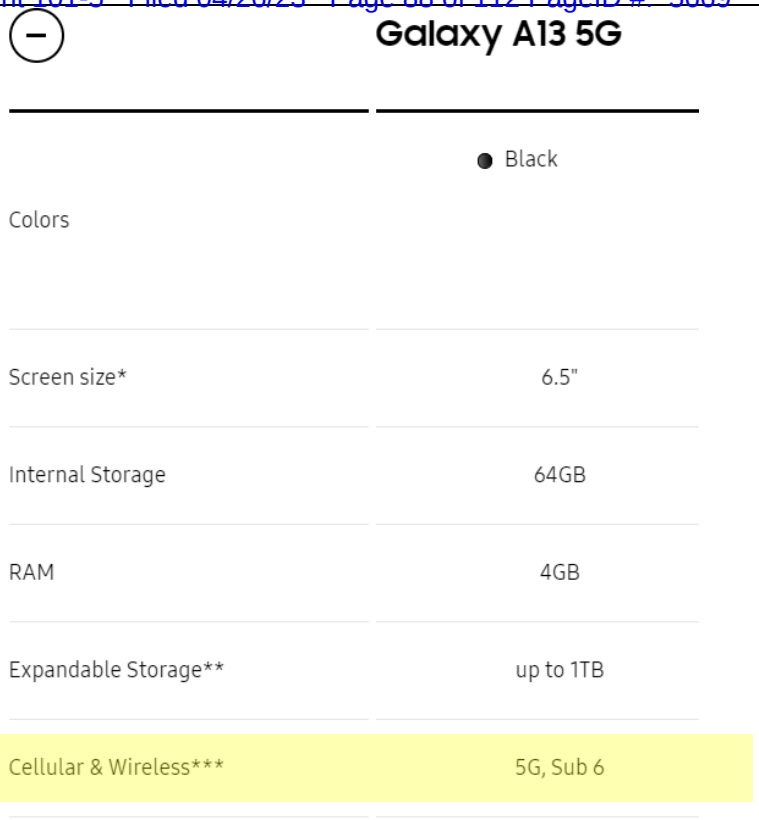
Screenshot showing processor supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



Screenshot showing processor supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a13-5g/).

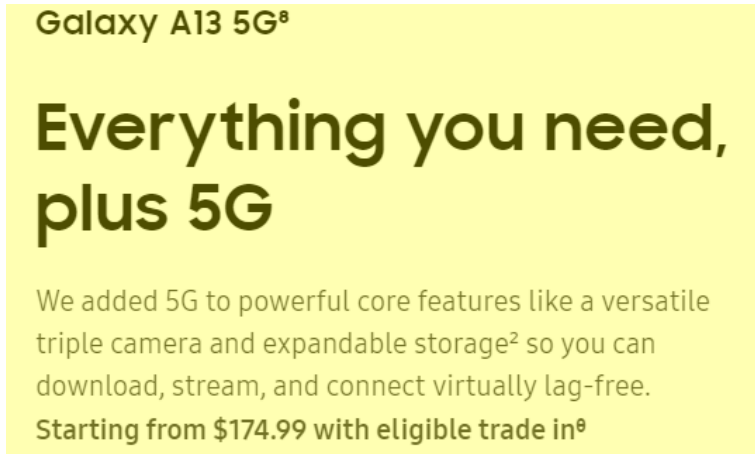
The Accused Device can be configured as a mobile terminal to support 5G telecommunications standard for providing services like blazing-fast speed, and virtually lag-free download and stream.

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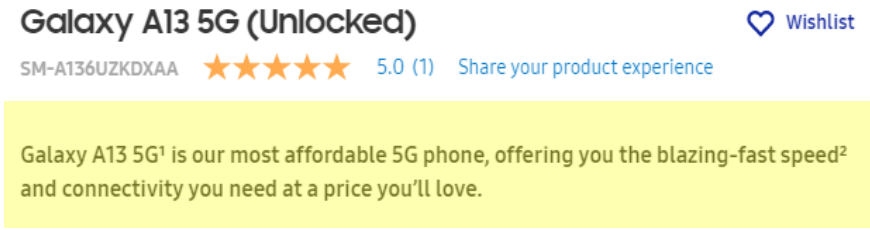


	Galaxy A13 5G
	● Black
Colors	
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).





Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 38.213 version 16.5.0 Release 16 (5G; NR; Physical layer procedures for control), 3GPP TS 38.300 version 16.5.0 Release 16 (5G; NR; NR and NG-RAN Overall description; Stage-2) and 3GPP TS 38.321 version 16.4.0 Release 16 (5G; NR; Medium Access Control (MAC) protocol specification).

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ETSI TS 138 213 V16.5.0 (2021-04)



5G;
NR;
Physical layer procedures for control
(3GPP TS 38.213 version 16.5.0 Release 16)

1 Scope

The present document specifies and establishes the characteristics of the physical layer procedures for control operations in 5G-NR.

Screenshot showing the scope of standard 3GPP TS 38.213 version 16.5.0 Release 16 supported by the Accused Device (available on page 7 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).



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	1 Scope The present document provides an overview and overall description of the NG-RAN and focuses on the radio interface protocol architecture of NR connected to 5GC (E-UTRA connected to 5GC is covered in the 36 series). Details of the radio interface protocols are specified in companion specifications of the 38 series. Screenshot showing the scope of standard 3GPP TS 38.300 version 16.5.0 Release 16 supported by the Accused Device (available on page 11 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

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ETSI TS 138 321 V16.4.0 (2021-04)



5G;
NR;
Medium Access Control (MAC) protocol specification
(3GPP TS 38.321 version 16.4.0 Release 16)

1 Scope

The present document specifies the NR MAC protocol.

Screenshot showing the scope of standard 3GPP TS 38.321 version 16.4.0 Release 16 supported by the Accused Device (available on page 9 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

Upon information and belief, the Accused Device is configured to perform the random access procedure. The random access procedure is triggered by a number of events.

5.1 Random Access procedure

5.1.1 Random Access procedure initialization

The Random Access procedure described in this clause is initiated by a PDCCH order, by the MAC entity itself, or by RRC for the events in accordance with TS 38.300 [2]. There is only one Random Access procedure ongoing at any point in time in a MAC entity. The Random Access procedure on an SCell shall only be initiated by a PDCCH order with *ra-PreambleIndex* different from 0b000000.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 17 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

9.2.6 Random Access Procedure

The random access procedure is triggered by a number of events:

- Initial access from RRC_IDLE;
- RRC Connection Re-establishment procedure;
- DL or UL data arrival during RRC_CONNECTED when UL synchronisation status is "non-synchronised";
- UL data arrival during RRC_CONNECTED when there are no PUCCH resources for SR available;
- SR failure;
- Request by RRC upon synchronous reconfiguration (e.g. handover);
- Transition from RRC_INACTIVE;
- To establish time alignment for a secondary TAG;
- Request for Other SI (see clause 7.3);
- Beam failure recovery;
- Consistent UL LBT failure on SpCell.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Accused Device is configured to support Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

Screenshot showing Type-1 L1 Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on page 41 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

Upon information and belief, the Accused Device is also configured to support 4-step RA type with MSG1. The RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA).

	Two types of random access procedure are supported: 4-step RA type with MSG1 and 2-step RA type with MSGA. Both types of RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA) as shown on Figure 9.2.6-1 below. The UE selects the type of random access at initiation of the random access procedure based on network configuration: - when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type; - when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type; - when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type. Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 87 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
18a. wherein the sending unit is configured to: send a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource;	The Accused Device is configured to comprise a sending unit wherein the sending unit is configured to send a preamble to an evolved Node B (eNB) over a time-frequency resource, the time-frequency resource comprising a time domain resource and a frequency domain resource. Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 38.213 version 16.5.0 Release 16 (5G; NR; Physical layer procedures for control), 3GPP TS 38.300 version 16.5.0 Release 16 (5G; NR; NR and NG-RAN Overall description; Stage-2) and 3GPP TS 38.321 version 16.4.0 Release 16 (5G; NR; Medium Access Control (MAC) protocol specification). The Accused Device is configured to select the type of random access at the initiation of the random access procedure based on the network configuration and sends a random access preamble to an evolved Node B (eNB). Upon information and belief, the Accused Device is also configured to select the 4-step RA type with MSG1. The MSG1 of the 4-step RA type consists of a preamble on PRACH wherein PRACH is a time-frequency resource.

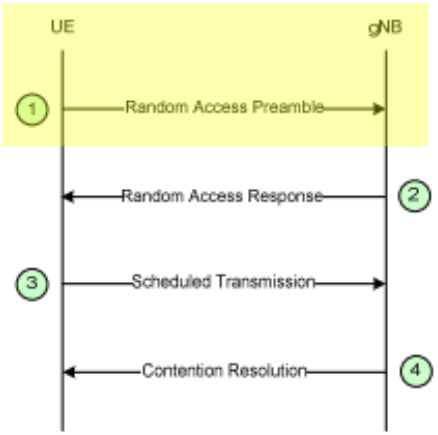
Two types of random access procedure are supported: 4-step RA type with MSG1 and 2-step RA type with MSGA. Both types of RA procedure support contention-based random access (CBRA) and contention-free random access (CFRA) as shown on Figure 9.2.6-1 below.

The UE selects the type of random access at initiation of the random access procedure based on network configuration:

- when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type;
- when CFRA resources for 4-step RA type are configured, UE performs random access with 4-step RA type;
- when CFRA resources for 2-step RA type are configured, UE performs random access with 2-step RA type.

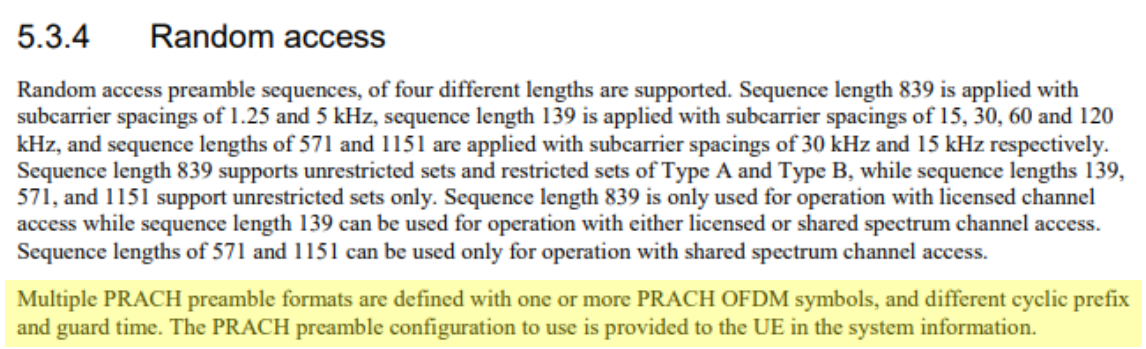
The network does not configure CFRA resources for 4-step and 2-step RA types at the same time for a Bandwidth Part (BWP). CFRA with 2-step RA type is only supported for handover.

The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.



(a) CBRA with 4-step RA type

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).



5.3.4 Random access

Random access preamble sequences, of four different lengths are supported. Sequence length 839 is applied with subcarrier spacings of 1.25 and 5 kHz, sequence length 139 is applied with subcarrier spacings of 15, 30, 60 and 120 kHz, and sequence lengths of 571 and 1151 are applied with subcarrier spacings of 30 kHz and 15 kHz respectively. Sequence length 839 supports unrestricted sets and restricted sets of Type A and Type B, while sequence lengths 139, 571, and 1151 support unrestricted sets only. Sequence length 839 is only used for operation with licensed channel access while sequence length 139 can be used for operation with either licensed or shared spectrum channel access. Sequence lengths of 571 and 1151 can be used only for operation with shared spectrum channel access.

Multiple PRACH preamble formats are defined with one or more PRACH OFDM symbols, and different cyclic prefix and guard time. The PRACH preamble configuration to use is provided to the UE in the system information.

Screenshot showing PRACH resource from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 34 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Accused Device configured as the User Equipment (UE) transmits the Random Access Preamble with the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted. The RA-RNTI associated with the PRACH resource comprises a time domain resource and a frequency domain resource.

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5.1.3 Random Access Preamble transmission

The MAC entity shall, for each Random Access Preamble:

1> if *PREAMBLE_TRANSMISSION_COUNTER* is greater than one; and

1> if the notification of suspending power ramping counter has not been received from lower layers; and

1> if LBT failure indication was not received from lower layers for the last Random Access Preamble transmission; and

1> if SSB or CSI-RS selected is not changed from the selection in the last Random Access Preamble transmission:

2> increment *PREAMBLE_POWER_RAMPING_COUNTER* by 1.

1> select the value of *DELTA_PREAMBLE* according to clause 7.3;

1> set *PREAMBLE_RECEIVED_TARGET_POWER* to *preambleReceivedTargetPower* + *DELTA_PREAMBLE* + (*PREAMBLE_POWER_RAMPING_COUNTER* – 1) × *PREAMBLE_POWER_RAMPING_STEP* + *POWER_OFFSET_2STEP_RA*;

1> except for contention-free Random Access Preamble for beam failure recovery request, compute the RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted;

1> instruct the physical layer to transmit the Random Access Preamble using the selected PRACH occasion, corresponding RA-RNTI (if available), *PREAMBLE_INDEX*, and *PREAMBLE_RECEIVED_TARGET_POWER*.

The RA-RNTI associated with the PRACH occasion in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + s\_id + 14 \times t\_id + 14 \times 80 \times f\_id + 14 \times 80 \times 8 \times ul\_carrier\_id$$

where s_id is the index of the first OFDM symbol of the PRACH occasion ($0 \le s\_id < 14$), t_id is the index of the first slot of the PRACH occasion in a system frame ($0 \le t\_id < 80$), where the subcarrier spacing to determine t_id is based on the value of μ specified in clause 5.3.2 in TS 38.211 [8], f_id is the index of the PRACH occasion in the frequency domain ($0 \le f\_id < 8$), and ul_carrier_id is the UL carrier used for Random Access Preamble transmission (0 for NUL carrier, and 1 for SUL carrier).

Screenshot showing Random Access Preamble transmission by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on pages 27 and 28 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

During the random access procedure, the following identities are also used:

- RA-RNTI: identification of the Random Access Response in the downlink;

Screenshot showing definition of RA-RNTI supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the UE receives a preamble index, a preamble SCS, PPRACH,target , a corresponding RA-RNTI, and a PRACH resource (time resources and frequency resources) from the higher layers (eNB). The PRACH resources are used for the transmission of preamble over a time-frequency resource.

8 Random access procedure

Prior to initiation of the physical random access procedure, Layer 1 receives from higher layers a set of SS/PBCH block indexes and provides to higher layers a corresponding set of RSRP measurements.

Prior to initiation of the physical random access procedure, Layer 1 may receive from higher layers an indication to perform a Type-1 random access procedure, as described in Clauses 8.1 through 8.4, or a Type-2 random access procedure as described in Clauses 8.1 through 8.2A.

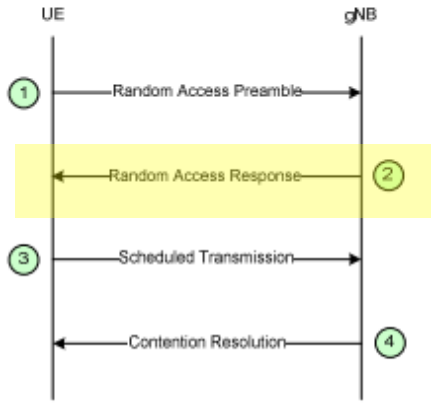
Prior to initiation of the physical random access procedure, Layer 1 receives the following information from the higher layers:

- Configuration of physical random access channel (PRACH) transmission parameters (PRACH preamble format, time resources, and frequency resources for PRACH transmission).
- Parameters for determining the root sequences and their cyclic shifts in the PRACH preamble sequence set (index to logical root sequence table, cyclic shift (N_{CS}), and set type (unrestricted, restricted set A, or restricted set B)).

From the physical layer perspective, the Type-1 L1 random access procedure includes the transmission of random access preamble (Msg1) in a PRACH, random access response (RAR) message with a PDCCH/PDSCH (Msg2), and when applicable, the transmission of a PUSCH scheduled by a RAR UL grant, and PDSCH for contention resolution.

	8.1 Random access preamble Physical random access procedure is triggered upon request of a PRACH transmission by higher layers or by a PDCCH order. A configuration by higher layers for a PRACH transmission includes the following: - A configuration for PRACH transmission [4, TS 38.211]. - A preamble index, a preamble SCS, $P_{\text{PRACH,target}}$, a corresponding RA-RNTI, and a PRACH resource. A PRACH is transmitted using the selected PRACH format with transmission power $P_{\text{PRACH},b,f,c}(i)$, as described in Clause 7.4, on the indicated PRACH resource. For Type-1 random access procedure, a UE is provided a number N of SS/PBCH block indexes associated with one PRACH occasion and a number R of contention based preambles per SS/PBCH block index per valid PRACH occasion by *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*. Screenshot showing the transmission of random access preamble (Msg1) in a PRACH from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 41 and 42 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
18b. the monitoring unit is configured to: monitor a Random Access Response (RAR) corresponding to the preamble and sent by the eNB; and	The Accused Device is configured to comprise a monitoring unit wherein the monitoring unit is configured to monitor a Random Access Response (RAR) corresponding to the preamble and sent by the eNB. Upon information and belief, the Accused Device is configured to monitor a Random Access Response (RAR) corresponding to the preamble from the eNB. For contention-based random access (CBRA), the UE receives a Random Access Response (RAR) from the eNB. The UE monitors the physical downlink channel PDCCH for Random Access Response (RAR) while the ra-ResponseWindow is running. The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.

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(a) CBRA with 4-step RA type

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

5.1.4 Random Access Response reception

Once the Random Access Preamble is transmitted and regardless of the possible occurrence of a measurement gap, the MAC entity shall:

1> if the contention-free Random Access Preamble for beam failure recovery request was transmitted by the MAC entity:

2> start the *ra-ResponseWindow* configured in *BeamFailureRecoveryConfig* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor for a PDCCH transmission on the search space indicated by *recoverySearchSpaceId* of the SpCell identified by the C-RNTI while *ra-ResponseWindow* is running.

1> else:

2> start the *ra-ResponseWindow* configured in *RACH-ConfigCommon* at the first PDCCH occasion as specified in TS 38.213 [6] from the end of the Random Access Preamble transmission;

2> monitor the PDCCH of the SpCell for Random Access Response(s) identified by the RA-RNTI while the *ra-ResponseWindow* is running.

Screenshot showing Random Access Response reception by the Accused Device from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.2 Random access response - Type-1 random access procedure

In response to a PRACH transmission, a UE attempts to detect a DCI format 1_0 with CRC scrambled by a corresponding RA-RNTI during a window controlled by higher layers [11, TS 38.321]. The window starts at the first symbol of the earliest CORESET the UE is configured to receive PDCCH for Type1-PDCCH CSS set, as defined in Clause 10.1, that is at least one symbol, after the last symbol of the PRACH occasion corresponding to the PRACH transmission, where the symbol duration corresponds to the SCS for Type1-PDCCH CSS set as defined in Clause 10.1. The length of the window in number of slots, based on the SCS for Type1-PDCCH CSS set, is provided by *ra-ResponseWindow*.

If the UE detects the DCI format 1_0 with CRC scrambled by the corresponding RA-RNTI and LSBs of a SFN field in the DCI format 1_0, if included and applicable, are same as corresponding LSBs of the SFN where the UE transmitted PRACH, and the UE receives a transport block in a corresponding PDSCH within the window, the UE passes the transport block to higher layers. The higher layers parse the transport block for a random access preamble identity

(RAPID) associated with the PRACH transmission. If the higher layers identify the RAPID in RAR message(s) of the transport block, the higher layers indicate an uplink grant to the physical layer. This is referred to as random access response (RAR) UL grant in the physical layer.

Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 46 and 47 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf).

Upon information and belief, the UE initiating the random access procedure may be UEs in RRC-IDLE and RRC-INACTIVE protocol states (UE group). The random access procedure is triggered by a number of events.

7.3.2 Scheduling

The MIB is mapped on the BCCH and carried on BCH while all other SI messages are mapped on the BCCH, where they are dynamically carried on DL-SCH. The scheduling of SI messages part of Other SI is indicated by *SIB1*.

For UEs in RRC_IDLE and RRC_INACTIVE, a request for Other SI triggers a random access procedure (see clause 9.2.6) where MSG3 includes the SI request message unless the requested SI is associated to a subset of the PRACH resources, in which case MSG1 is used for indication of the requested Other SI. When MSG1 is used, the minimum granularity of the request is one SI message (i.e. a set of SIBs), one RACH preamble and/or PRACH resource can be used to request multiple SI messages and the gNB acknowledges the request in MSG2. When MSG 3 is used, the gNB acknowledges the request in MSG4.

Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 54 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

7.2 Protocol States

RRC supports the following states which can be characterised as follows:

- **RRC_IDLE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging for mobile terminated data is initiated by 5GC;
  - DRX for CN paging configured by NAS.
- **RRC_INACTIVE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging is initiated by NG-RAN (RAN paging);
  - RAN-based notification area (RNA) is managed by NG- RAN;
  - DRX for RAN paging configured by NG-RAN;
  - 5GC - NG-RAN connection (both C/U-planes) is established for UE;
  - The UE AS context is stored in NG-RAN and the UE;
  - NG-RAN knows the RNA which the UE belongs to.

Screenshot showing Protocol States supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 52 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

	To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).
18c. the sending unit is further configured to: send a message 3 according to a Uplink (UL) grant allocated to the UE, wherein the message 3 comprises a number of UEs having random access requests in a UE group or a number of UEs contained in the UE group or a pre-set UE number.	The Accused Device comprises a sending unit which is further configured to send a message 3 according to a Uplink (UL) grant allocated to the UE, wherein the message 3 comprises a number of UEs having random access requests in a UE group or a number of UEs contained in the UE group or a pre-set UE number. Upon information and belief, the UE initiating the random access procedure may be UEs in RRC-IDLE and RRC-INACTIVE protocol states (UE group). The random access procedure is triggered by a number of events. 7.3.2 Scheduling The MIB is mapped on the BCCH and carried on BCH while all other SI messages are mapped on the BCCH, where they are dynamically carried on DL-SCH. The scheduling of SI messages part of Other SI is indicated by *SIB1*. For UEs in RRC_IDLE and RRC_INACTIVE, a request for Other SI triggers a random access procedure (see clause 9.2.6) where MSG3 includes the SI request message unless the requested SI is associated to a subset of the PRACH resources, in which case MSG1 is used for indication of the requested Other SI. When MSG1 is used, the minimum granularity of the request is one SI message (i.e. a set of SIBs), one RACH preamble and/or PRACH resource can be used to request multiple SI messages and the gNB acknowledges the request in MSG2. When MSG 3 is used, the gNB acknowledges the request in MSG4. Screenshot showing Random Access Procedure supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 54 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

7.2 Protocol States

RRC supports the following states which can be characterised as follows:

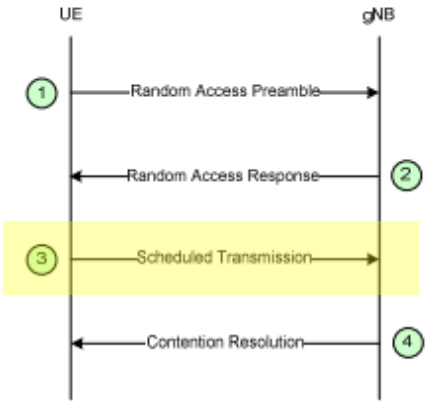
- **RRC_IDLE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging for mobile terminated data is initiated by 5GC;
  - DRX for CN paging configured by NAS.
- **RRC_INACTIVE**:
  - PLMN selection;
  - Broadcast of system information;
  - Cell re-selection mobility;
  - Paging is initiated by NG-RAN (RAN paging);
  - RAN-based notification area (RNA) is managed by NG- RAN;
  - DRX for RAN paging configured by NG-RAN;
  - 5GC - NG-RAN connection (both C/U-planes) is established for UE;
  - The UE AS context is stored in NG-RAN and the UE;
  - NG-RAN knows the RNA which the UE belongs to.

Screenshot showing Protocol States supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 52 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, for contention-based random access (CBRA), the Accused Device is configured to send a Msg3 using the UL grant scheduled in the response.

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The MSG1 of the 4-step RA type consists of a preamble on PRACH. After MSG1 transmission, the UE monitors for a response from the network within a configured window. For CFRA, dedicated preamble for MSG1 transmission is assigned by the network and upon receiving random access response from the network, the UE ends the random access procedure as shown in Figure 9.2.6-1(c). For CBRA, upon reception of the random access response, the UE sends MSG3 using the UL grant scheduled in the response and monitors contention resolution as shown in Figure 9.2.6-1(a). If contention resolution is not successful after MSG3 (re)transmission(s), the UE goes back to MSG1 transmission.



(a) CBRA with 4-step RA type

Screenshot showing 4-step RA type with MSG1 supported by the Accused Device from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on pages 87 and 88 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

Upon information and belief, the Msg3 comprises a C-RNTI field which is a unique UE identification used as an identifier of the RRC Connection and for scheduling. The C-RNTI MAC CE field contains the C-RNTI of the MAC entity (User Equipment).

Upon information and belief, the C-RNTI MAC CE field comprises a pre-set UE number.

Msg3: Message transmitted on UL-SCH containing a C-RNTI MAC CE or CCCH SDU, submitted from upper layer and associated with the UE Contention Resolution Identity, as part of a Random Access procedure.

Screenshot showing Msg3 definition from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.1.5 Contention Resolution

Once Msg3 is transmitted the MAC entity shall:

1> start the *ra-ContentionResolutionTimer* and restart the *ra-ContentionResolutionTimer* at each HARQ retransmission in the first symbol after the end of the Msg3 transmission;

1> monitor the PDCCH while the *ra-ContentionResolutionTimer* is running regardless of the possible occurrence of a measurement gap;

1> if notification of a reception of a PDCCH transmission of the SpCell is received from lower layers:

2> if the C-RNTI MAC CE was included in Msg3:

3> if the Random Access procedure was initiated for SpCell beam failure recovery (as specified in clause 5.17) and the PDCCH transmission is addressed to the C-RNTI; or

Screenshot showing Msg3 transmission with C-RNTI from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 30 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

5.4.1 UL Grant reception

Uplink grant is either received dynamically on the PDCCH, in a Random Access Response, configured semi-persistently by RRC or determined to be associated with the PUSCH resource of MSGA as specified in clause 5.1.2a. The MAC entity shall have an uplink grant to transmit on the UL-SCH. To perform the requested transmissions, the MAC layer receives HARQ information from lower layers. An uplink grant addressed to CS-RNTI with NDI = 0 is considered as a configured uplink grant. An uplink grant addressed to CS-RNTI with NDI = 1 is considered as a dynamic uplink grant.

If the MAC entity has a C-RNTI, a Temporary C-RNTI, or CS-RNTI, the MAC entity shall for each PDCCH occasion and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this PDCCH occasion:

1> if an uplink grant for this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or

1> if an uplink grant has been received in a Random Access Response:

2> if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's CS-RNTI or a configured uplink grant:

3> consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.

2> if the uplink grant is for MAC entity's C-RNTI, and the identified HARQ process is configured for a configured uplink grant:

3> start or restart the *configuredGrantTimer* for the corresponding HARQ process, if configured.

Screenshot showing Msg3 transmission according to a Uplink (UL) grant from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 42 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

6.1.3.2 C-RNTI MAC CE

The C-RNTI MAC CE is identified by MAC subheader with LCID as specified in Table 6.2.1-2.

It has a fixed size and consists of a single field defined as follows (Figure 6.1.3.2-1):

- C-RNTI: This field contains the C-RNTI of the MAC entity. The length of the field is 16 bits.

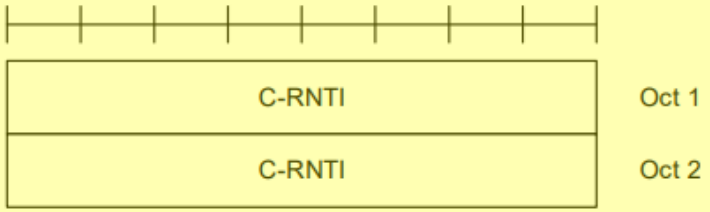


Figure 6.1.3.2-1: C-RNTI MAC CE

Screenshot showing C-RNTI MAC CE from standard 3GPP TS 38.321 version 16.4.0 Release 16 (available on page 114 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138321/16.04.00_60/ts_138321v160400p.pdf).

8.1 UE Identities

In this clause, the identities used by NR connected to 5GC are listed. For scheduling at cell level, the following identities are used:

- C-RNTI: unique UE identification used as an identifier of the RRC Connection and for scheduling;

Screenshot showing C-RNTI from standard 3GPP TS 38.300 version 16.5.0 Release 16 (available on page 57 from https://www.etsi.org/deliver/etsi_ts/138300_138399/138300/16.05.00_60/ts_138300v160500p.pdf).

8.3 PUSCH scheduled by RAR UL grant

An active UL BWP, as described in Clause 12 and in [4, TS 38.211], for a PUSCH transmission scheduled by a RAR UL grant is indicated by higher layers.

	A UE transmits a transport block in a PUSCH scheduled by a RAR UL grant in a corresponding RAR message using redundancy version number 0. If a TC-RNTI is provided by higher layers, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by TC-RNTI. Otherwise, the scrambling initialization of the PUSCH corresponding to the RAR UL grant in clause 8.2 is by C-RNTI. Msg3 PUSCH retransmissions, if any, of the transport block, are scheduled by a DCI format 0_0 with CRC scrambled by a TC-RNTI provided in the corresponding RAR message [11, TS 38.321]. The UE always transmits the PUSCH scheduled by a RAR UL grant without repetitions. Screenshot showing the Random Access Response from standard 3GPP TS 38.213 version 16.5.0 Release 16 (available on pages 49 and 51 from https://www.etsi.org/deliver/etsi_ts/138200_138299/138213/16.05.00_60/ts_138213v160500p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g. data processors and other internal components), and software (e.g., software and firmware).

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EXHIBIT 6

EXHIBIT D1

Patent Number: US 10,594,443

Patent Title: Transmitting method, receiving method and nodes for HARQ information

Filing Date: 2016-07-07

Publication Date: 2018-08-09

Claim 1: A method for transmitting hybrid automatic repeat request (HARQ) information, comprising:

detecting, by a first node, N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result; the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M; a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and

transmitting, by the first node, the HARQ information to the second node.

Accused Product: Samsung Galaxy A13 5G Smartphone

References Used:
Samsung Galaxy A13 5G Highlights

Samsung Galaxy A13 5G Models

Samsung Galaxy A13 5G Compare

Buy Samsung Galaxy A13 5G (Unlocked)

3GPP TS 36.302 version 16.1.0 Release 16 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer)

3GPP TS 36.212 version 14.13.0 Release 14 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding)

Reference Links:

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https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA

https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models

https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare

https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/

https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf

https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf

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INFRINGEMENT OF THE PATENT US 10,594,443 BY SAMSUNG GALAXY A13 5G SMARTPHONE DEVICE

Overview

Plaintiff accuses the making, using, selling, offering for sale and/or importation of Defendant Samsung (fka SAMSUNG ELECTRONICS CO., LTD.) and Defendant's parents, affiliates, subsidiaries ("Samsung" or "Defendant") accused system and method, including without limitation the products implementing 3GPP 5th generation telecommunications technology standard (5G) features (Galaxy A13 5G Smartphone) and all other substantially similar products (the "Accused Device(s)") of directly infringing U.S. Patent No. (the "'443 Patent"). The term "Accused Device(s)" includes the associated computer hardware and internal semiconductors, software and data, and processes and methods related thereto. The foregoing infringing products includes operating characteristics that infringe upon the claims of the '443 Patent which teaches a method for transmitting hybrid automatic repeat request (HARQ) information. The technical solution of the '443 Patent enables a network node to transmit HARQ information without requiring strong correlation for the channel, conserving transmission resources and improving system throughput while reducing the HARQ information feedback overhead.

Plaintiff further accuses Samsung of indirectly infringing the '443 Patent by providing its customers and others the Accused Devices to utilize in an infringing manner. Samsung intends to cause infringement by its customers and users as Samsung instructs the users to use the Accused Device in an infringing manner for example, by providing features like HyperFast downloads, lag-free gaming and streaming, HD video calling, etc. Samsung further instructs users to operate the Accused Device in an infringing manner, for example, by providing instructions on using 5G enabled features like HyperFast downloads, lag-free gaming and streaming, HD video calling, etc. Samsung also provides support services for the Accused Device, including providing instructions, configurations, guides, online materials and technical support.

The asserted claims include elements that are implemented, at least in part, by proprietary electronics, firmware and software in the Accused Device. The precise designs, processes, and algorithms used in them are held secret, at least in part, and are not publicly available in their entirety. An inspection of the Accused Device, and an analysis of Samsung's documentation and/or source code may be necessary to fully and accurately describe all infringing features and functionality of the Accused Device and, accordingly, Plaintiff reserves the right to supplement these contentions once such information is made available to Plaintiff. Furthermore, Plaintiff reserves the right to revise these contentions, including as discovery in the case progresses, in view of the Court's final claim construction in this action and in connection with the provision of its expert reports.

10,594,443 Claim 1	Evidence
1. A method for transmitting hybrid automatic repeat request (HARQ) information, comprising:	This is the preamble of the claim and is not limiting. This element, if construed as a limitation, is present literally and under the doctrine of equivalents in the Accused Device. The Accused Device is a smartphone device comprising Octa-Core processor, PLS TFT LCD display, high resolution front and rear cameras, 4GB RAM with 64GB internal storage and 5000mAh battery. The Accused Device is configured to support features like Side Sensor Fingerprint, expandable memory etc. The Accused Device is available in different models varying based on Cell Phone Carrier, Internal Memory and Color. The various models available for the Accused Device are A136UZKDXAA, SM-A136ULGDXAA, SM-A136UZKAATT, SM-A136ULGAATT, SM-A136UZKAXAU, and SM-A136UZKAUSC.

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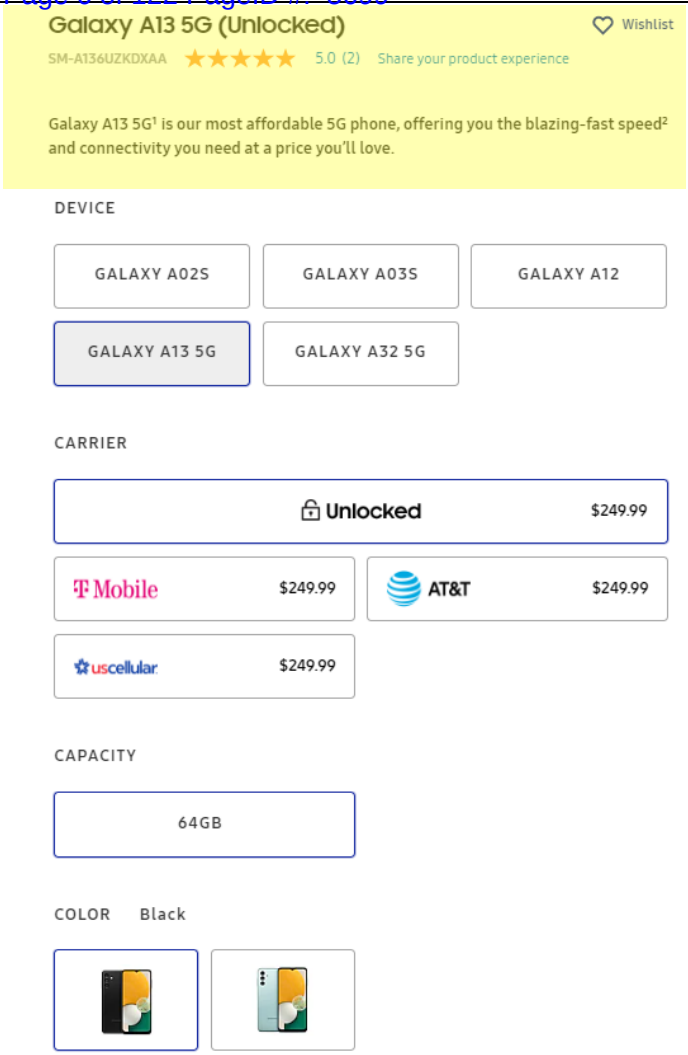


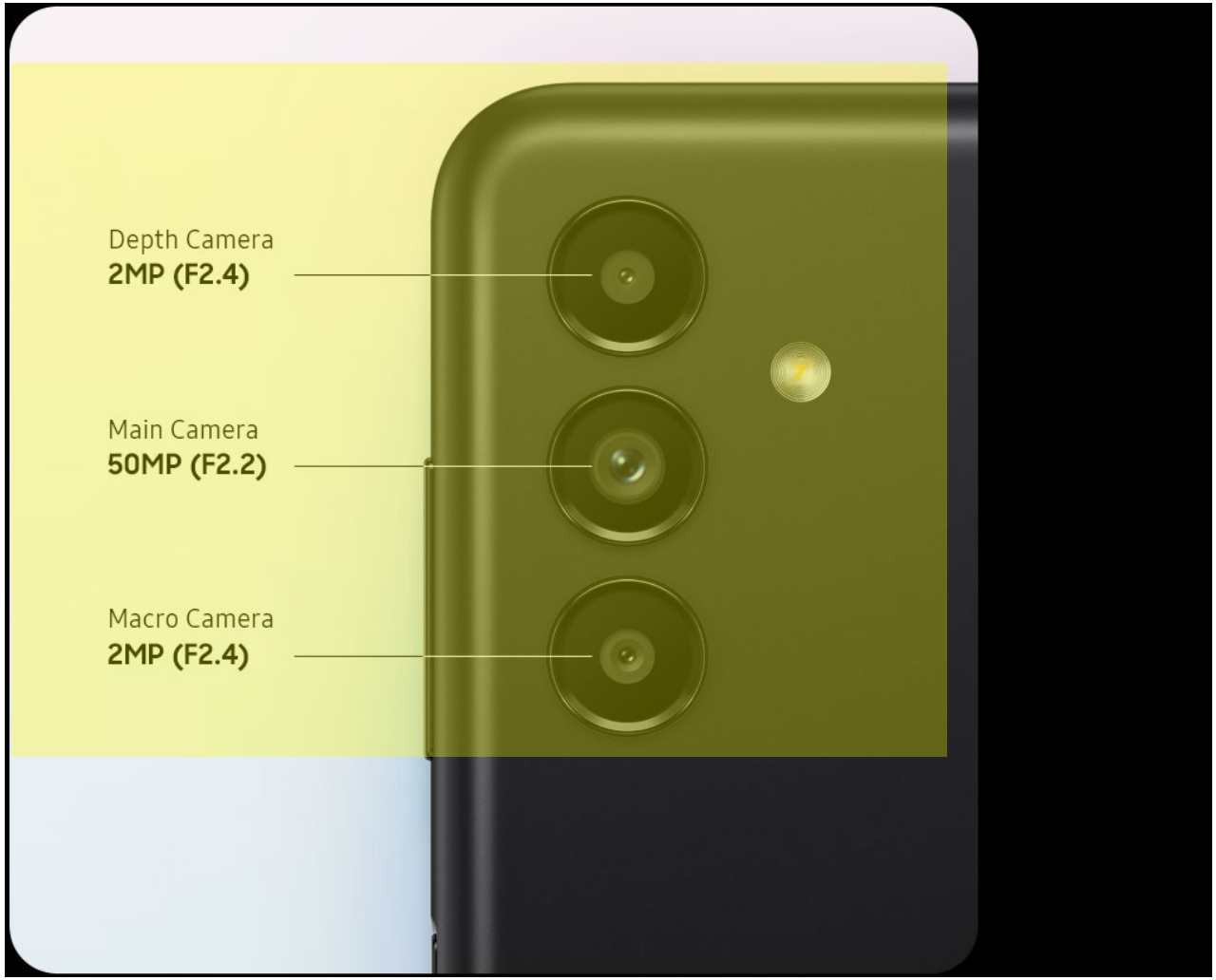
Image of the Accused Device Galaxy A13 5G Smartphone SM-A136UZKDXAA (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

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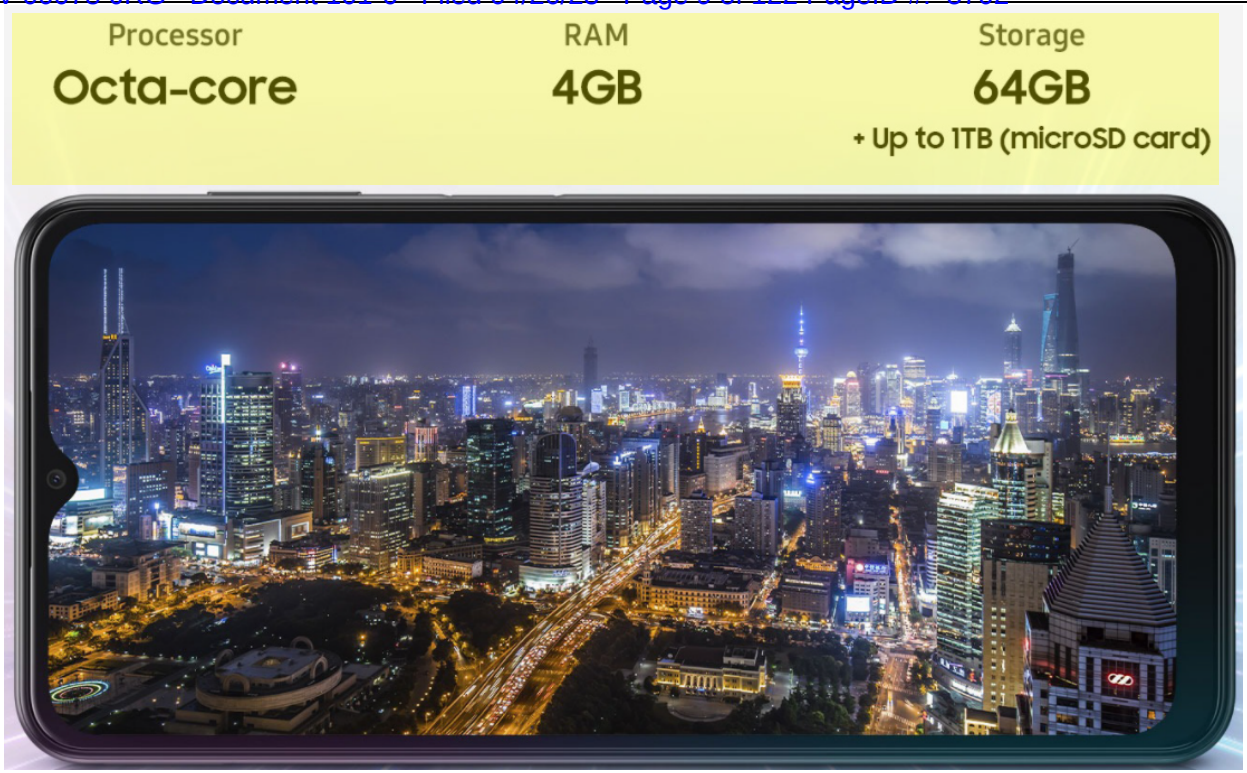
Screenshot showing Image of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).

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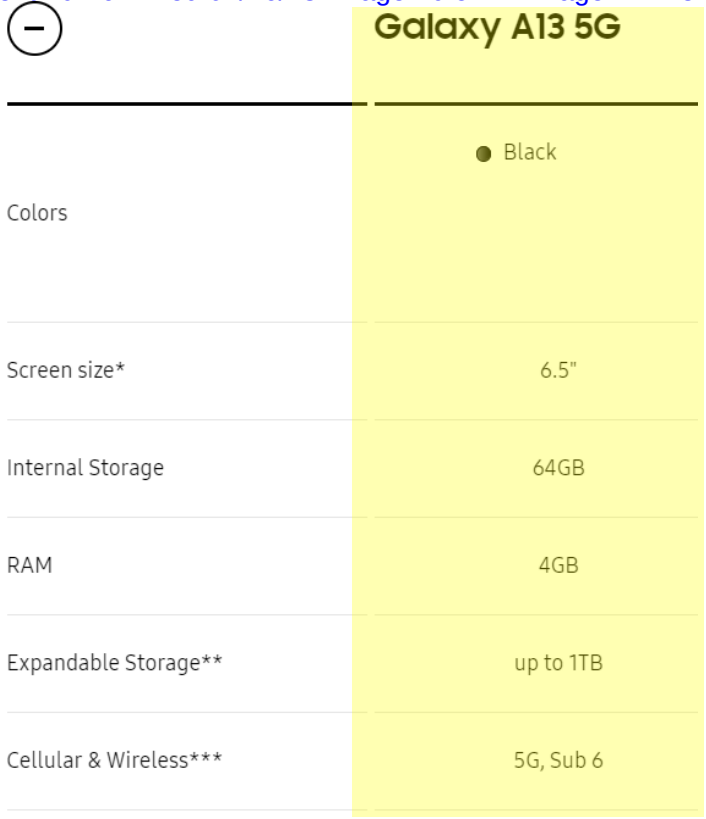


Screenshot showing camera of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

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Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

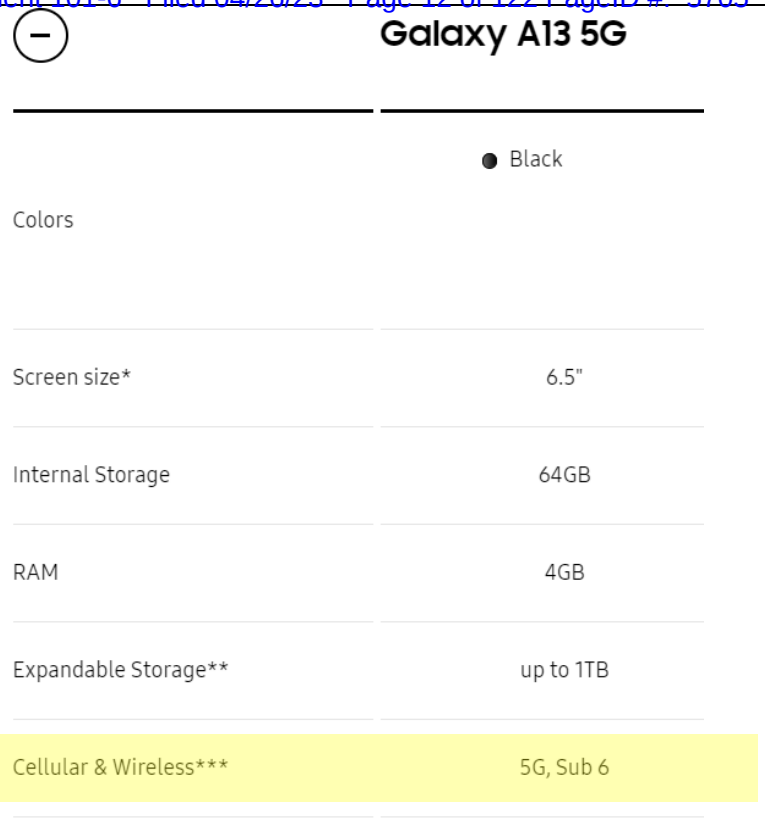
	

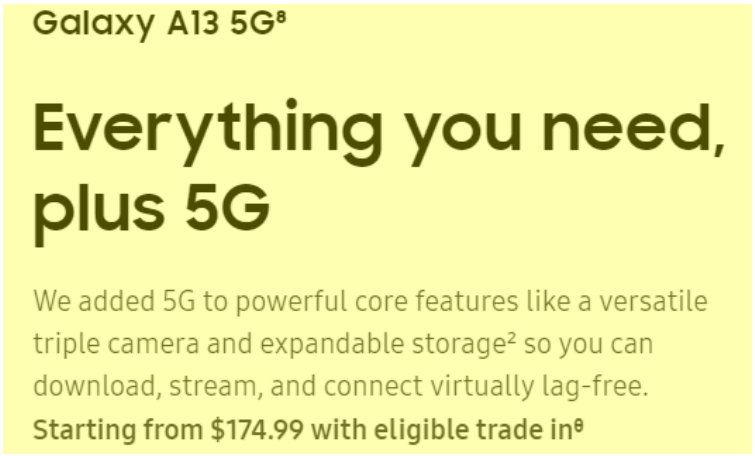
	Galaxy A13 5G
Colors	● Black
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Display type	Flat
Fingerprint Sensor	Side Fingerprint Sensor
Front Camera	5MP Selfie Camera
Rear Camera	50MP Main Camera 2MP Macro Camera 2MP Depth Camera
Battery Capacity****	5000mAh (typical)

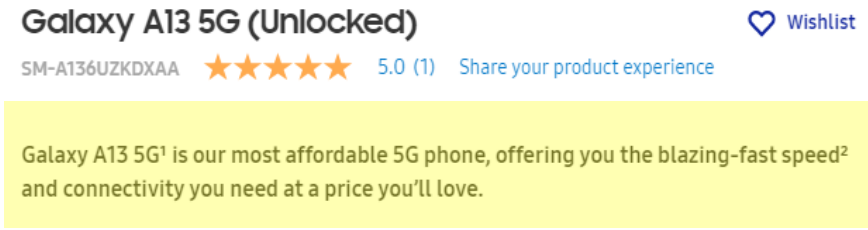
Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).

The Accused Device can be configured as a mobile terminal to support 5G telecommunications standard for providing services like blazing-fast speed, and virtually lag-free download and stream.

	 Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).





Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 36.302 version 16.1.0 Release 16 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer) and 3GPP TS 36.212 version 14.13.0 Release 14 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding).

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ETSI TS 136 302 V16.1.0 (2020-07)



LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Services provided by the physical layer
(3GPP TS 36.302 version 16.1.0 Release 16)

1 Scope

The present document is a technical specification of the services provided by the physical layer of E-UTRA to upper layers.

Screenshot showing the scope of standard 3GPP TS 36.302 version 16.1.0 Release 16 supported by the Accused Device (available on page 6 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

ETSI TS 136 212 V14.13.0 (2020-07)



LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Multiplexing and channel coding
(3GPP TS 36.212 version 14.13.0 Release 14)

1 Scope

The present document specifies the coding, multiplexing and mapping to physical channels for E-UTRA.

Screenshot showing the scope of standard 3GPP TS 36.212 version 14.13.0 Release 16 supported by the Accused Device (available on page 8 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

Upon information and belief, the Accused Device is configured for transmitting hybrid automatic repeat request (HARQ) information to a Node B on an uplink shared channel.

6.1.1 Uplink Shared Channel

The physical-layer model for Uplink Shared Channel transmission is described based on the corresponding physical-layer-processing chain, see Figure 6.1.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue. It should be noted that, in the cases of PUSCH and NPUSCH, the scheduling decision is fully done at the network side. The uplink transmission control in the UE then configures the uplink physical-layer processing, based on uplink transport-format and resource-assignment information received on the downlink.

The model of Figure 6.1.1-1 also captures

- Transport via physical layer of Hybrid-ARQ related information associated with the PUSCH, to the peer HARQ process at the transmitter side;
- Transport via physical layer of corresponding HARQ acknowledgements to PUSCH transmitter side (except for NB-IoT UEs).

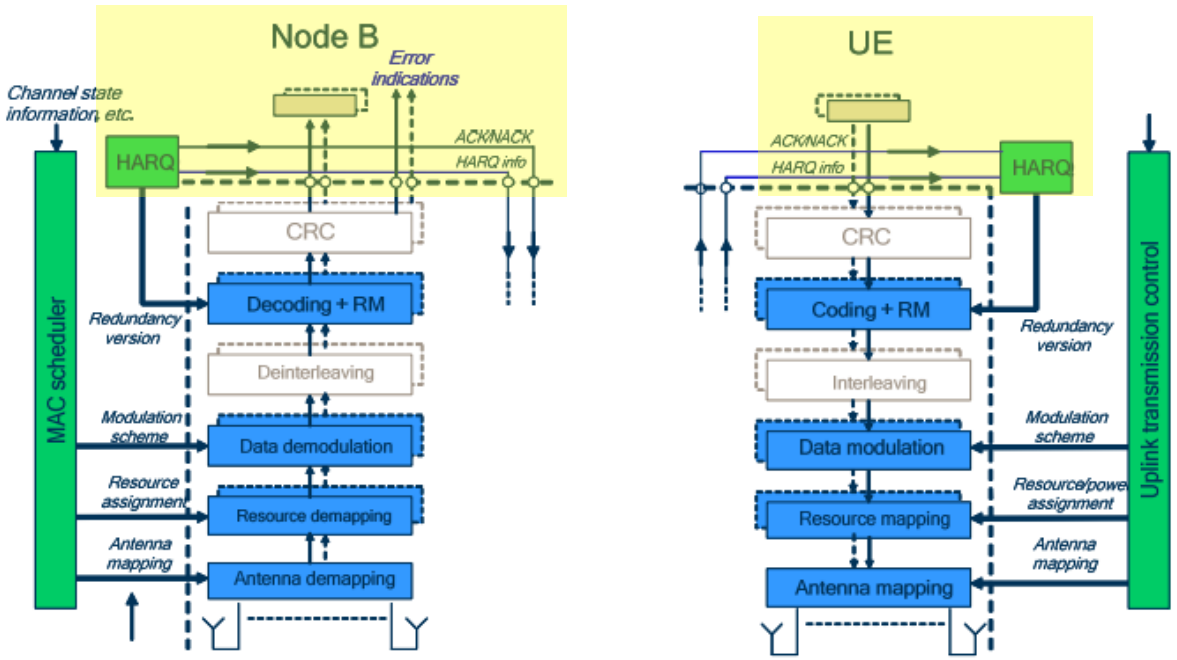


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on pages 10 and 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).

1a. detecting, by a first node, N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result; the M bits of	The Accused Device, configured as the first node, is configured for detecting N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result; the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks. Upon information and belief, the Accused Device is configured for receiving N transport blocks of dynamic size from the Node B and transmitting HARQ acknowledgement information associated with the PUSCH to the Node B.

HARQ information being used to indicate a receiving status of the N transmission blocks;	Upon information and belief, the HARQ acknowledgement information comprises of Cyclic Redundancy Check (CRC) and transport-block-error indication.

6.1.1 Uplink Shared Channel

The physical-layer model for Uplink Shared Channel transmission is described based on the corresponding physical-layer-processing chain, see Figure 6.1.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue. It should be noted that, in the cases of PUSCH and NPUSCH, the scheduling decision is fully done at the network side. The uplink transmission control in the UE then configures the uplink physical-layer processing, based on uplink transport-format and resource-assignment information received on the downlink.

- **Higher-layer data passed to/from the physical layer**
- One transport block of dynamic size delivered to the physical layer once every TTI.
- **CRC and transport-block-error indication**
- Transport-block-error indication delivered to higher layers.
- **FEC and rate matching**
- Channel coding rate is implicitly given by the combination of transport block size, modulation scheme and resource assignment;
- Physical layer model support of HARQ: in case of Incremental Redundancy, the corresponding Layer 2 Hybrid-ARQ process controls what redundancy version is to be used for the physical layer transmission for each TTI.

The model of Figure 6.1.1-1 also captures

- Transport via physical layer of Hybrid-ARQ related information associated with the PUSCH, to the peer HARQ process at the transmitter side;
- Transport via physical layer of corresponding HARQ acknowledgements to PUSCH transmitter side (except for NB-IoT UEs).

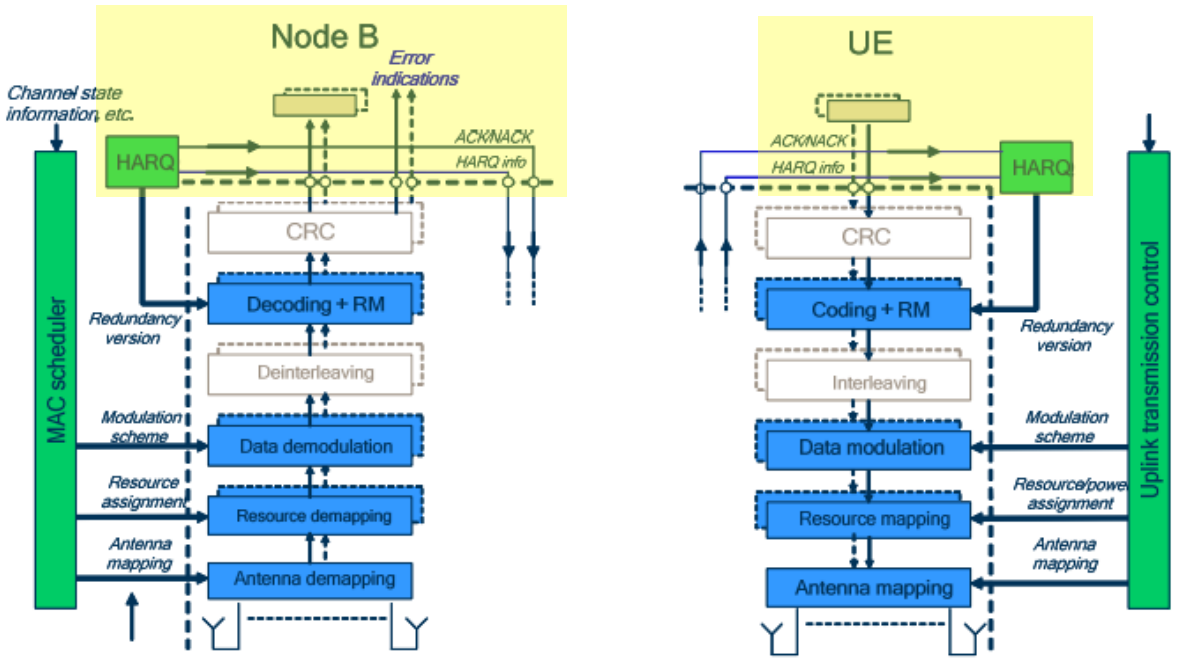


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on pages 10 and 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

Upon information and belief, the HARQ-ACK is attached with Cyclic Redundancy Check (CRC) bits for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length.

5.2.2.6 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication, and CSI-RS resource indication (CRI). Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When control data are transmitted in the PUSCH, the channel coding for HARQ-ACK, rank indication (including RI only, joint report of RI/i1, joint report of CRI/RI, joint report of CRI/RI/i1, joint report of CRI/RI/PTI, joint report of RI/i1,p-2, and joint report of RI/PTI), CRI and channel quality information $o_0, o_1, o_2, ..., o_{O-1}$ is done independently. Parameters i1,1-1 , i1,2-1 , i1,1-2 , i1,2-2 , i1,p-2 correspond to parameters $i_{1,1}$, $i_{1,2}$, d_1, d_2, and I_p in clause 7.2.4 of [3].

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 27 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

- If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is o_0^{ACK} $o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
1b. among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;	The Accused Device is so configured that among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length. - If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \ldots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, \ldots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
1c. a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and	The Accused Device is so configured that a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k. Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \ldots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, \ldots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
1d. transmitting, by the first node, the HARQ information to the second node.	The Accused Device is configured for transmitting the HARQ information to the second node. Upon information and belief, the Accused Device is configured for transmitting hybrid automatic repeat request (HARQ) information to the Node B on an uplink shared channel. 6.1.1 Uplink Shared Channel The physical-layer model for Uplink Shared Channel transmission is described based on the corresponding physical-layer-processing chain, see Figure 6.1.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue. It should be noted that, in the cases of PUSCH and NPUSCH, the scheduling decision is fully done at the network side. The uplink transmission control in the UE then configures the uplink physical-layer processing, based on uplink transport-format and resource-assignment information received on the downlink. The model of Figure 6.1.1-1 also captures - Transport via physical layer of Hybrid-ARQ related information associated with the PUSCH, to the peer HARQ process at the transmitter side; - Transport via physical layer of corresponding HARQ acknowledgements to PUSCH transmitter side (except for NB-IoT UEs).

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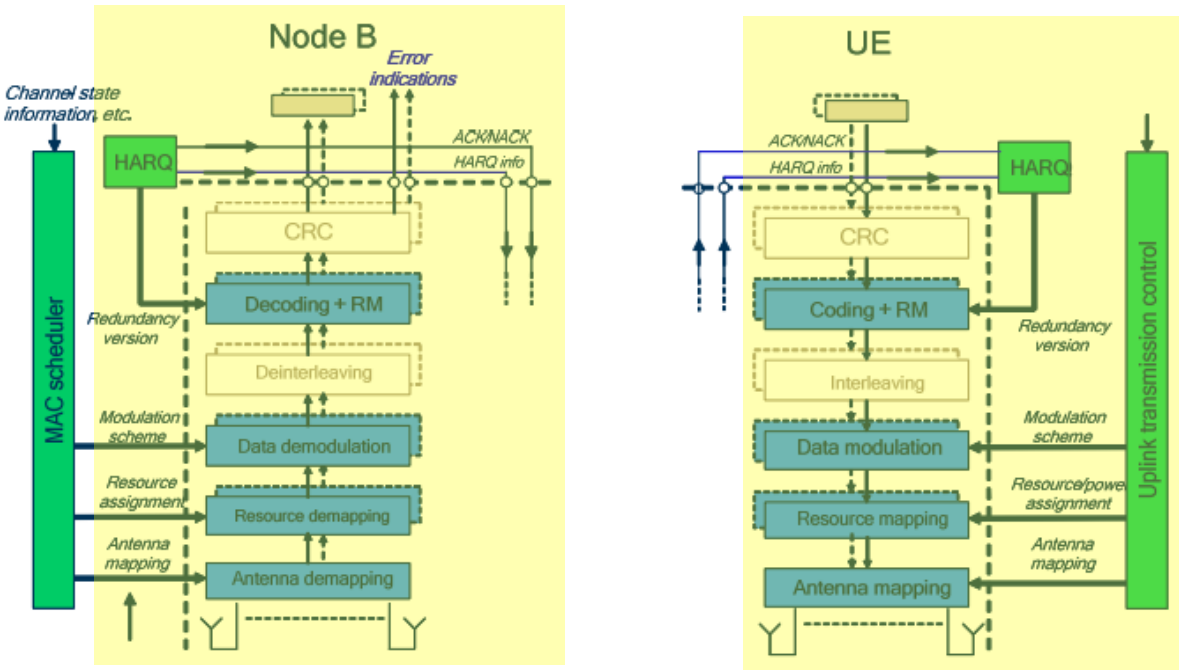


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on pages 10 and 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).

10,594,443 Claim 2	Evidence
2. The method according to claim 1, wherein the length type of M2 is configured by a radio resource control (RRC) signaling	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is configured wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k.

transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k.	Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 6	**Evidence**
6. The method according to claim 1, wherein if M2<M, then an indication domain of M1 bits of the M bits is used to indicate a value of k or indicate the length type of M2, wherein M1=M−M2.	Every claim limitation of claim 1 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is configured wherein if M2<M, then an indication domain of M1 bits of the M bits is used to indicate a value of k or indicate the length type of M2, wherein M1=M−M2. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length, $L < B$. Upon information and belief, for HARQ-ACK, the input bits sequence of the transport block (of length A) provides an indication of the length L of the CRC attachment. The CRC bits are predefined to be of length 8 bits for HARQ-ACK.

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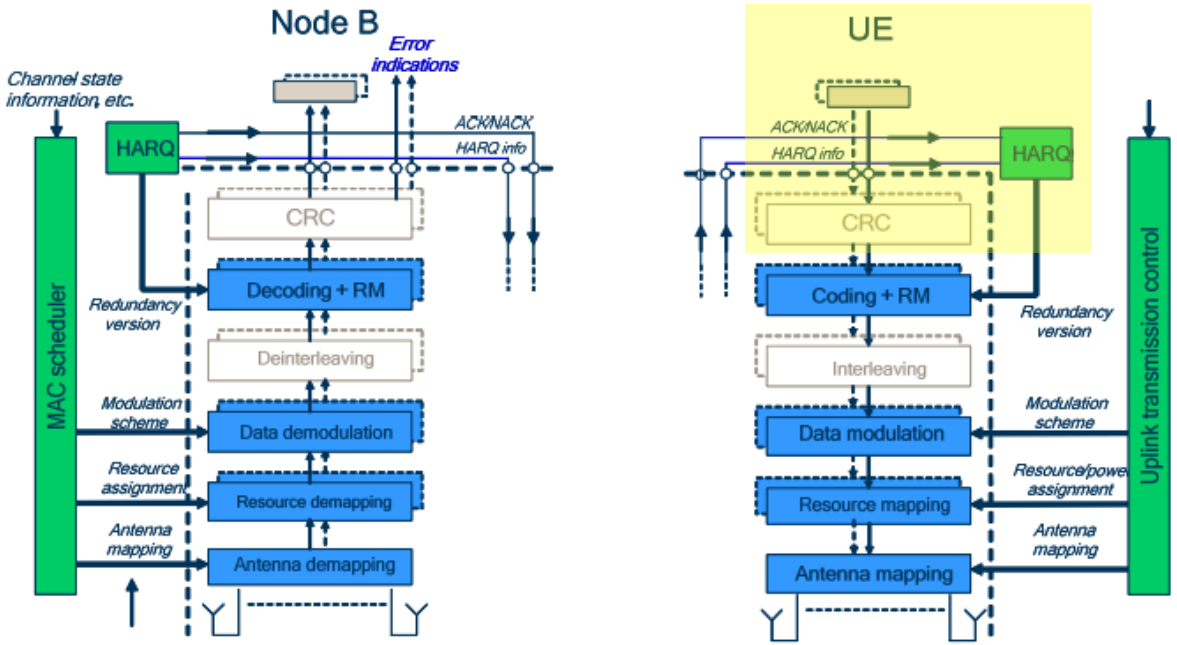


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

- If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from

	https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. The precise manner in which the received HARQ-ACK information from the Node B is decoded by the Accused Device configured as the User Equipment to obtain M1 bits which is used to indicate the length type of the CRC bits is not publicly available. This is a software limitation and the software of the Accused System is not publicly available. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 8	**Evidence**
8. A method for receiving hybrid automatic repeat request (HARQ) information, comprising:	This is the preamble of the claim and is not limiting. This element, if construed as a limitation, is present literally and under the doctrine of equivalents in the Accused Device. The Accused Device is a smartphone device comprising Octa-Core processor, PLS TFT LCD display, high resolution front and rear cameras, 4GB RAM with 64GB internal storage and 5000mAh battery. The Accused Device is configured to support features like Side Sensor Fingerprint, expandable memory etc. The Accused Device is available in different models varying based on Cell Phone Carrier, Internal Memory and Color. The various models available for the Accused Device are A136UZKDXAA, SM-A136ULGDXAA, SM-A136UZKAATT, SM-A136ULGAATT, SM-A136UZKAXAU, and SM-A136UZKAUSC.

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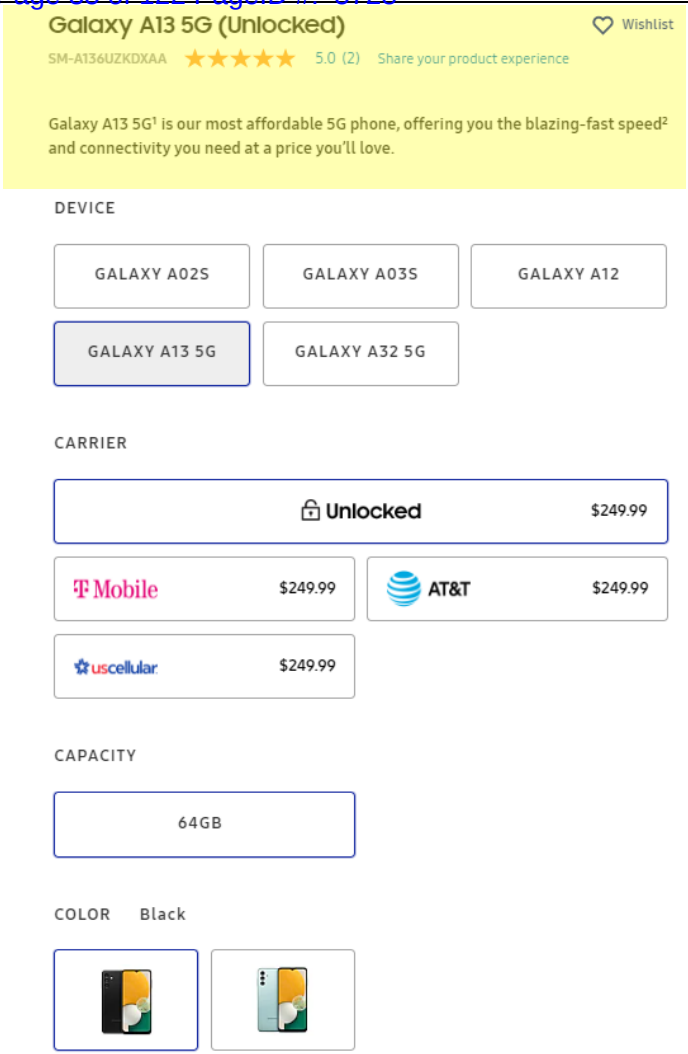
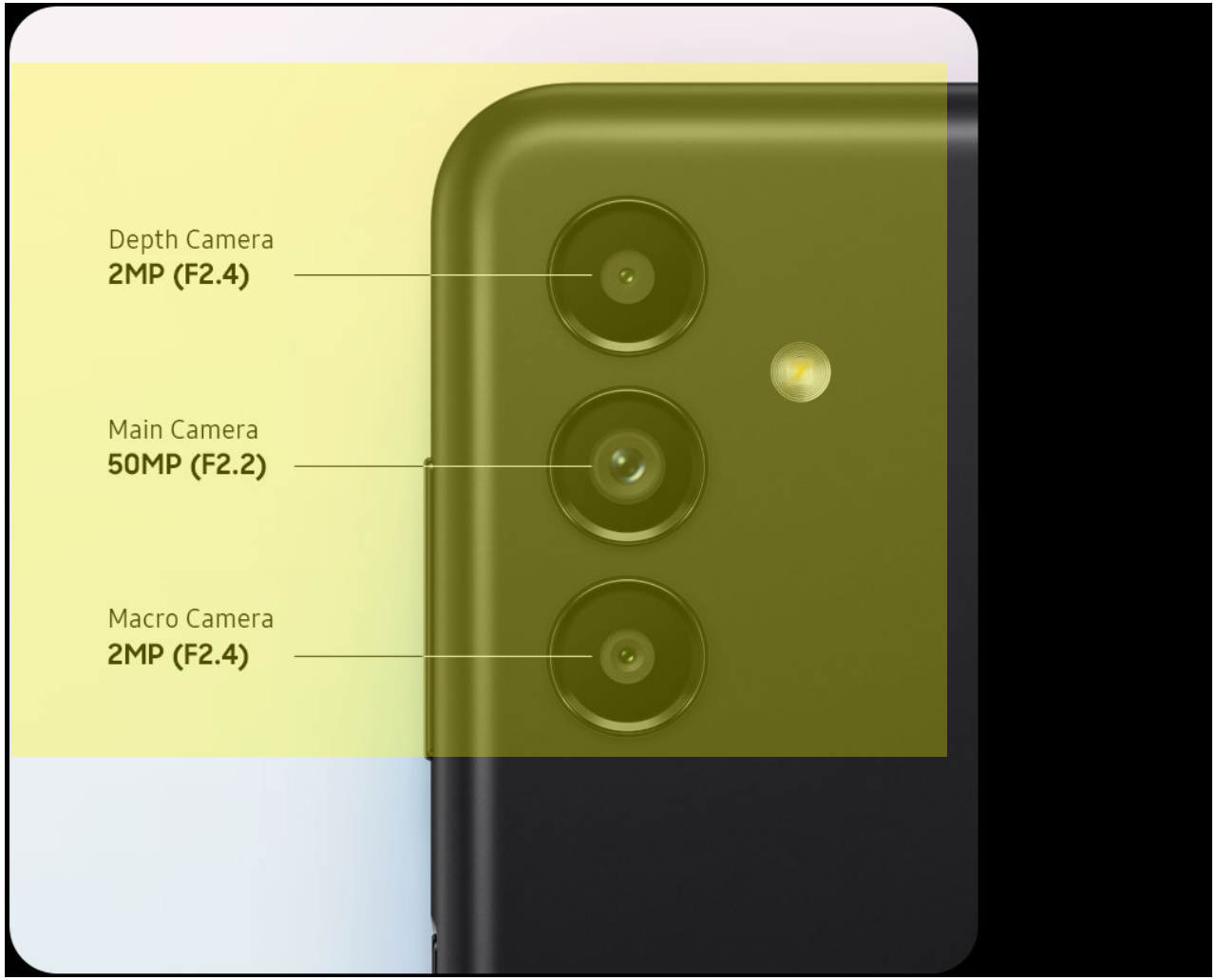


Image of the Accused Device Galaxy A13 5G Smartphone SM-A136UZKDXAA (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

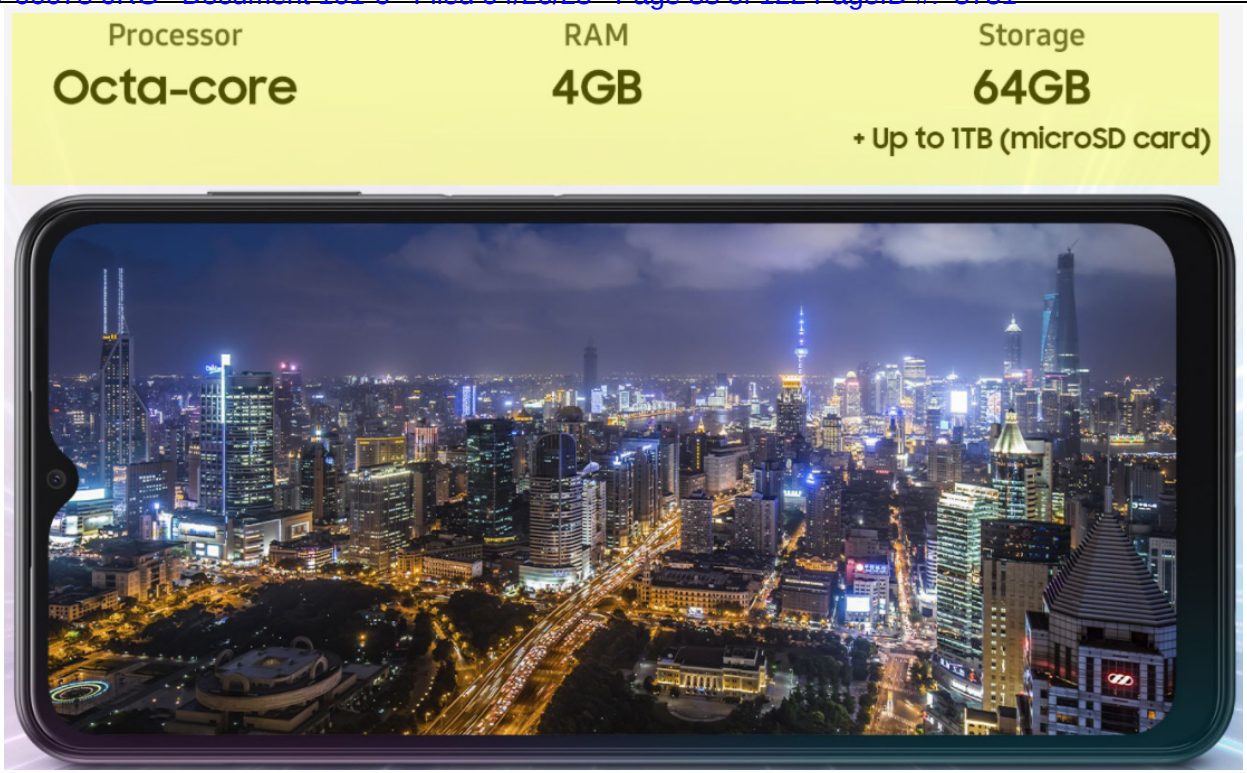


Screenshot showing Image of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).

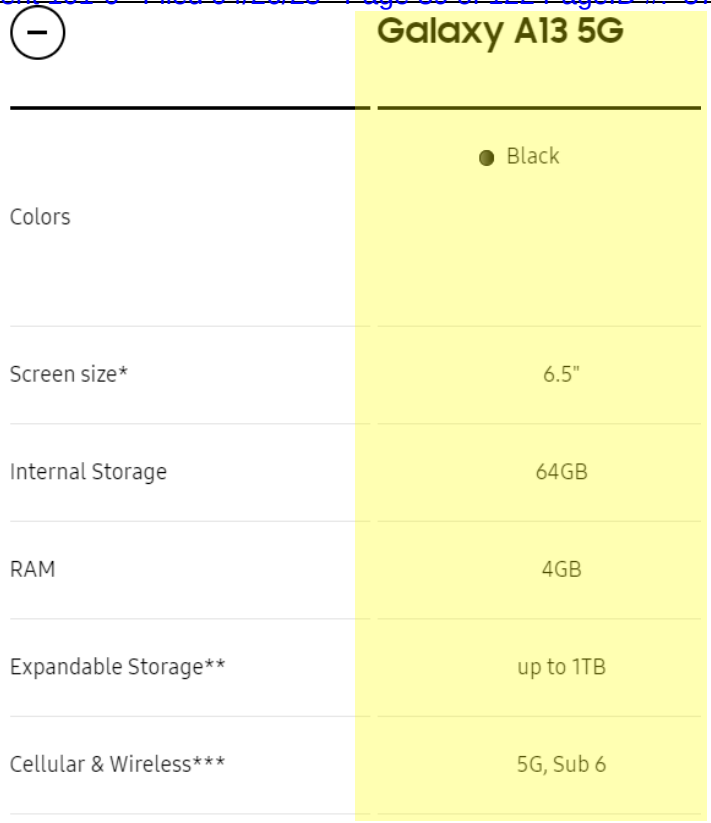
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Screenshot showing camera of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



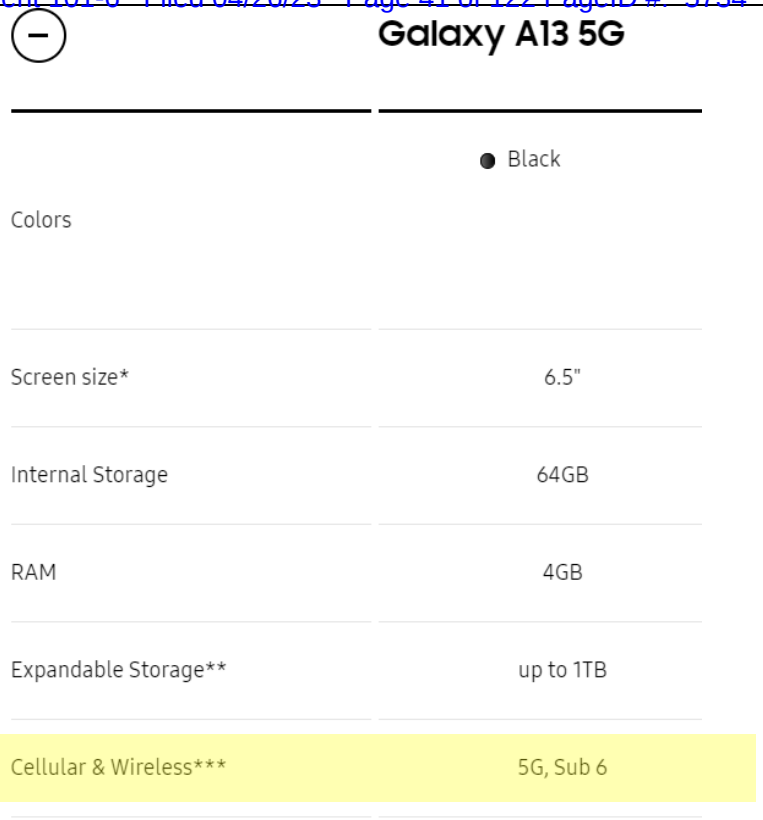
Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

	 Galaxy A13 5G Black Colors Screen size* 6.5" Internal Storage 64GB RAM 4GB Expandable Storage** up to 1TB Cellular & Wireless*** 5G, Sub 6

Display type	Flat
Fingerprint Sensor	Side Fingerprint Sensor
Front Camera	5MP Selfie Camera
Rear Camera	50MP Main Camera 2MP Macro Camera 2MP Depth Camera
Battery Capacity****	5000mAh (typical)

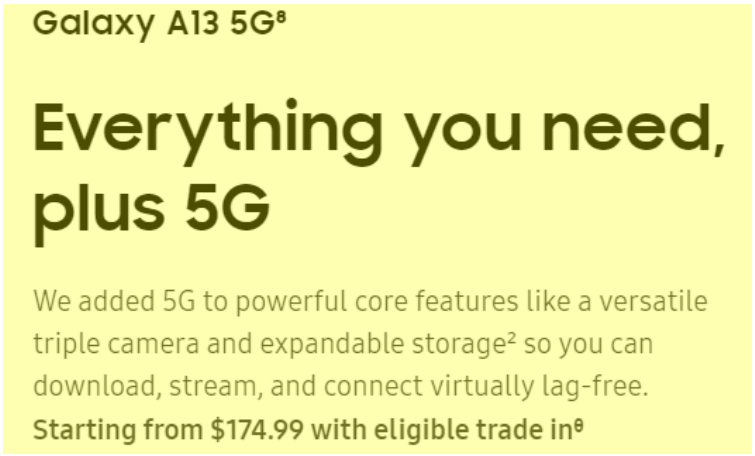
Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).

The Accused Device can be configured as a mobile terminal to support 5G telecommunications standard for providing services like blazing-fast speed, and virtually lag-free download and stream.

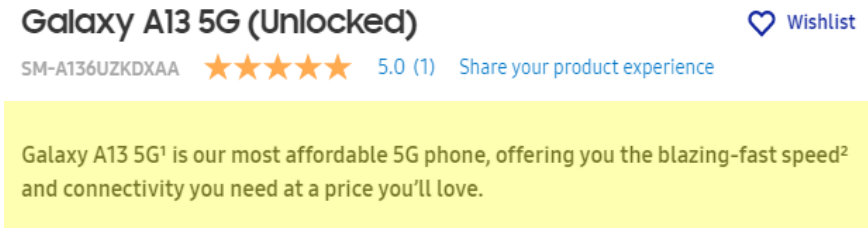


Galaxy A13 5G	
	● Black
Colors	
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).





Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 36.302 version 16.1.0 Release 16 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer) and 3GPP TS 36.212 version 14.13.0 Release 14 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding).

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ETSI TS 136 302 V16.1.0 (2020-07)



LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Services provided by the physical layer
(3GPP TS 36.302 version 16.1.0 Release 16)

1 Scope

The present document is a technical specification of the services provided by the physical layer of E-UTRA to upper layers.

Screenshot showing the scope of standard 3GPP TS 36.302 version 16.1.0 Release 16 supported by the Accused Device (available on page 6 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).



Screenshot showing the scope of standard 3GPP TS 36.212 version 14.13.0 Release 16 supported by the Accused Device (available on page 8 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

Upon information and belief, the Accused Device is configured for receiving hybrid automatic repeat request (HARQ) information from a Node B on a downlink-shared channel.

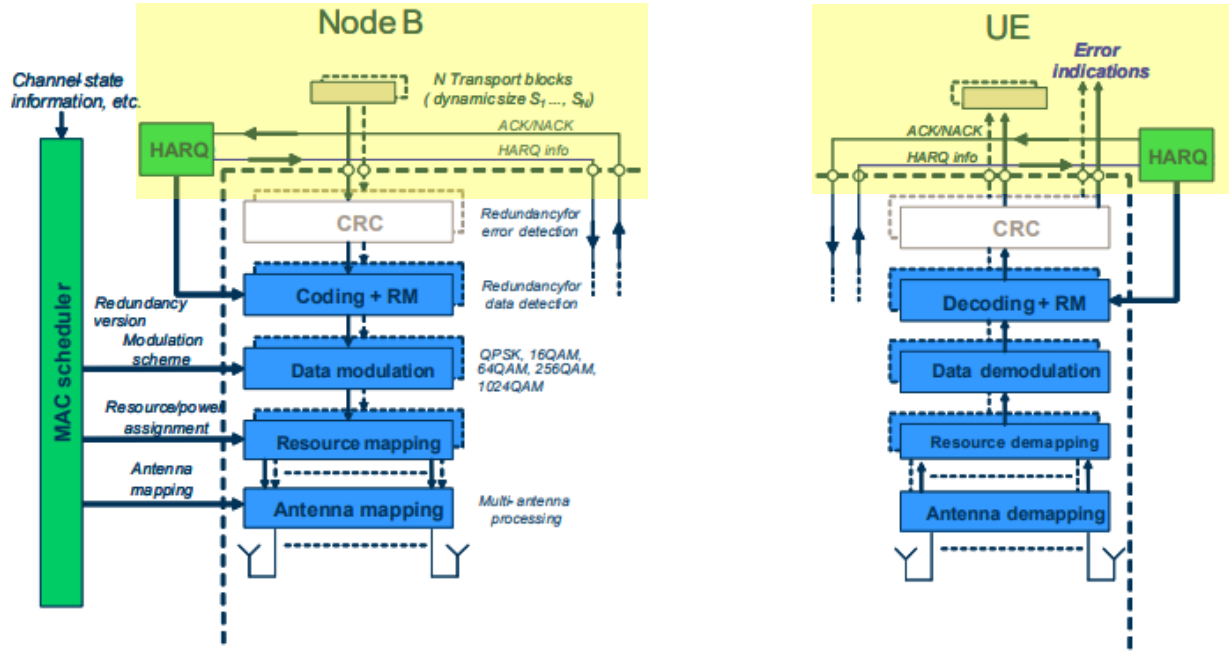
6.2.1 Downlink-Shared Channel

The physical-layer model for Downlink Shared Channel transmission is described based on the corresponding PDSCH or NPDSCH physical-layer-processing chain, see Figure 6.2.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue on the figure.

- **Support for Hybrid-ARQ-related signalling**

The model of Figure 6.2.1-1 also captures:

- Transport via physical layer of Hybrid-ARQ related information associated with the PDSCH, to the peer HARQ process at the receiver side;
- Transport via physical layer of corresponding HARQ acknowledgements to PDSCH transmitter side.

	 **Figure 6.2.1-1: Physical-layer model for DL-SCH transmission** Screenshot showing the HARQ transmission from Node B to the Accused Device configured as the User Equipment (available on pages 12 and 13 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
8a. receiving, by a second node, M bits of HARQ information transmitted by a first node; the M bits of HARQ information being used to indicate whether N transmission blocks transmitted	The Accused Device, configured as the second node, is configured for receiving M bits of HARQ information transmitted by a Node B configured as the first node, wherein the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the Accused Device be correctly received by the first node. Upon information and belief, the Accused Device is configured for transmitting N transport blocks of dynamic size to the Node B. The Accused Device also receives HARQ acknowledgement information associated with the PDSCH from the Node B.

to the first node by the second node be correctly received by the first node;	Upon information and belief, the HARQ acknowledgement information comprises of Cyclic Redundancy Check (CRC) and transport-block-error indication. 6.2.1 Downlink-Shared Channel The physical-layer model for Downlink Shared Channel transmission is described based on the corresponding PDSCH or NPDSCH physical-layer-processing chain, see Figure 6.2.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue on the figure. - **Higher-layer data passed to/from the physical layer** - N (up to two) transport blocks of dynamic size delivered to the physical layer once every TTI. - **CRC and transport-block-error indication** - Transport-block-error indication delivered to higher layers. - **FEC and rate matching** - Channel coding rate is implicitly given by the combination of transport block size, modulation scheme and resource assignment; - Physical layer model support of HARQ: in case of Incremental Redundancy, the corresponding Layer 2 Hybrid-ARQ process controls what redundancy version is to be used for the physical layer transmission for each TTI. - **Support for Hybrid-ARQ-related signalling** The model of Figure 6.2.1-1 also captures: - Transport via physical layer of Hybrid-ARQ related information associated with the PDSCH, to the peer HARQ process at the receiver side; - Transport via physical layer of corresponding HARQ acknowledgements to PDSCH transmitter side.

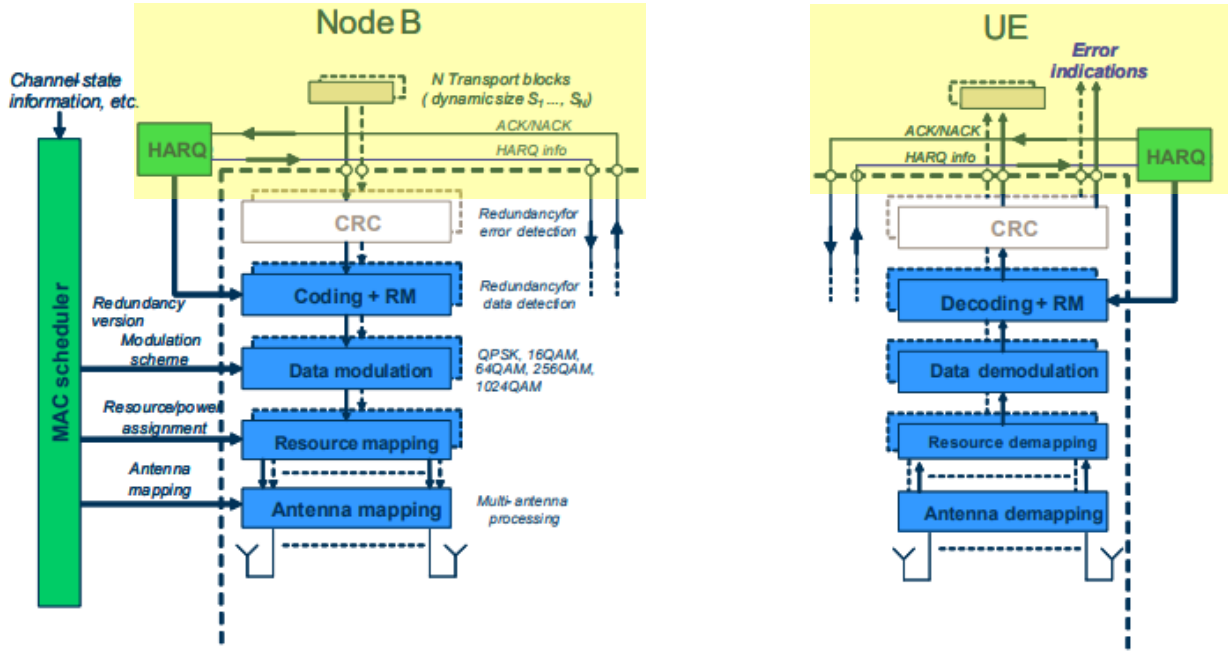


Figure 6.2.1-1: Physical-layer model for DL-SCH transmission

Screenshot showing the HARQ transmission from Node B to the Accused Device configured as the User Equipment (available on pages 12 and 13 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

Upon information and belief, the HARQ-ACK is attached with Cyclic Redundancy Check (CRC) bits for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length.

5.2.2.6 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication, and CSI-RS resource indication (CRI). Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When control data are transmitted in the PUSCH, the channel coding for HARQ-ACK, rank indication (including RI only, joint report of RI/i1, joint report of CRI/RI, joint report of CRI/RI/i1, joint report of CRI/RI/PTI, joint report of RI/i1,p-2, and joint report of RI/PTI), CRI and channel quality information $o_0, o_1, o_2, ..., o_{O-1}$ is done independently. Parameters i1,1-1 , i1,2-1 , i1,1-2 , i1,2-2 , i1,p-2 correspond to parameters $i_{1,1}$, $i_{1,2}$, d_1, d_2, and I_p in clause 7.2.4 of [3].

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 27 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

- If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is o_0^{ACK} $o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
8b. among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;	The Accused Device is so configured that among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length. - If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \ldots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, \ldots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
8c. a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k;	The Accused Device is so configured that a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k. Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \ldots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, \ldots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
8d. if M2=M, then, obtaining, by the second node, the M bits of HARQ information through a blind detection and obtaining the positions of the k erroneous transmission blocks indicated by the M2 bits; and if M2<M, then, obtaining, by the second node, M1 bits of the M bits through decoding, M1=M−M2, an indication domain of the M1 bits of the M bits being used to indicate a value of k or indicate the length type of M2; determining M2 bits according to the M1 bits and obtaining the positions of the k erroneous transmission blocks indicated by the M2 bits.	The Accused Device is configured that if M2<M, then, obtaining, by the second node, M1 bits of the M bits through decoding, M1=M−M2, an indication domain of the M1 bits of the M bits being used to indicate a value of k or indicate the length type of M2; determining M2 bits according to the M1 bits and obtaining the positions of the k erroneous transmission blocks indicated by the M2 bits. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length, $L < B$. Upon information and belief, for HARQ-ACK, the input bits sequence of the transport block (of length A) provides an indication of the length L of the CRC attachment. The CRC bits are predefined to be of length 8 bits for HARQ-ACK. The Accused Device configured as the UE decodes the HARQ with CRC attachment to obtain the positions of the erroneous transmission blocks. NOTE: The signalling of transport-format and resource-allocation is not captured in the physical-layer model. At the transmitter side, this information can be directly derived from the configuration of the physical layer. The physical layer then transports this information over the radio interface to its peer physical layer, presumably multiplexed in one way or another with the HARQ-related information. On the receiver side, this information is, in contrast to the HARQ-related information, used directly within the physical layer for PDSCH demodulation, decoding etc., without passing through higher layers.

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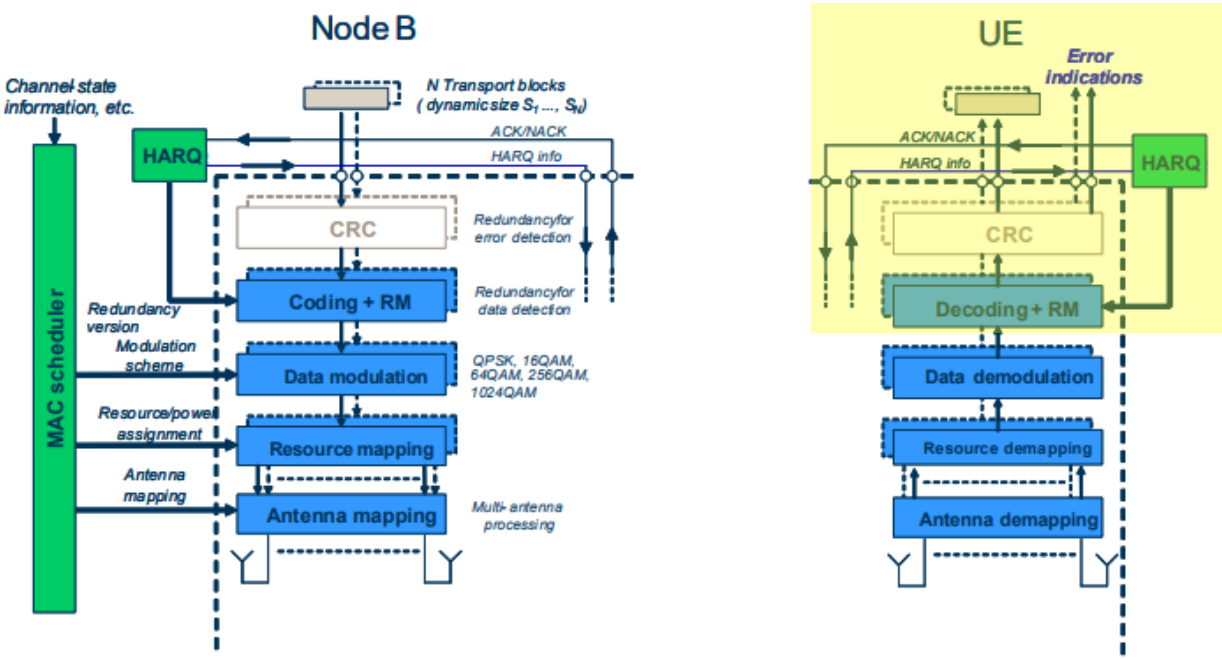


Figure 6.2.1-1: Physical-layer model for DL-SCH transmission

Screenshot showing the HARQ transmission from Node B to the Accused Device configured as the User Equipment (available on pages 12 and 13 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

- If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from

	https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. The precise manner in which the received HARQ-ACK information from the Node B is decoded by the Accused Device configured as the User Equipment to obtain M1 bits which is used to indicate the length type of the CRC bits is not publicly available. This is a software limitation and the software of the Accused System is not publicly available. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 9	**Evidence**
9. The method according to claim 8, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k.	Every claim limitation of claim 8 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is configured wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k. Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 10	**Evidence**
10. A node, comprising:	This is the preamble of the claim and is not limiting. This element, if construed as a limitation, is present literally and under the doctrine of equivalents in the Accused Device. The Accused Device is a smartphone device comprising Octa-Core processor, PLS TFT LCD display, high resolution front and rear cameras, 4GB RAM with 64GB internal storage and 5000mAh battery. The Accused Device is configured to support features like Side Sensor Fingerprint, expandable memory etc. The Accused Device is available in different models varying based on Cell Phone Carrier, Internal Memory and Color. The various models available for the Accused Device are A136UZKDXAA, SM-A136ULGDXAA, SM-A136UZKAATT, SM-A136ULGAATT, SM-A136UZKAXAU, and SM-A136UZKAUSC.

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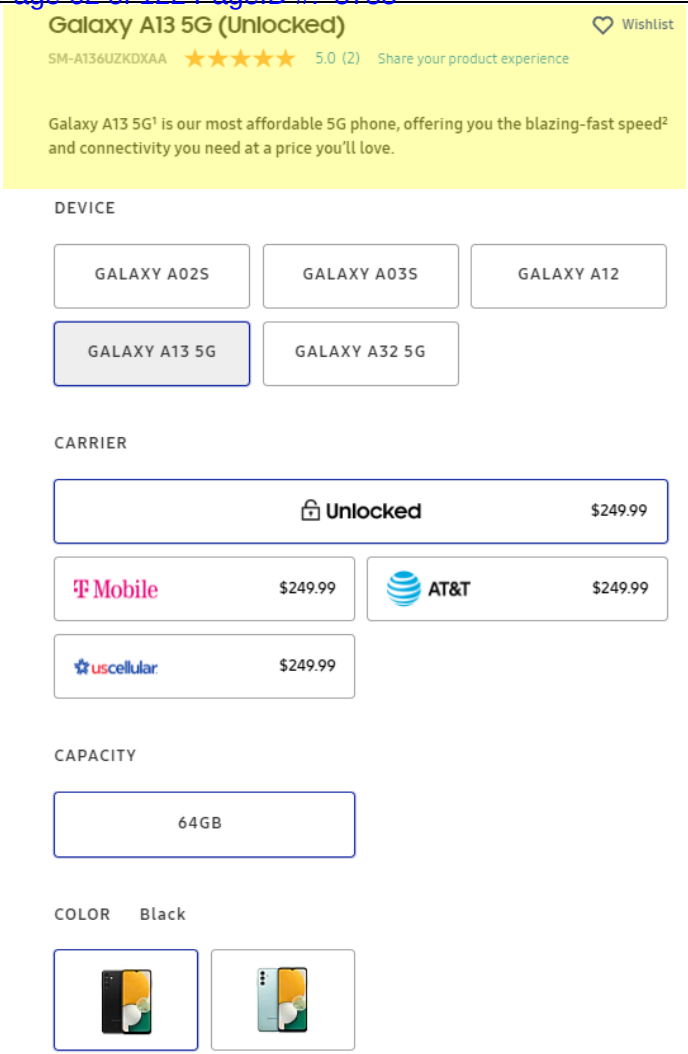
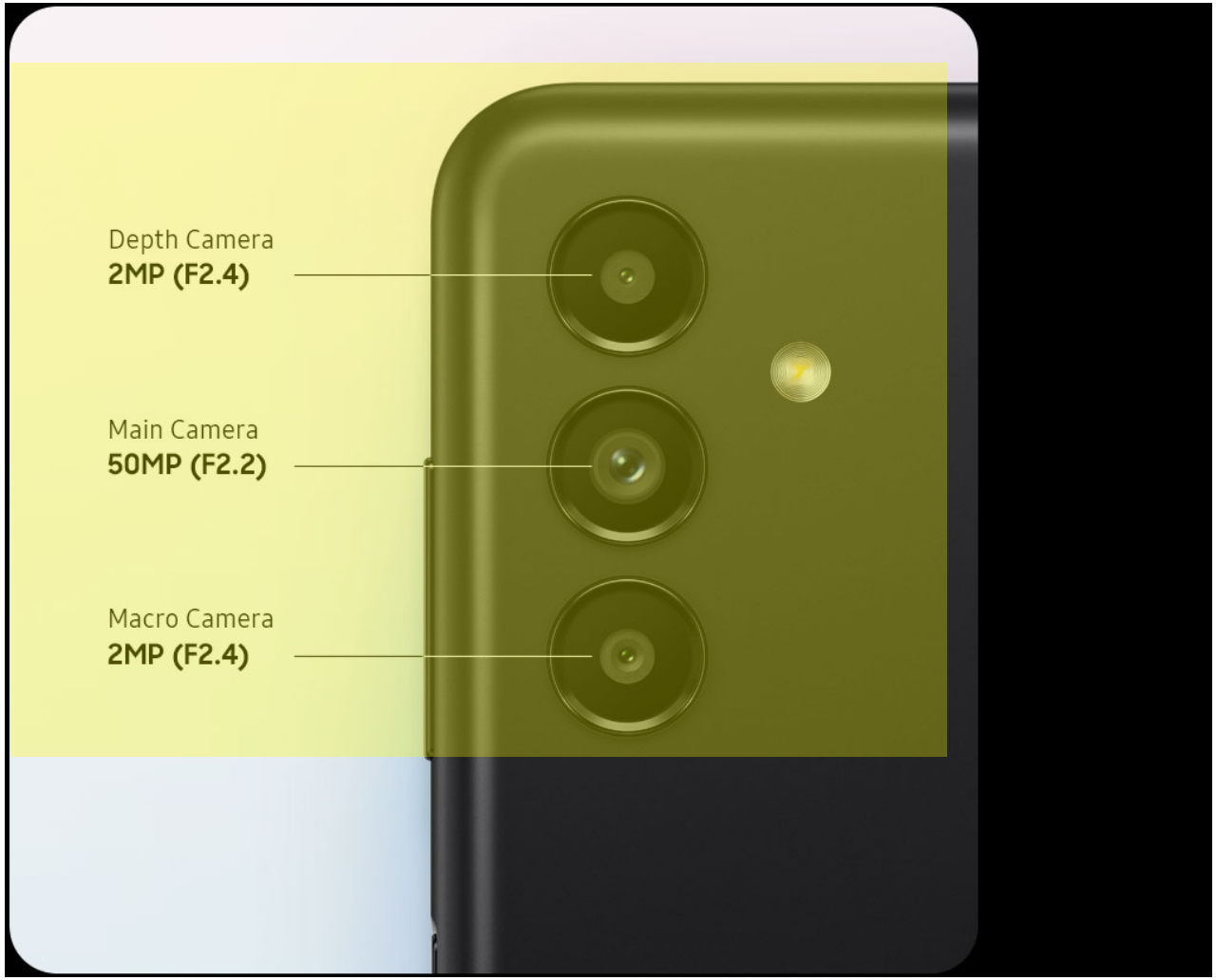


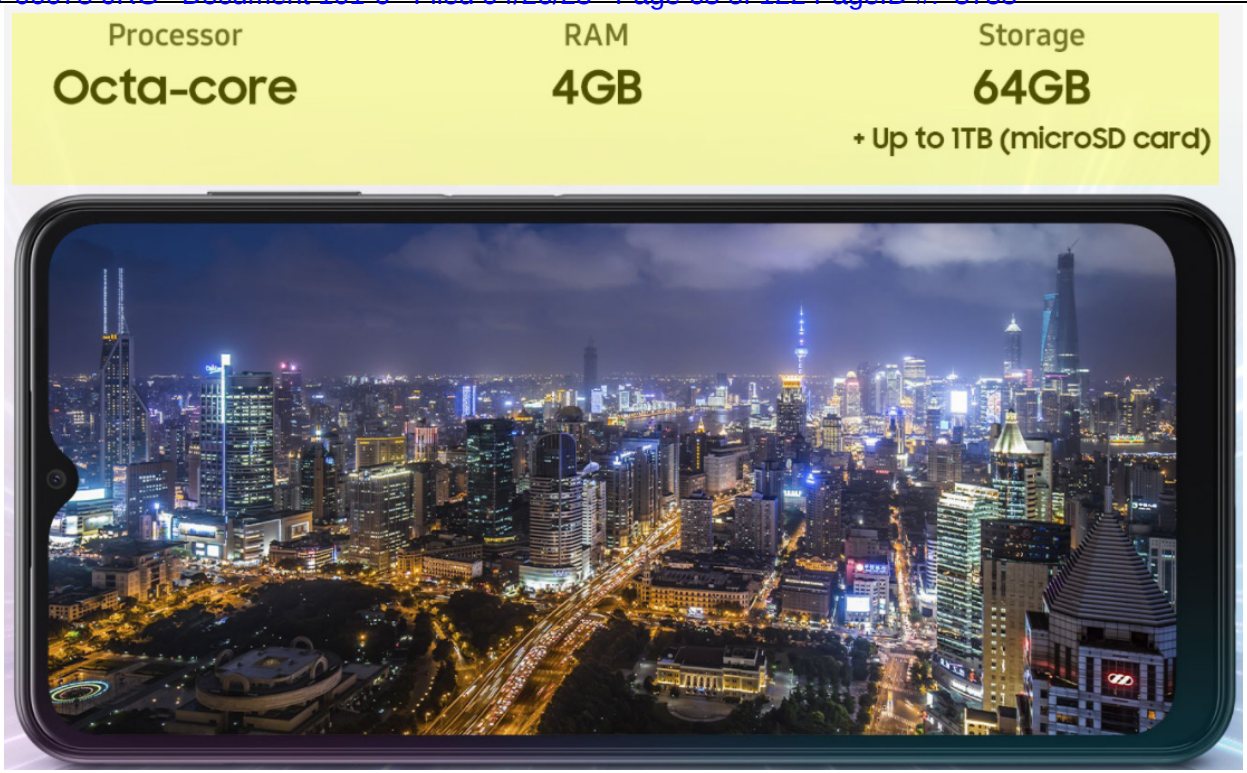
Image of the Accused Device Galaxy A13 5G Smartphone SM-A136UZKDXAA (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



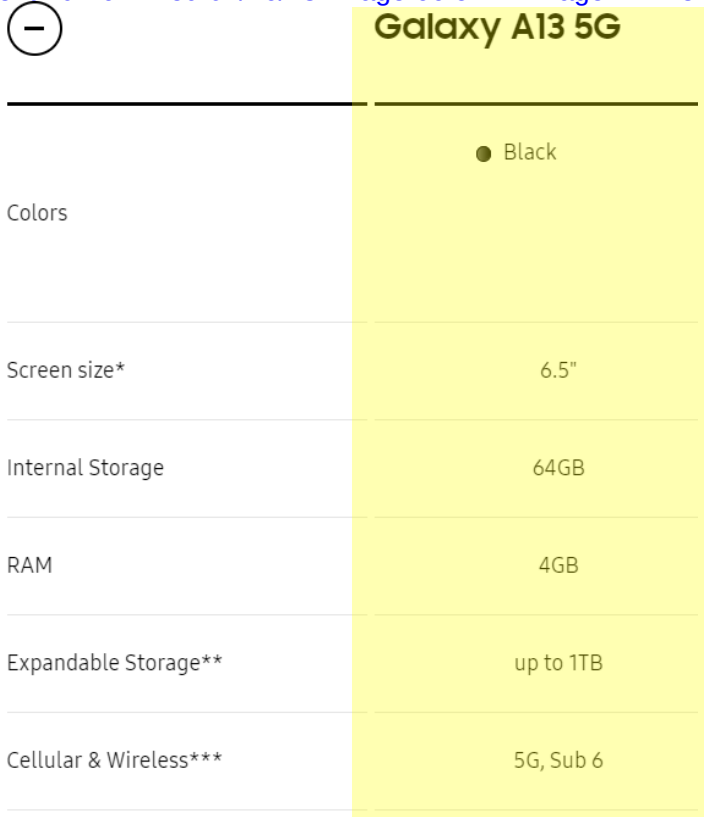
Screenshot showing Image of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).



Screenshot showing camera of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

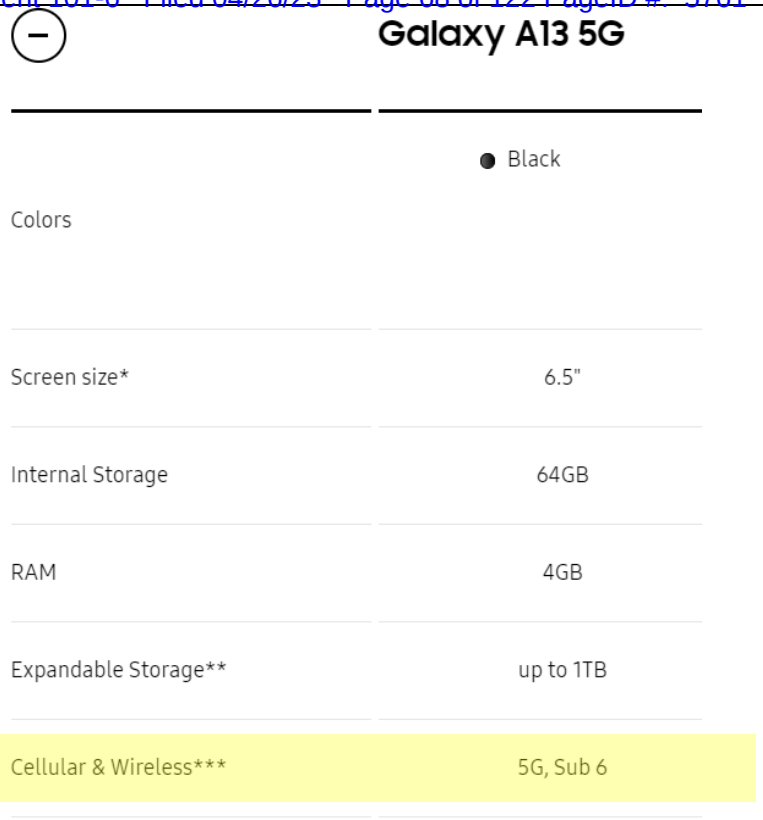
	

Galaxy A13 5G
Black
Colors
Screen size*
6.5"
Internal Storage
64GB
RAM
4GB
Expandable Storage**
up to 1TB
Cellular & Wireless***
5G, Sub 6

Display type	Flat
Fingerprint Sensor	Side Fingerprint Sensor
Front Camera	5MP Selfie Camera
Rear Camera	50MP Main Camera 2MP Macro Camera 2MP Depth Camera
Battery Capacity****	5000mAh (typical)

Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).

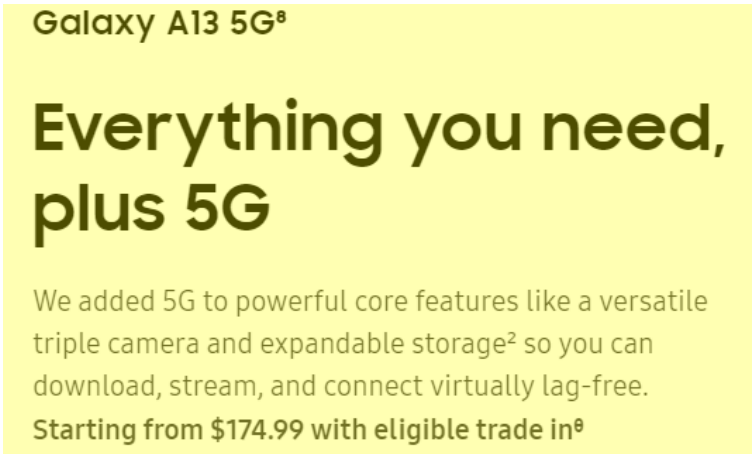
The Accused Device can be configured as a mobile terminal to support 5G telecommunications standard for providing services like blazing-fast speed, and virtually lag-free download and stream.



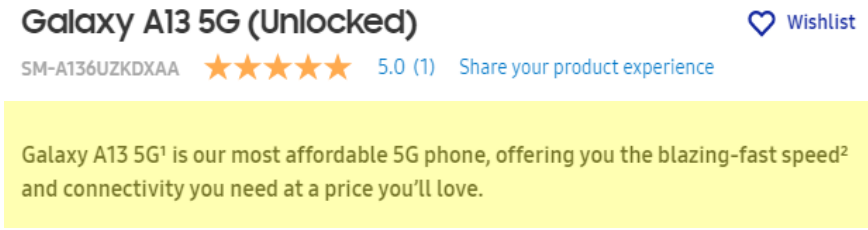
Galaxy A13 5G

	● Black
Colors	
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).



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Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 36.302 version 16.1.0 Release 16 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer) and 3GPP TS 36.212 version 14.13.0 Release 14 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding).

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ETSI TS 136 302 V16.1.0 (2020-07)



LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Services provided by the physical layer
(3GPP TS 36.302 version 16.1.0 Release 16)

1 Scope

The present document is a technical specification of the services provided by the physical layer of E-UTRA to upper layers.

Screenshot showing the scope of standard 3GPP TS 36.302 version 16.1.0 Release 16 supported by the Accused Device (available on page 6 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

ETSI TS 136 212 V14.13.0 (2020-07)



LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Multiplexing and channel coding
(3GPP TS 36.212 version 14.13.0 Release 14)

1 Scope

The present document specifies the coding, multiplexing and mapping to physical channels for E-UTRA.

Screenshot showing the scope of standard 3GPP TS 36.212 version 14.13.0 Release 16 supported by the Accused Device (available on page 8 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

Upon information and belief, the Accused Device is configured for receiving hybrid automatic repeat request (HARQ) information from a Node B on a downlink-shared channel.

6.2.1 Downlink-Shared Channel

The physical-layer model for Downlink Shared Channel transmission is described based on the corresponding PDSCH or NPDSCH physical-layer-processing chain, see Figure 6.2.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue on the figure.

- **Support for Hybrid-ARQ-related signalling**

The model of Figure 6.2.1-1 also captures:

- Transport via physical layer of Hybrid-ARQ related information associated with the PDSCH, to the peer HARQ process at the receiver side;
- Transport via physical layer of corresponding HARQ acknowledgements to PDSCH transmitter side.

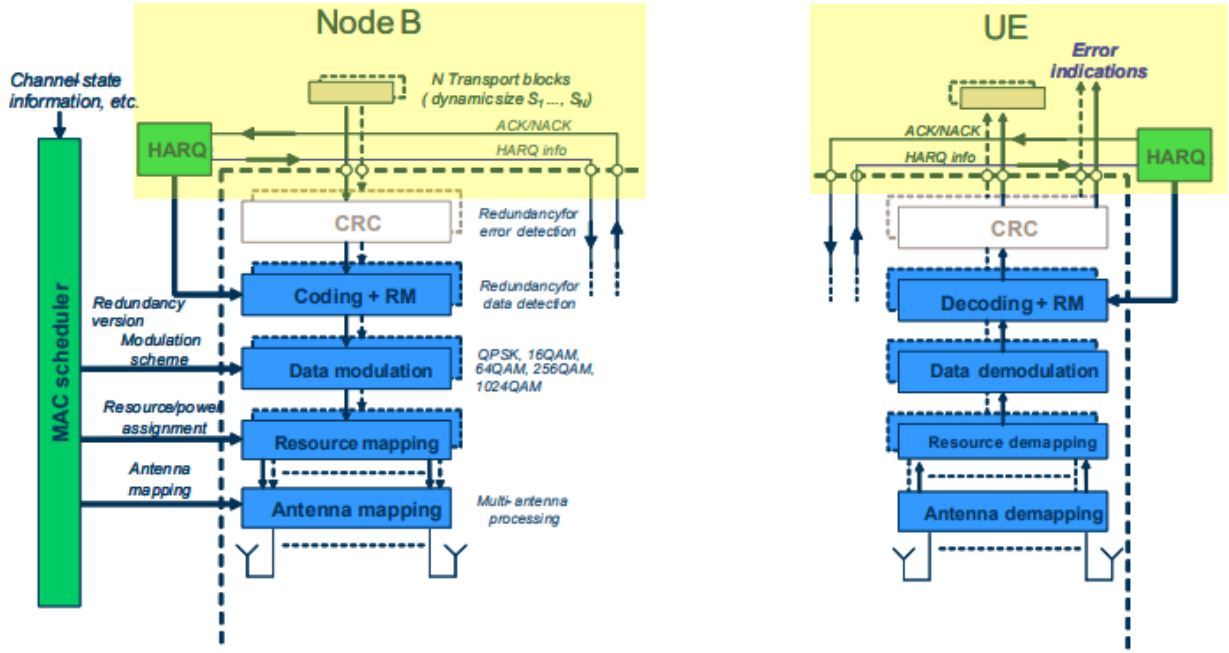


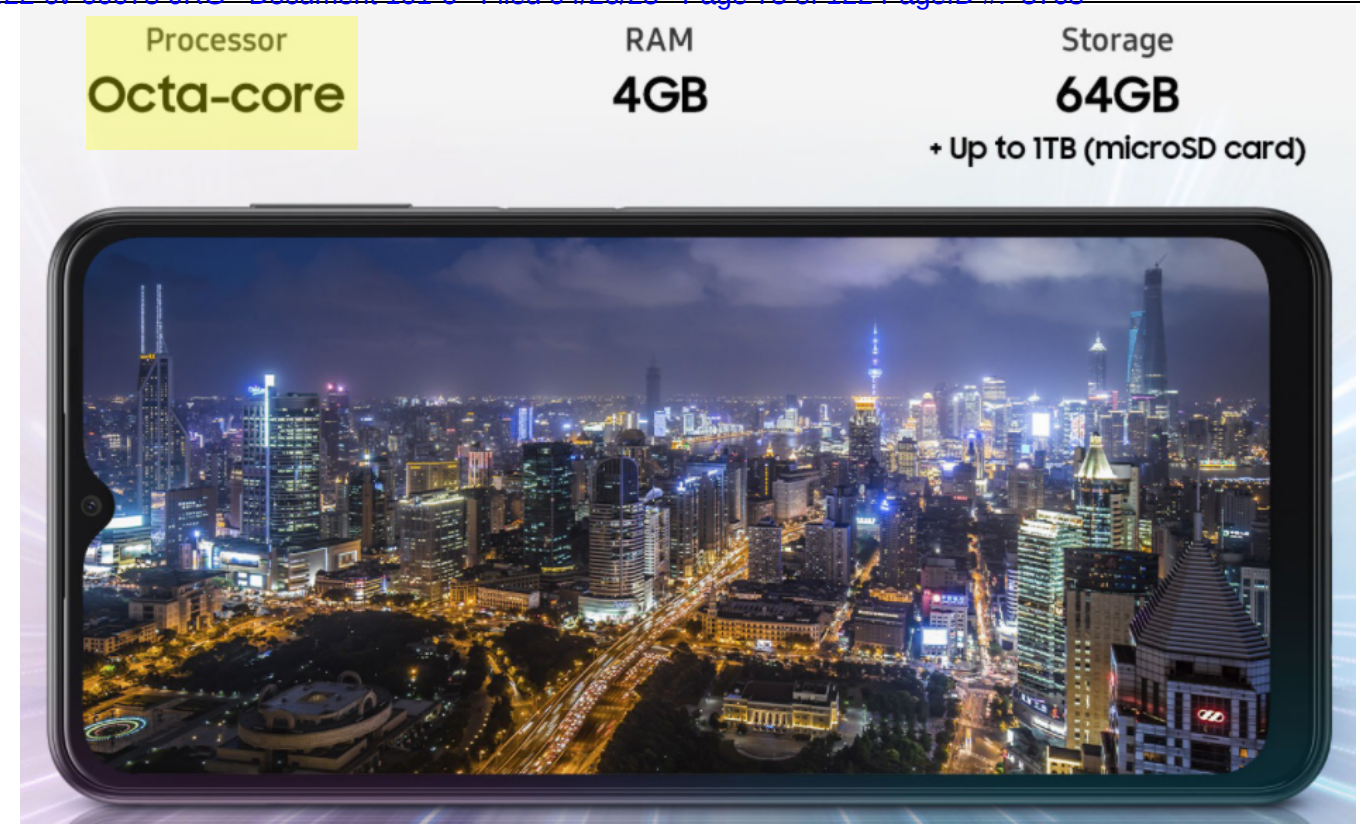
Figure 6.2.1-1: Physical-layer model for DL-SCH transmission

Screenshot showing the HARQ transmission from Node B to the Accused Device configured as the User Equipment (available on pages 12 and 13 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).

10a. at least one processor; and	The Accused Device is configured to comprise a processor. Upon information and belief, the Accused Device comprises an Octa-core processor.



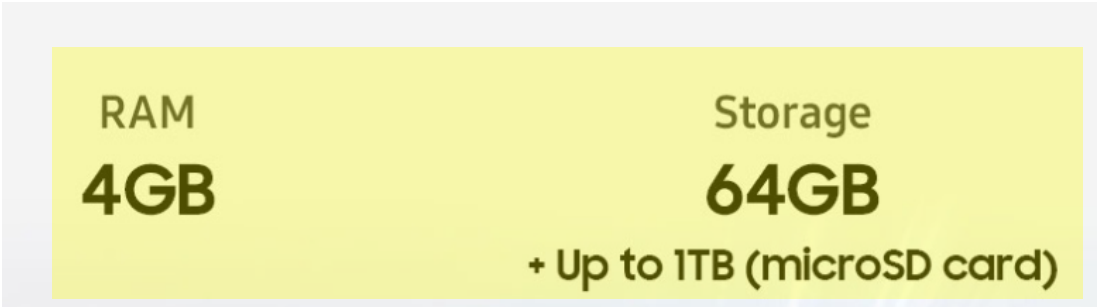
Processor	
CPU Type	**CPU Speed**
Octa-Core	2.2GHz, 2GHz

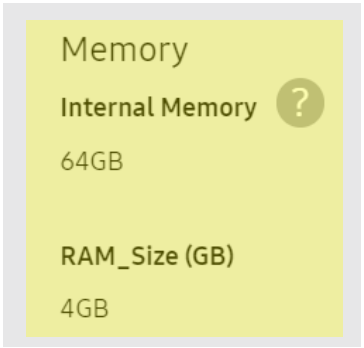
Screenshots showing the processor supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

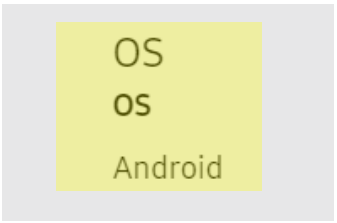
To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10b. a memory communicably connected with the at least one processor and configured for storing computer-executable instructions executable by the at least one processor;	The Accused Device is configured to comprise a memory communicably connected with the at least one processor and configured for storing computer-executable instructions executable by the at least one processor. Upon information and belief, the Accused Device comprises 4GB RAM with 64GB internal storage. The memory of the Accused Device is configured to store and execute Android Operating System. **Galaxy A13 5G** ● Black Colors Screen size* 6.5" Internal Storage 64GB RAM 4GB

Screenshot showing memory supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).







Screenshot showing memory and operating system supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10c. wherein the computer-executable instructions when executed by the at least one processor causes the at least one processor to perform; detecting N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result; the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks;	The Accused Device is configured for storing computer-executable instructions which were when executed by the at least one processor causes the at least one processor to perform detecting N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result; the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks. Upon information and belief, the Accused Device is configured for receiving N transport blocks of dynamic size from the Node B and transmitting HARQ acknowledgement information associated with the PUSCH to the Node B. Upon information and belief, the HARQ acknowledgement information comprises of Cyclic Redundancy Check (CRC) and transport-block-error indication. 6.1.1 Uplink Shared Channel The physical-layer model for Uplink Shared Channel transmission is described based on the corresponding physical-layer-processing chain, see Figure 6.1.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue. It should be noted that, in the cases of PUSCH and NPUSCH, the scheduling decision is fully done at the network side. The uplink transmission control in the UE then configures the uplink physical-layer processing, based on uplink transport-format and resource-assignment information received on the downlink. - **Higher-layer data passed to/from the physical layer** - One transport block of dynamic size delivered to the physical layer once every TTI. - **CRC and transport-block-error indication** - Transport-block-error indication delivered to higher layers. - **FEC and rate matching** - Channel coding rate is implicitly given by the combination of transport block size, modulation scheme and resource assignment; - Physical layer model support of HARQ: in case of Incremental Redundancy, the corresponding Layer 2 Hybrid-ARQ process controls what redundancy version is to be used for the physical layer transmission for each TTI.

The model of Figure 6.1.1-1 also captures

- Transport via physical layer of Hybrid-ARQ related information associated with the PUSCH, to the peer HARQ process at the transmitter side;
- Transport via physical layer of corresponding HARQ acknowledgements to PUSCH transmitter side (except for NB-IoT UEs).

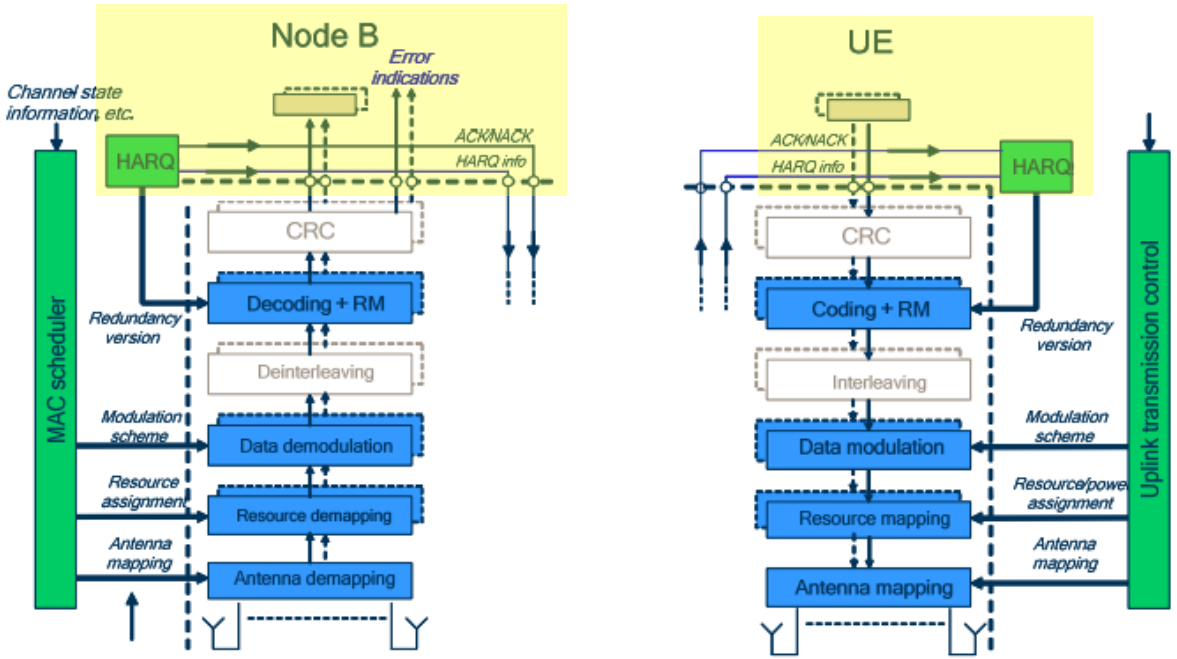


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on pages 10 and 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

Upon information and belief, the HARQ-ACK is attached with Cyclic Redundancy Check (CRC) bits for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length.

5.2.2.6 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication, and CSI-RS resource indication (CRI). Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When control data are transmitted in the PUSCH, the channel coding for HARQ-ACK, rank indication (including RI only, joint report of RI/i1, joint report of CRI/RI, joint report of CRI/RI/i1, joint report of CRI/RI/PTI, joint report of RI/i1,p-2, and joint report of RI/PTI), CRI and channel quality information $o_0, o_1, o_2, ..., o_{O-1}$ is done independently. Parameters i1,1-1 , i1,2-1 , i1,1-2 , i1,2-2 , i1,p-2 correspond to parameters $i_{1,1}$, $i_{1,2}$, d_1, d_2, and I_p in clause 7.2.4 of [3].

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 27 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

- If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is o_0^{ACK} $o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10d. among the M bits, M2 bits bring used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;	The Accused Device is so configured that among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length. - If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \ldots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, \ldots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10e. a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and	The Accused Device is so configured that a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k. Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10f. transmitting the HARQ information to the second node.	The Accused Device is configured for transmitting the HARQ information to the second node. Upon information and belief, the Accused Device is configured for transmitting hybrid automatic repeat request (HARQ) information to a Node B on an uplink shared channel. 6.1.1 Uplink Shared Channel The physical-layer model for Uplink Shared Channel transmission is described based on the corresponding physical-layer-processing chain, see Figure 6.1.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue. It should be noted that, in the cases of PUSCH and NPUSCH, the scheduling decision is fully done at the network side. The uplink transmission control in the UE then configures the uplink physical-layer processing, based on uplink transport-format and resource-assignment information received on the downlink. The model of Figure 6.1.1-1 also captures - Transport via physical layer of Hybrid-ARQ related information associated with the PUSCH, to the peer HARQ process at the transmitter side; - Transport via physical layer of corresponding HARQ acknowledgements to PUSCH transmitter side (except for NB-IoT UEs).

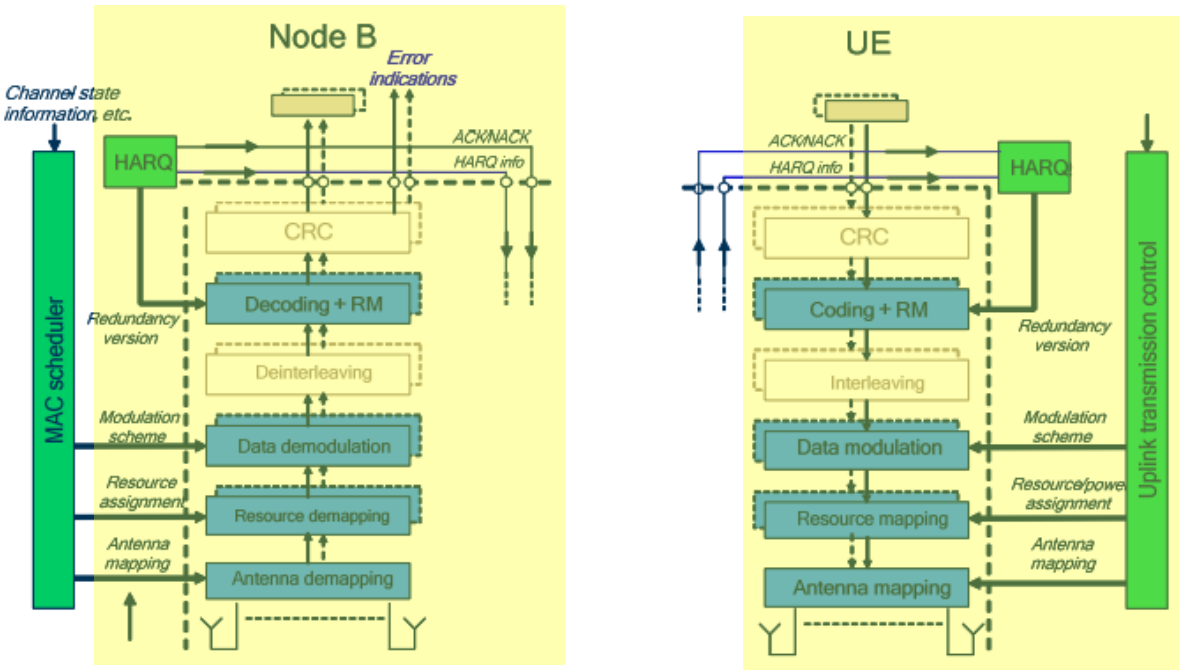


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on pages 10 and 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it.

Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).

10,594,443 Claim 11	Evidence
11. The node according to claim 10, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the another node;	Every claim limitation of claim 10 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is configured wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k.

or configured by a downlink control information (DCI) signaling transmitted by the another node; or determined by the node; or predefined; or determined by the node based on k.	Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 15	**Evidence**
15. The node according to claim 10, wherein if M2<M, then an indication domain of M1 bits of the M bits is used to indicate a value of k or indicate the length type of M2, wherein M1=M−M2.	Every claim limitation of claim 10 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is configured wherein if M2<M, then an indication domain of M1 bits of the M bits is used to indicate a value of k or indicate the length type of M2, wherein M1=M−M2. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length, $L < B$. Upon information and belief, for HARQ-ACK, the input bits sequence of the transport block (of length A) provides an indication of the length L of the CRC attachment. The CRC bits are predefined to be of length 8 bits for HARQ-ACK.

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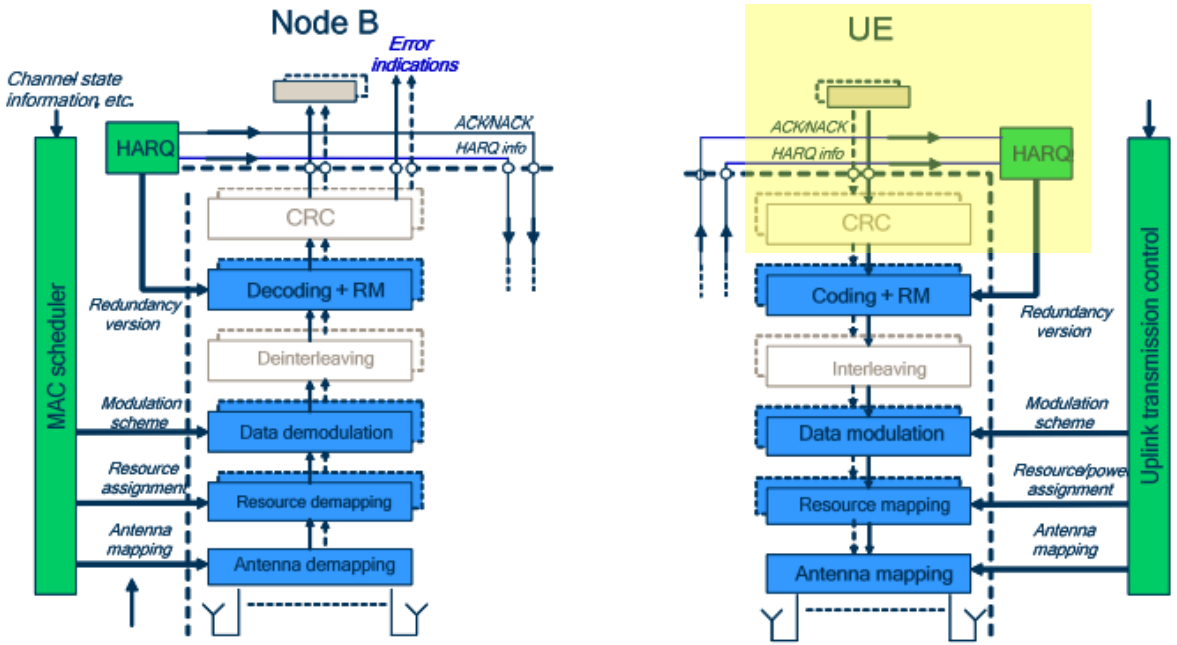


Figure 6.1.1-1: Physical-layer model for UL-SCH transmission

Screenshot showing the HARQ transmission from the Accused Device configured as the User Equipment to the Node B (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

- If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from

	https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. The precise manner in which the received HARQ-ACK information from the Node B is decoded by the Accused Device configured as the User Equipment to obtain M1 bits which is used to indicate the length type of the CRC bits is not publicly available. This is a software limitation and the software of the Accused System is not publicly available. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 17	**Evidence**
17. A node, comprising:	This is the preamble of the claim and is not limiting. This element, if construed as a limitation, is present literally and under the doctrine of equivalents in the Accused Device. The Accused Device is a smartphone device comprising Octa-Core processor, PLS TFT LCD display, high resolution front and rear cameras, 4GB RAM with 64GB internal storage and 5000mAh battery. The Accused Device is configured to support features like Side Sensor Fingerprint, expandable memory etc. The Accused Device is available in different models varying based on Cell Phone Carrier, Internal Memory and Color. The various models available for the Accused Device are A136UZKDXAA, SM-A136ULGDXAA, SM-A136UZKAATT, SM-A136ULGAATT, SM-A136UZKAXAU, and SM-A136UZKAUSC.

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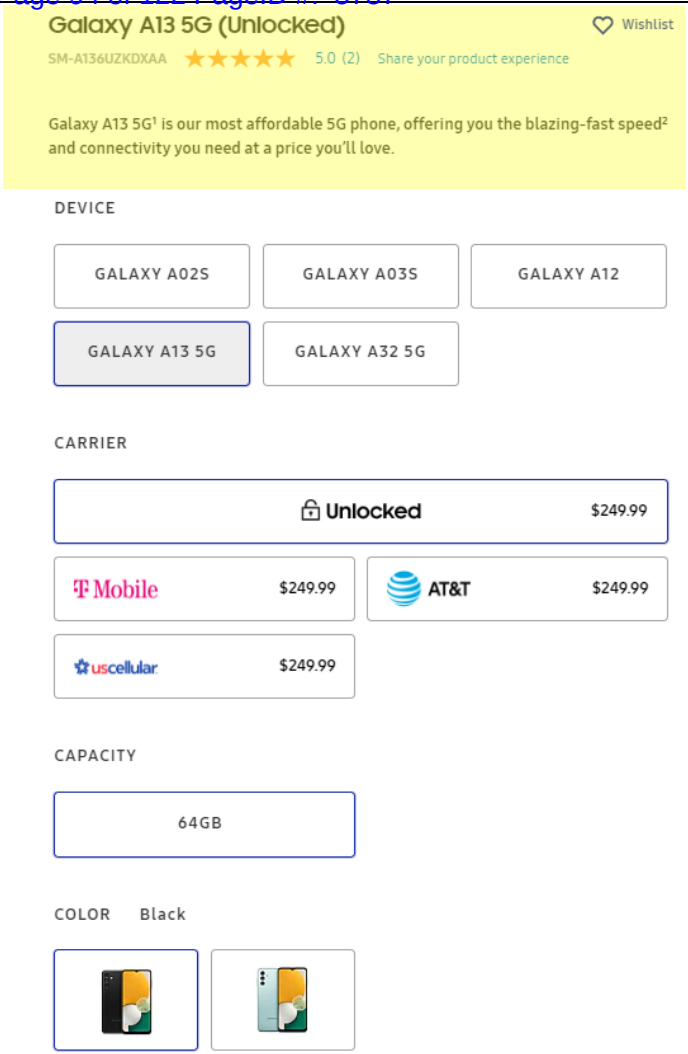
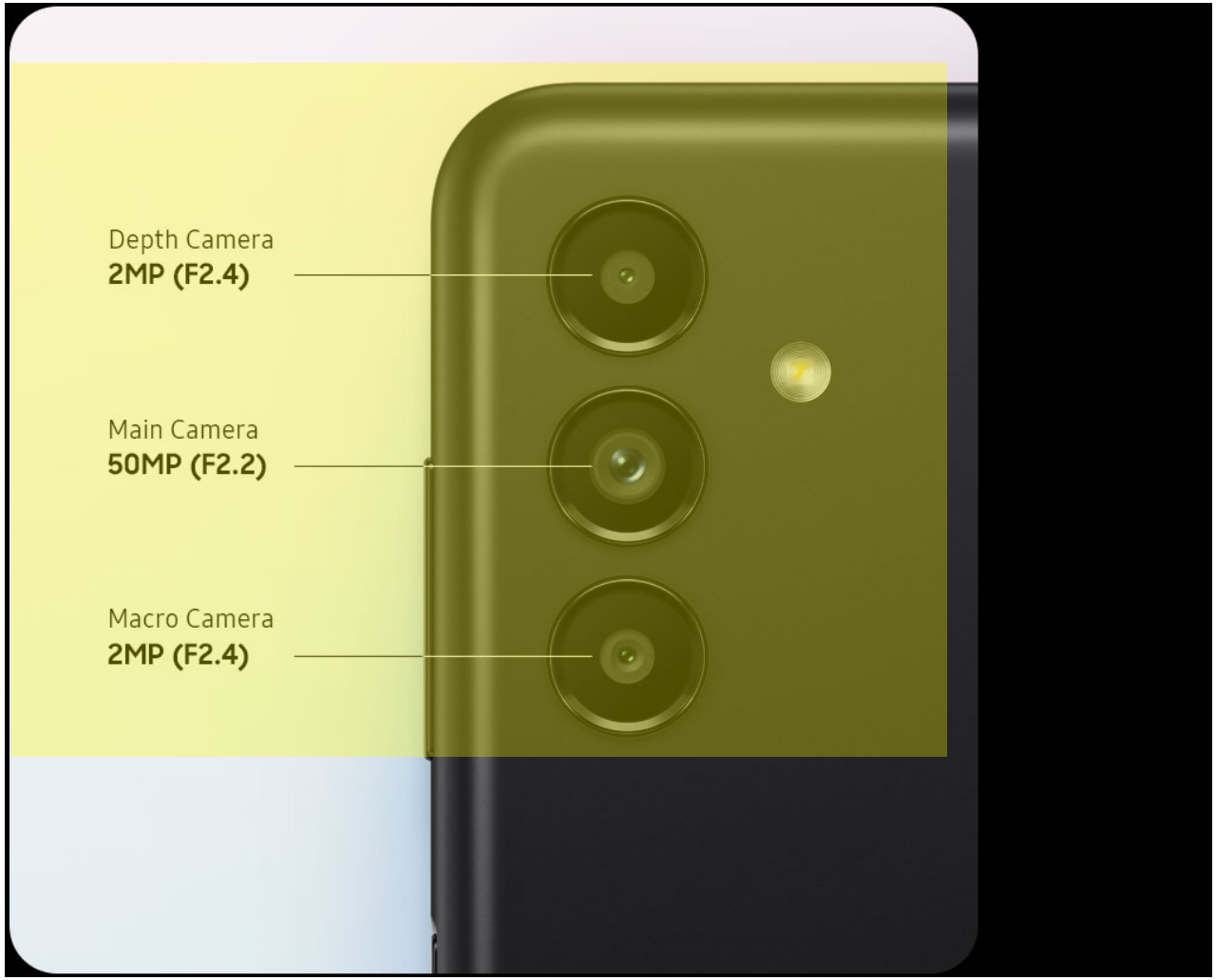


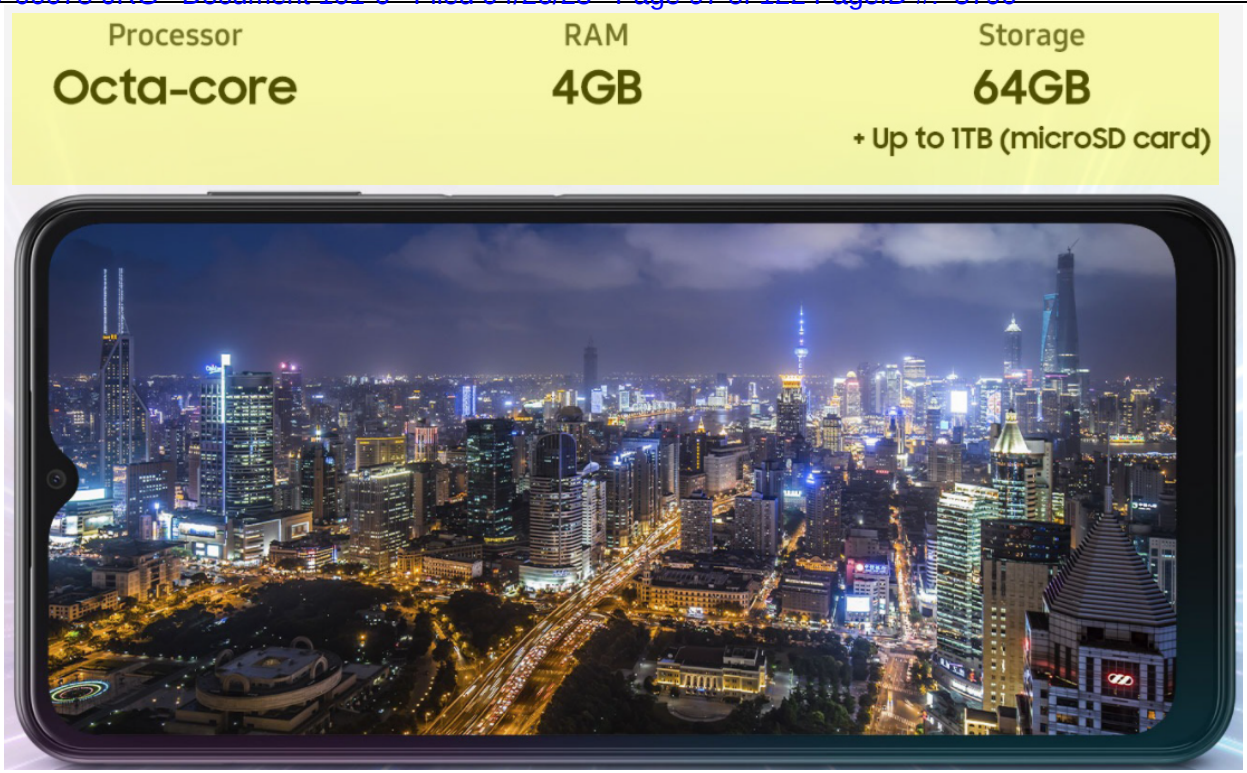
Image of the Accused Device Galaxy A13 5G Smartphone SM-A136UZKDXAA (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



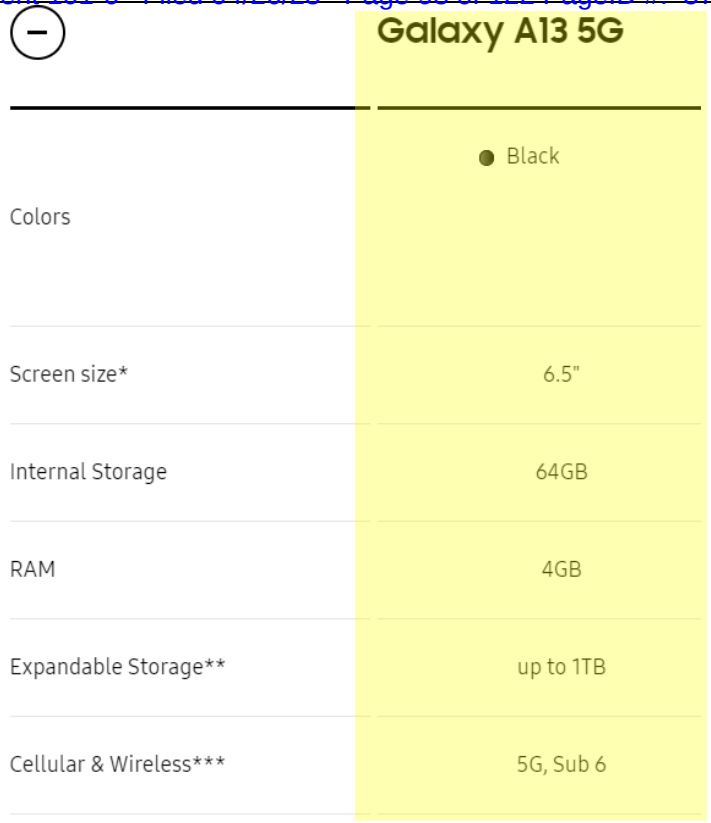
Screenshot showing Image of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).



Screenshot showing camera of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).



Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

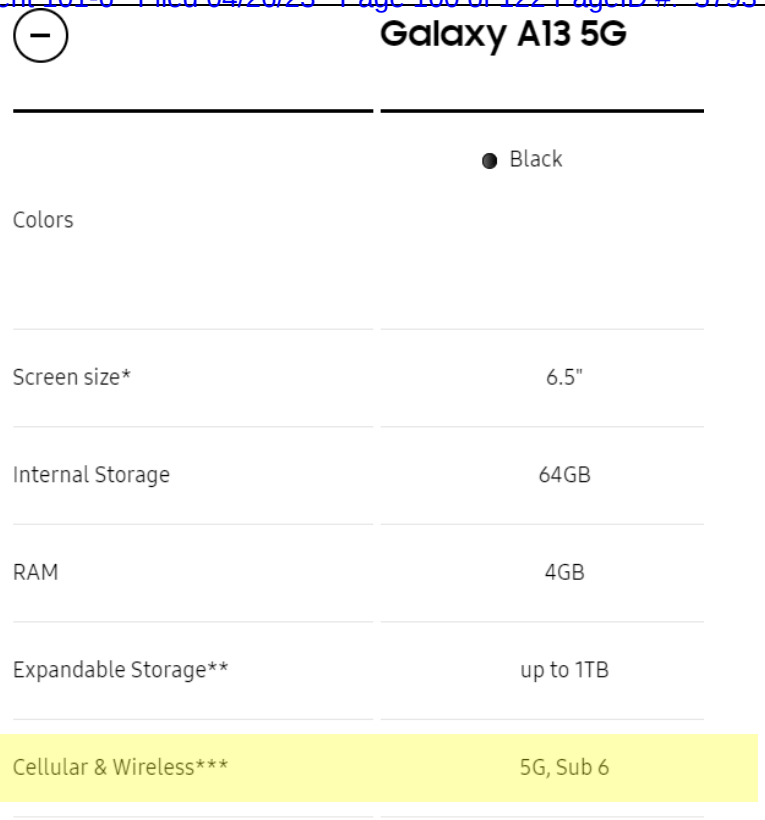
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Display type	Flat
Fingerprint Sensor	Side Fingerprint Sensor
Front Camera	5MP Selfie Camera
Rear Camera	50MP Main Camera 2MP Macro Camera 2MP Depth Camera
Battery Capacity****	5000mAh (typical)

Screenshot showing features of the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).

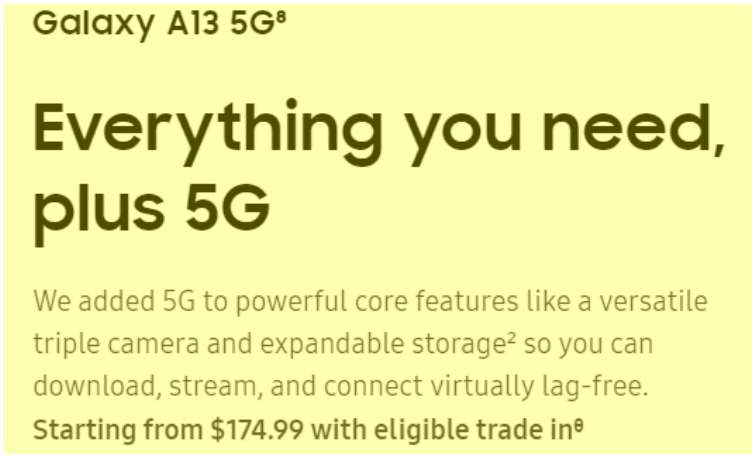
The Accused Device can be configured as a mobile terminal to support 5G telecommunications standard for providing services like blazing-fast speed, and virtually lag-free download and stream.

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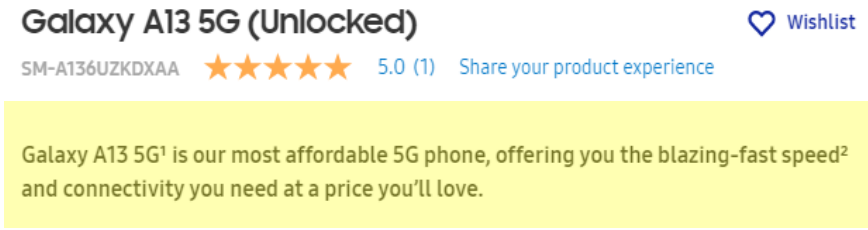


Galaxy A13 5G	
	● Black
Colors	
Screen size*	6.5"
Internal Storage	64GB
RAM	4GB
Expandable Storage**	up to 1TB
Cellular & Wireless***	5G, Sub 6

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).



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Network

2G GSM
GSM850, GSM900,
DCS1800, PCS1900

3G UMTS
B1(2100), B2(1900), B4(AWS),
B5(850), B8(900)

4G FDD LTE
B1(2100), B2(1900), B3(1800),
B4(AWS), B5(850), B7(2600),
B12(700), B13(700), B14(700),
B20(800), B25(1900), B26(850),
B29(700), B30(2300), B66(AWS-3), B71(600)

4G TDD LTE
B38(2600), B39(1900),
B40(2300),
B41(2500), B48(3600)

SIM Slot Type
SIM 1 + SIM 2 + MicroSD

5G FDD Sub6
N2(1900), N5(850), N66(AWS-3),
N71(600)

5G TDD mmWave
N41(2500), N48(3500), N77(3700)

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured as a User Equipment Terminal and supports 3GPP 5G Standard, including but not limited to 3GPP TS 36.302 version 16.1.0 Release 16 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Services provided by the physical layer) and 3GPP TS 36.212 version 14.13.0 Release 14 (LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding).

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ETSI TS 136 302 V16.1.0 (2020-07)



LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Services provided by the physical layer
(3GPP TS 36.302 version 16.1.0 Release 16)

1 Scope

The present document is a technical specification of the services provided by the physical layer of E-UTRA to upper layers.

Screenshot showing the scope of standard 3GPP TS 36.302 version 16.1.0 Release 16 supported by the Accused Device (available on page 6 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

ETSI TS 136 212 V14.13.0 (2020-07)

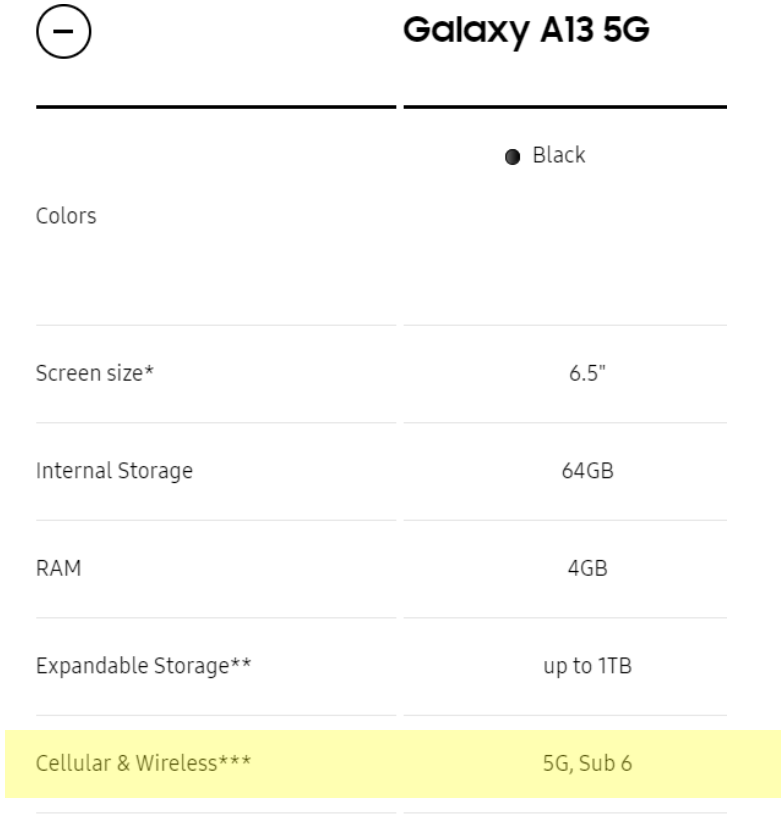


LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Multiplexing and channel coding
(3GPP TS 36.212 version 14.13.0 Release 14)

1 Scope

The present document specifies the coding, multiplexing and mapping to physical channels for E-UTRA.

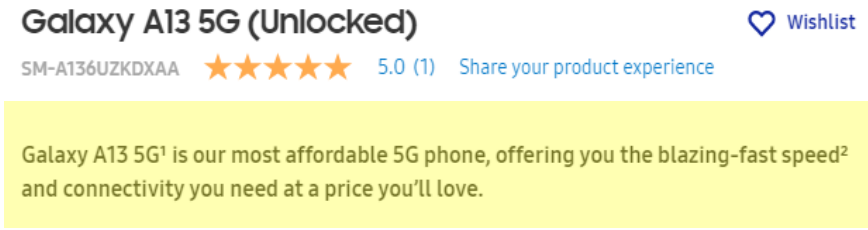
Screenshot showing the scope of standard 3GPP TS 36.212 version 14.13.0 Release 16 supported by the Accused Device (available on page 8 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

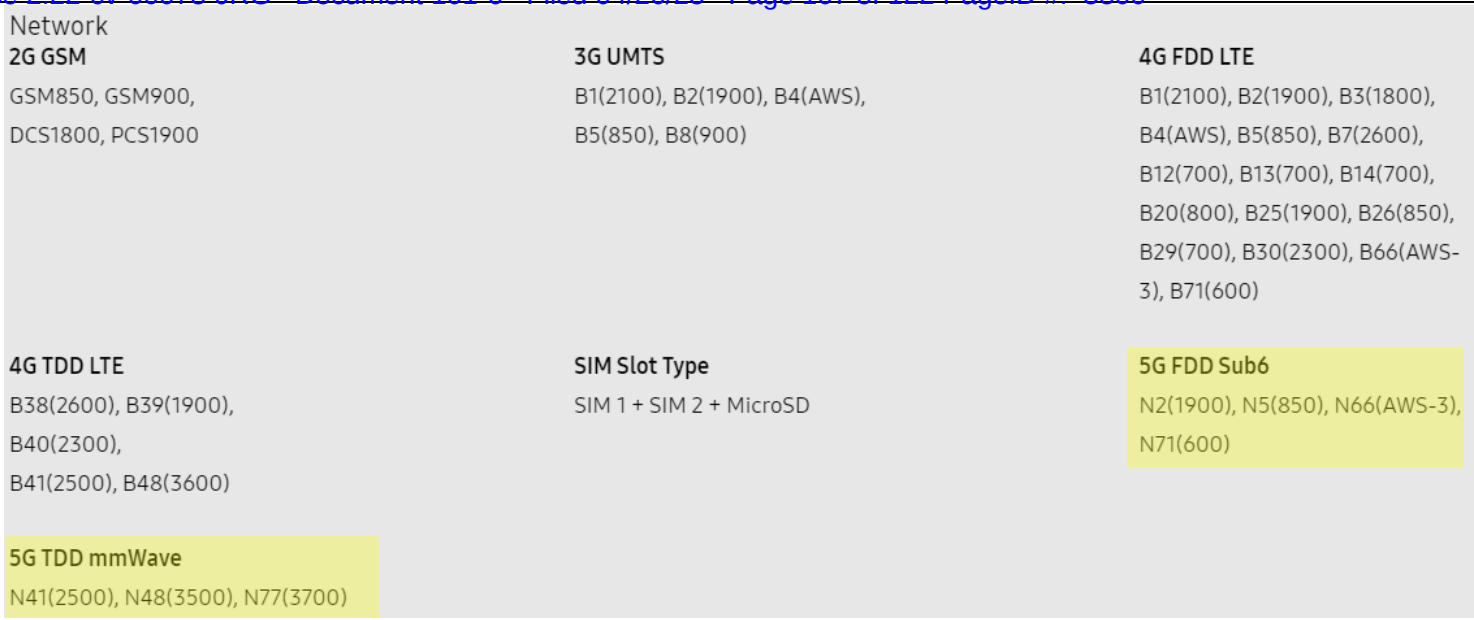
	To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
17a. a receiver configured to receive hybrid automatic repeat request (HARQ) information of M bits transmitted by another node; the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to another node by the node be correctly received by the another node;	The Accused Device is configured to comprise a receiver configured to receive hybrid automatic repeat request (HARQ) information of M bits transmitted by another node; the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to another node by the node be correctly received by the another node. Upon information and belief, the Accused Device is configured to comprise a receiver for receiving 5G communication signals.  Galaxy A13 5G Black Colors Screen size* 6.5" Internal Storage 64GB RAM 4GB Expandable Storage** up to 1TB Cellular & Wireless*** 5G, Sub 6

Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#compare).



Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/smartphones/galaxy-a-series/?modelCode=SM-A136ULGDXAA#models).





Screenshots showing 5G technology standard supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the Accused Device is configured for transmitting N transport blocks of dynamic size to the Node B. The Accused Device also receives HARQ acknowledgement information associated with the PDSCH from the Node B.

Upon information and belief, the HARQ acknowledgement information comprises of Cyclic Redundancy Check (CRC) and transport-block-error indication.

6.2.1 Downlink-Shared Channel

The physical-layer model for Downlink Shared Channel transmission is described based on the corresponding PDSCH or NPDSCH physical-layer-processing chain, see Figure 6.2.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue on the figure.

- **Higher-layer data passed to/from the physical layer**
- N (up to two) transport blocks of dynamic size delivered to the physical layer once every TTI.
- **CRC and transport-block-error indication**
- Transport-block-error indication delivered to higher layers.
- **FEC and rate matching**
- Channel coding rate is implicitly given by the combination of transport block size, modulation scheme and resource assignment;
- Physical layer model support of HARQ: in case of Incremental Redundancy, the corresponding Layer 2 Hybrid-ARQ process controls what redundancy version is to be used for the physical layer transmission for each TTI.

- **Support for Hybrid-ARQ-related signalling**

The model of Figure 6.2.1-1 also captures:

- Transport via physical layer of Hybrid-ARQ related information associated with the PDSCH, to the peer HARQ process at the receiver side;
- Transport via physical layer of corresponding HARQ acknowledgements to PDSCH transmitter side.

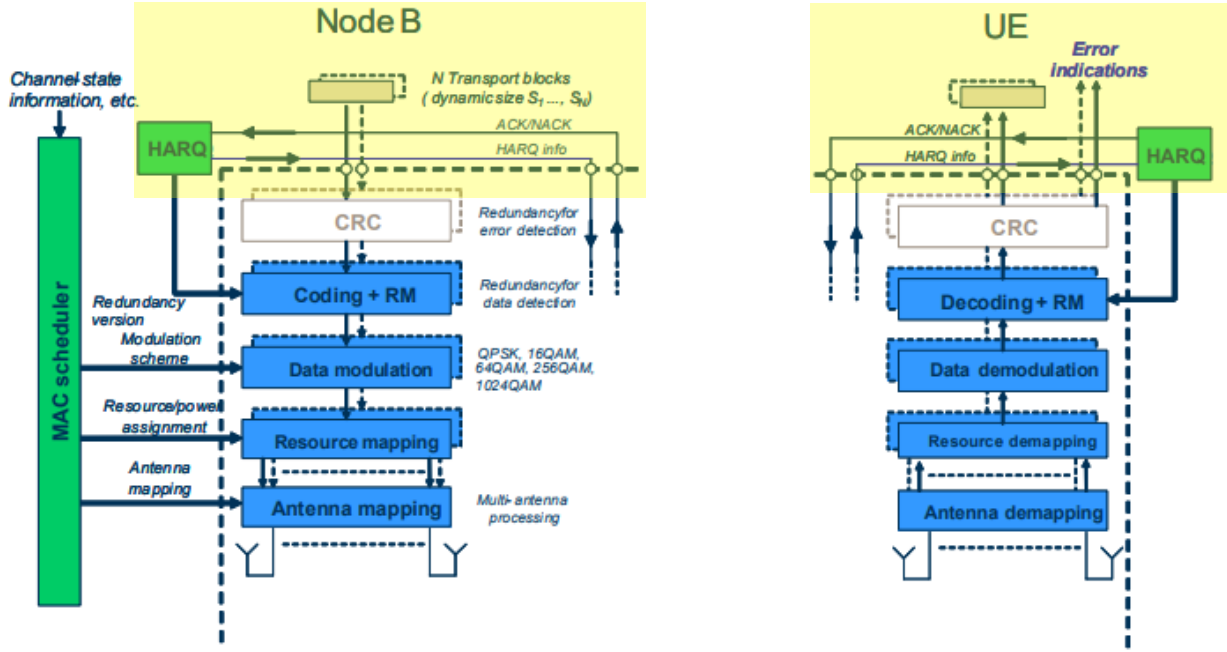


Figure 6.2.1-1: Physical-layer model for DL-SCH transmission

Screenshot showing the HARQ transmission from Node B to the Accused Device configured as the User Equipment (available on pages 12 and 13 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

Upon information and belief, the HARQ-ACK is attached with Cyclic Redundancy Check (CRC) bits for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length.

5.2.2.6 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication, and CSI-RS resource indication (CRI). Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When control data are transmitted in the PUSCH, the channel coding for HARQ-ACK, rank indication (including RI only, joint report of RI/i1, joint report of CRI/RI, joint report of CRI/RI/i1, joint report of CRI/RI/PTI, joint report of RI/i1,p-2, and joint report of RI/PTI), CRI and channel quality information $o_0, o_1, o_2, ..., o_{O-1}$ is done independently. Parameters i1,1-1 , i1,2-1 , i1,1-2 , i1,2-2 , i1,p-2 correspond to parameters $i_{1,1}$, $i_{1,2}$, d_1, d_2, and I_p in clause 7.2.4 of [3].

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 27 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

- If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is o_0^{ACK} $o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
17b. among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;	The Accused Device is so configured that among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M. Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length. - If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \ldots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, \ldots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
17c. a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k;	The Accused Device is so configured that a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k. Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

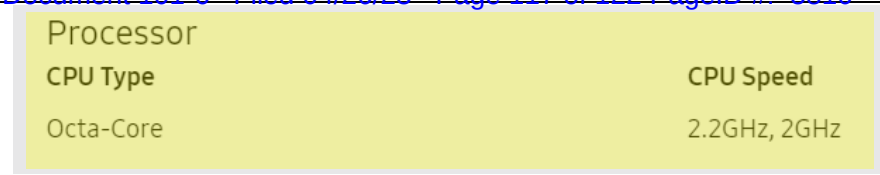
$b_k = a_k$ for $k = 0, 1, 2, ..., A\text{-}1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L\text{-}1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
17d. a processor configured to obtain the M bits of HARQ information through a blind detection and obtain the positions of the k erroneous transmission blocks indicated by the M2 bits if M2=M; wherein the processor is further configured to: obtain M1 bits of the M bits by decoding if M2<M, wherein M1=M−M2, an indication domain of M1 bits of the M bits being used to indicate a value of k or indicate the length type of M2; and determine the M2 bits according to the M1 bits and obtain the positions of the k erroneous transmission blocks indicated by the M2 bits.	The Accused Device is configured to comprise a processor configured to obtain the M bits of HARQ information through a blind detection and obtain the positions of the k erroneous transmission blocks indicated by the M2 bits if M2=M; wherein the processor is further configured to: obtain M1 bits of the M bits by decoding if M2<M, wherein M1=M−M2, an indication domain of M1 bits of the M bits being used to indicate a value of k or indicate the length type of M2; and determine the M2 bits according to the M1 bits and obtain the positions of the k erroneous transmission blocks indicated by the M2 bits. Upon information and belief, the Accused Device comprises an Octa-core processor. 



Screenshots showing the processor supported by the Accused Device (available from https://www.samsung.com/us/mobile/phones/galaxy-a/galaxy-a13-5g-unlocked-sm-a136uzkdxaa/).

Upon information and belief, the CRC bits attached to the HARQ-ACK information being used for transport-block-error indication. The total number of bits generated after CRC attachment is denoted as $B = A + L$, where L denotes the CRC length, $L < B$.

Upon information and belief, for HARQ-ACK, the input bits sequence of the transport block (of length A) provides an indication of the length L of the CRC attachment. The CRC bits are predefined to be of length 8 bits for HARQ-ACK.

The Accused Device configured as the UE decodes the HARQ with CRC attachment to obtain the positions of the erroneous transmission blocks.

NOTE: The signalling of transport-format and resource-allocation is not captured in the physical-layer model. At the transmitter side, this information can be directly derived from the configuration of the physical layer. The physical layer then transports this information over the radio interface to its peer physical layer, presumably multiplexed in one way or another with the HARQ-related information. On the receiver side, this information is, in contrast to the HARQ-related information, used directly within the physical layer for PDSCH demodulation, decoding etc., without passing through higher layers.

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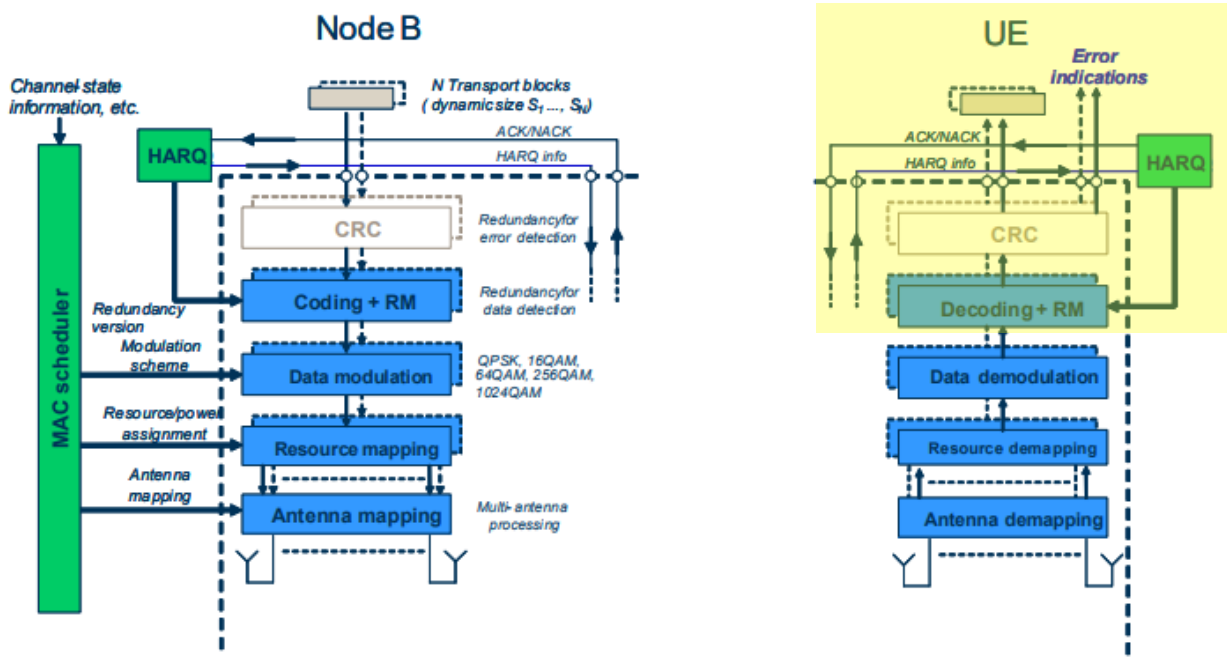


Figure 6.2.1-1: Physical-layer model for DL-SCH transmission

Screenshot showing the HARQ transmission from Node B to the Accused Device configured as the User Equipment (available on pages 12 and 13 from https://www.etsi.org/deliver/etsi_ts/136300_136399/136302/16.01.00_60/ts_136302v160100p.pdf).

- If HARQ-ACK feedback consists of O^{ACK}>22 bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from

	https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf). To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. The precise manner in which the received HARQ-ACK information from the Node B is decoded by the Accused Device configured as the User Equipment to obtain M1 bits which is used to indicate the length type of the CRC bits is not publicly available. This is a software limitation and the software of the Accused System is not publicly available. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).
10,594,443 Claim 18	**Evidence**
18. The node according to claim 17, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the node; or configured by a downlink control information (DCI) signaling transmitted by the node; or determined by the another node; or predefined; or determined by the another node based on k.	Every claim limitation of claim 17 is present in the Accused Device as described above and incorporated herein by reference. Upon information and belief, the Accused Device is configured wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the node; or configured by a downlink control information (DCI) signaling transmitted by the node; or determined by the another node; or predefined; or determined by the another node based on k. Upon information and belief, the CRC attachment to the HARQ-ACK bits is performed by setting the length of CRC bits L to predefined 8 bits. - If HARQ-ACK feedback consists of $O^{ACK}>22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, ..., q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to clauses 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}\ o_1^{ACK}, ..., o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation. Screenshot showing the HARQ-ACK feedback transmission from Node B to the Accused Device (available on page 31 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

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5.1.1 CRC calculation

Denote the input bits to the CRC computation by $a_0, a_1, a_2, a_3, ..., a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, ..., p_{L-1}$. A is the size of the input sequence and L is the number of parity bits. The parity bits are generated by one of the following cyclic generator polynomials:

- $g_{CRC24A}(D) = [D^{24} + D^{23} + D^{18} + D^{17} + D^{14} + D^{11} + D^{10} + D^7 + D^6 + D^5 + D^4 + D^3 + D + 1]$ and;
- $g_{CRC24B}(D) = [D^{24} + D^{23} + D^6 + D^5 + D + 1]$ for a CRC length $L = 24$ and;
- $g_{CRC16}(D) = [D^{16} + D^{12} + D^5 + 1]$ for a CRC length $L = 16$.
- $g_{CRC8}(D) = [D^8 + D^7 + D^4 + D^3 + D + 1]$ for a CRC length of $L = 8$.

The encoding is performed in a systematic form, which means that in GF(2), the polynomial:

$$a_0 D^{A+23} + a_1 D^{A+22} + ... + a_{A-1} D^{24} + p_0 D^{23} + p_1 D^{22} + ... + p_{22} D^1 + p_{23}$$

yields a remainder equal to 0 when divided by the corresponding length-24 CRC generator polynomial, $g_{CRC24A}(D)$ or $g_{CRC24B}(D)$, the polynomial:

$$a_0 D^{A+15} + a_1 D^{A+14} + ... + a_{A-1} D^{16} + p_0 D^{15} + p_1 D^{14} + ... + p_{14} D^1 + p_{15}$$

yields a remainder equal to 0 when divided by $g_{CRC16}(D)$, and the polynomial:

$$a_0 D^{A+7} + a_1 D^{A+6} + ... + a_{A-1} D^8 + p_0 D^7 + p_1 D^6 + ... + p_6 D^1 + p_7$$

yields a remainder equal to 0 when divided by $g_{CRC8}(D)$.

The bits after CRC attachment are denoted by $b_0, b_1, b_2, b_3, ..., b_{B-1}$, where $B = A + L$. The relation between a_k and b_k is:

$b_k = a_k$ for $k = 0, 1, 2, ..., A-1$

$b_k = p_{k-A}$ for $k = A, A+1, A+2, ..., A+L-1$.

Screenshot showing CRC calculation (available on page 11 from https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/14.13.00_60/ts_136212v141300p.pdf).

To the extent that this step is not literally present in the Accused Device, the Accused Device would nevertheless infringe under the doctrine

	of equivalents, because the Accused Device performs a step that is, if not literally the step recited in the claim, then equivalent to it. Plaintiff reserves the right to supplement these infringement contentions once it has been afforded the opportunity to review and inspect the internal hardware (e.g., data processors and other internal components), and software (e.g., software and firmware).

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EXHIBIT 7

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

G+ COMMUNICATIONS, LLC,
Patent Owner.

Case IPR2022-01598
Patent 10,594,443

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3. [1.c] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and" as required by Claim 1 and the respective dependent claims (Claims 2 and 6) of the '443 Patent 24

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5. [8.c] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k;" 31

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3. [10.f] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and" 32

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EXHIBIT LIST

Currently Filed – Patent Owner

Ex. No.	Description
2001	Declaration of Dr. Robert Akl, D.Sci.
2002	File History of the '443 Patent (Full Version)
2003	Memorandum Opinion and Order (Dkt. 41)
2004	Exhibit E1, Petitioner's Aug. 30, 2022, Invalidity Contentions

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CLAIM LISTING

Independent Claim 1	
1.Pre	A method for transmitting hybrid automatic repeat request (HARQ) information, comprising:
1.a	detecting, by a first node, N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result;
1.b	the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, $M2 \leq M$;
1.c	a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and
1.d	transmitting, by the first node, the HARQ information to the second node.

Dependent Claims 2 and 6	
2	The method according to claim 1, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k.
6	The method according to claim 1, wherein if $M2<M$, then an indication domain of M1 bits of the M bits is used to indicate a value of k or indicate the length type of M2, wherein $M1=M-M2$.

Independent Claim 8	
8.Pre	A method for receiving hybrid automatic repeat request (HARQ) information, comprising:
8.a	receiving, by a second node, M bits of HARQ information transmitted by a first node;

8.b	the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;
8.c	a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k;
8.d	if M2=M, then, obtaining, by the second node, the M bits of HARQ information through a blind detection and obtaining the positions of the k erroneous transmission blocks indicated by the M2 bits; and if M2<M, then, obtaining, by the second node, M1 bits of the M bits through decoding, M1=M−M2, an indication domain of the M1 bits of the M bits being used to indicate a value of k or indicate the length type of M2; determining M2 bits according to the M1 bits and obtaining the positions of the k erroneous transmission blocks indicated by the M2 bits.

Dependent Claim 9	
9	The method according to claim 8, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the second node; or configured by a downlink control information (DCI) signaling transmitted by the second node; or determined by the first node; or predefined; or determined by the first node based on k.

Independent Claim 10	
10.Pre	A node, comprising:
10.a	at least one processor; and
10.b	a memory communicably connected with the at least one processor and configured for storing computer-executable instructions executable by the at least one processor;
10.c	wherein the computer-executable instructions when executed by the at least one processor causes the at least one processor to perform;

10.d	detecting N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result;
10.e	the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks; among the M bits, M2 bits bring used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;
10.f	a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and
10.g	transmitting the HARQ information to the second node.

Dependent Claims 11 and 15	
11	The node according to claim 10, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the another node; or configured by a downlink control information (DCI) signaling transmitted by the another node; or determined by the node; or predefined; or determined by the node based on k.
15	The node according to claim 10, wherein if M2<M, then an indication domain of M1 bits of the M bits is used to indicate a value of k or indicate the length type of M2, wherein M1=M−M2.

Independent Claim 17	
17.Pre	A node, comprising:
17.a	a receiver configured to receive hybrid automatic repeat request (HARQ) information of M bits transmitted by another node;
17.b	the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to another node by the node be correctly received by the another node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;
17.c	a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined,

	and the second length type indicating a value of M2 being determined based on k;
17.d	a processor configured to obtain the M bits of HARQ information through a blind detection and obtain the positions of the k erroneous transmission blocks indicated by the M2 bits if M2=M;
17.e	wherein the processor is further configured to: obtain M1 bits of the M bits by decoding if M2<M, wherein M1=M−M2, an indication domain of M1 bits of the M bits being used to indicate a value of k or indicate the length type of M2; and determine the M2 bits according to the M1 bits and obtain the positions of the k erroneous transmission blocks indicated by the M2 bits.

Dependent Claim 18	
18	The node according to claim 17, wherein the length type of M2 is configured by a radio resource control (RRC) signaling transmitted by the node; or configured by a downlink control information (DCI) signaling transmitted by the node; or determined by the another node; or predefined; or determined by the another node based on k.

I. INTRODUCTION

G+ Communications, LLC, the owner of U.S. Patent No. 10,594,443 ("the '443 Patent"), submits this Preliminary Response to the Petition of Samsung Electronics Co., Ltd. ("Samsung" or "Petitioner") challenging the validity of claims 1-2, 6, 8-11, 15, 17, and 18 the '443 Patent ("Challenged Claims"). The Board should deny the Petition based on the merits and/or for discretionary reasons under either 35 U.S.C. §§ 314 or 325(d).

The Board should deny the Petition based on the merits because Petitioner has not established a reasonable likelihood that it will prevail on Ground 1 as presented in the Petition. In particular, Petitioner failed to meet its burden to show that U.S. Publication No. 2016/0233999 ("Kannan") (the sole anticipatory reference) teaches (either expressly or inherently) the following exemplary limitations:

- [1.a], [1.b], [8.b], [10.d], [10.e], [17.b]: "N transmission blocks";
- [1.b], [8.b], [10.e], [17.b]: "M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M"; and/or
- [1.c], [8.c], [10.f], [17.c]: "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k."

Alternatively, the Board should exercise its discretion and deny institution under 35 U.S.C. § 325(d) "because, the same or substantially the same prior art or arguments previously were presented to the Office," and Petitioner has not explained

how the Examiner erred in determining the patentability of the Challenged Claims. Petitioner further fails to address all the factors that are considered in determining whether to deny a petition under § 325(d), and any attempt to cure this deficiency is too late. In particular, the Examiner already considered International Pub. No. WO 2016/126653 (the "Kannan Pub"), which is cited on the face of the '443 Patent and included in its entirety in the '443 Patent's file history. Kannan cannot be meaningfully distinguished from the Kannan Pub in the context of the Challenged Claims. Indeed, both the Kannan Pub and Kannan include the same disclosures that Petitioner relies upon in its Petition.

Moreover, proceeding here is a poor use of the Board's resources. Petitioner asserted Kannan in co-pending litigation, and a Texas jury will consider invalidity of the '443 Patent before the Board is expected to render a final written decision here. This is true regardless of whether the calendared jury selection date or the median time-to-trial statistics are considered. Moreover, the co-pending litigation presents overlapping issues, and the parties and the district court have already expended (and will continue to expend) significant time and resources by the time the Board is expected to issue a decision on institution. Petitioner's purported stipulation that it "will not pursue the IPR grounds in the district court litigation" falls short of the type of stipulation—that it will not pursue "any grounds that could have reasonably been raised in the petition"—necessary to mitigate concerns of

potentially conflicting decisions and duplication of efforts. The Board should thus exercise its discretion to deny institution under 35 U.S.C § 314.

For these reasons, Patent Owner respectfully submits that this Petition does not warrant institution.

II. THE '443 PATENT PRESENTS A NOVEL SYSTEM AND METHOD FOR RECEIVING AND TRANSMITTING HARQ INFORMATION

The '443 Patent, entitled "Transmitting Method, Receiving Method and Nodes for HARQ Information," was filed as national stage application No. 15/749,354 on January 31, 2018, from PCT No. PCT/CN2016/089196, which was filed on July 7, 2017. Ex. 1001, p. 1. The '443 Patent issued on March 17, 2020, and claims priority to Chinese Patent Application 201510466184.5, filed on July 31, 2015. Ex. 1001, p. 1, 1:8-12. The '443 Patent is directed to a method and node for transmitting and receiving hybrid automatic repeat request (HARQ) information. *Id*., Abstract.

The '443 Patent identifies several drawbacks associated with prior art methods directed to reducing overhead and increasing throughput associated with transmitting and receiving HARQ. *Id*., 2:27-45. In general, to "improve a peak rate and also an experience of a user," a terminal node (i.e., "node 1") receives data transmitted by a base station node (i.e., "node 2"), detects whether a transmission block on every carrier wave/progress is correct or not (a receiving status), and feeds

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back either acknowledgement (ACK) or negative acknowledgement (NACK) information to the sending node (i.e., node 2). *Id*., 1:24-34.

In a long-time evolution (LTE) system of a third-generation partnership project (3GPP), HARQ information is sent by the terminal (node 1) based on the number of carrier wave(s) configured on a base station (node 2) and the transmission mode of each of the carrier wave(s). *Id*., 1:35-39. Each carrier wave utilizing spatial multiplexing transmission mode has two transmission blocks and thus "needs to feed back 2 bits of HARQ information; otherwise, each of the carrier wave(s) needs to feed back 1 bit of HARQ information (every carrier wave has 1 transmission block)." *Id*., 1:39-45. For example, 10 bits of HARQ information needs to be fed back over one uplink subframe if "the network provides the terminal with 5 carrier waves and the transmission mode of each of the carrier waves is in the spatial multiplexing mode." *Id*., 1:45-50. When the carrier wave is in a time division duplexing (TDD) mode or a frequency division duplexing (FDD) mode, the number of HARQ bits needed would be even greater. *Id*., 1:51-2:11.

To reduce the overhead of control signaling (e.g., HARQ bits) and power consumption, prior art technologies could adopt "a solution of binding the HARQ information of a plurality of transmission blocks in the same, predefined time domain or spatial domain" of a same carrier wave. *Id*., 2:12-22. This way, if both of the two transmission blocks "are detected as being correct," the terminal node (i.e.,

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node 1) would feed back 1 bit of ACK; otherwise, the terminal node would feed back 1 bit of NACK. *Id*., 2:19-26.

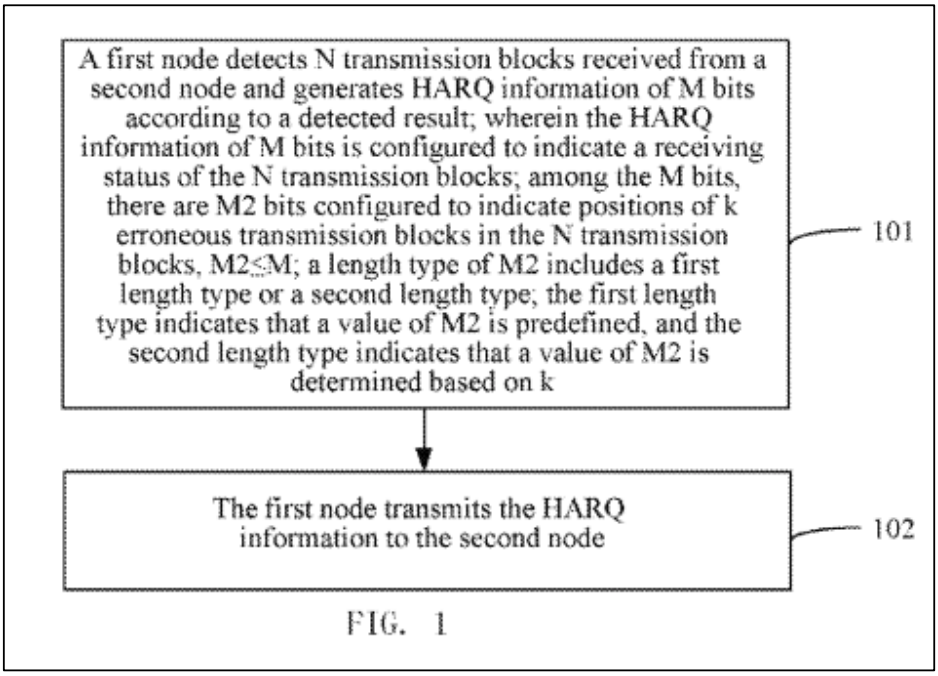
Using this technique had several drawbacks, however. For example, the base station node (node 2) would need to re-transmit both transmission blocks when it received a NACK feedback bit because it "cannot determine which of the transmission blocks is erroneous according to the HARQ information fed back by the node 1." *Id*., 2:27-33. Moreover, "an information channel experienced by the bound transmission blocks is required to have relatively stronger correlation, but information channels on different carrier waves usually are independent from each other." *Id*., 2:35-39.

The solution presented by the '443 Patent solves the aforementioned problems. In particular, the '443 Patent "provides a method for receiving HARQ information and a node, which does not require strong correlation for the channel, and can conserve transmission resources and improve system throughput while reducing the HARQ information feedback overhead." *Id*., 2:53-58.

To accomplish this, the '443 Patent discloses an embodiment in which "[a] first node detects N transmission blocks received from a second node." *Id*., 2:62-63. The first node "generat[es] M bits of HARQ information according to a detection result." *Id*., 2:63-64. The "M bits of HARQ information are used to indicate a receiving status of the N transmission blocks." *Id*., 2:64-66. "[A]mong the M bits,

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there are M2 bits used to indicate positions of k erroneous transmission blocks in the N transmission blocks" (i.e., M2≤M. "[A] length type of M2 includes a first length type or a second length type." *Id*., 2:66-3:1. "[The first length type indicates that a value of M2 is predefined, and the second length type indicates that a value of M2 is determined based on k." *Id*., 3:1-5. The first node then transmits the HARQ information to the second node. *Id*., 3:6-7. Figure 1 is a flow chart illustrating this embodiment:



Id., Fig. 1.

The '443 Patent teaches that the length type of M2 may be: "configured by a radio resource control (RRC) signaling transmitted by the second node; configured by a downlink control information (DCI) signaling transmitted by the second node;

determined by the first node; predefined; and determined by the first node based on k." *Id*., 6:45-50. For example, when the number of erroneous transmission blocks in the N transmission blocks (k) is ≤ a first threshold (kT1) and ≥ a second threshold (kT2), the length type of M2 is the second length type (i.e., the value of M2 is determined based on k); otherwise, the length type of M2 is the first length type (i.e., the value of M2 is predefined). *Id*., 6:51-55.

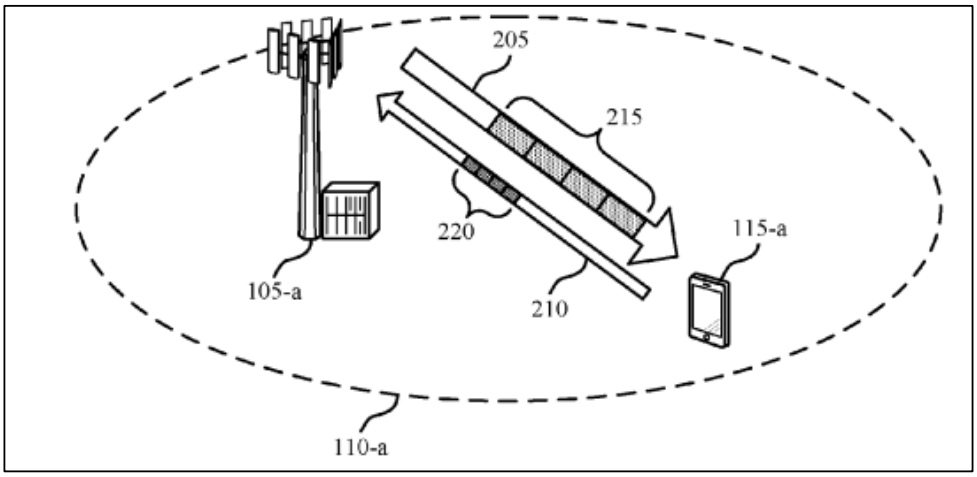
III. OVERVIEW OF KANNAN (EX. 1006)

Kannan, entitled "Efficient ACK/NACK Transmission," was filed as Application No. 15/012,560 on February 1, 2016, and published on August 11, 2016. Ex. 1006 at 1. Kannan purports to claim priority to U.S. Provisional Application No. 62/112,310 (the "'310 Provisional"), filed on February 5, 2015.[1]

[1] As discussed *infra*, International Pub. No. WO 2016/126653 A1 to Kannan ("Kannan WO"), which is cited on the face of the '443 Patent and included in the '443 File History along with a nine-page European Extended Supplementary Search Report dated June 25, 2018 received in European Patent Application No. 16 83 2167.7, also claims priority to U.S. Provisional Application No. 62/112,310 and cannot be meaningfully distinguished from the teachings of Kannan upon which Petitioner relies. Just like the '443 Patent, European Patent Application No. 16 83 2167.7 is based on PCT No. PCT/CN2016/089196.

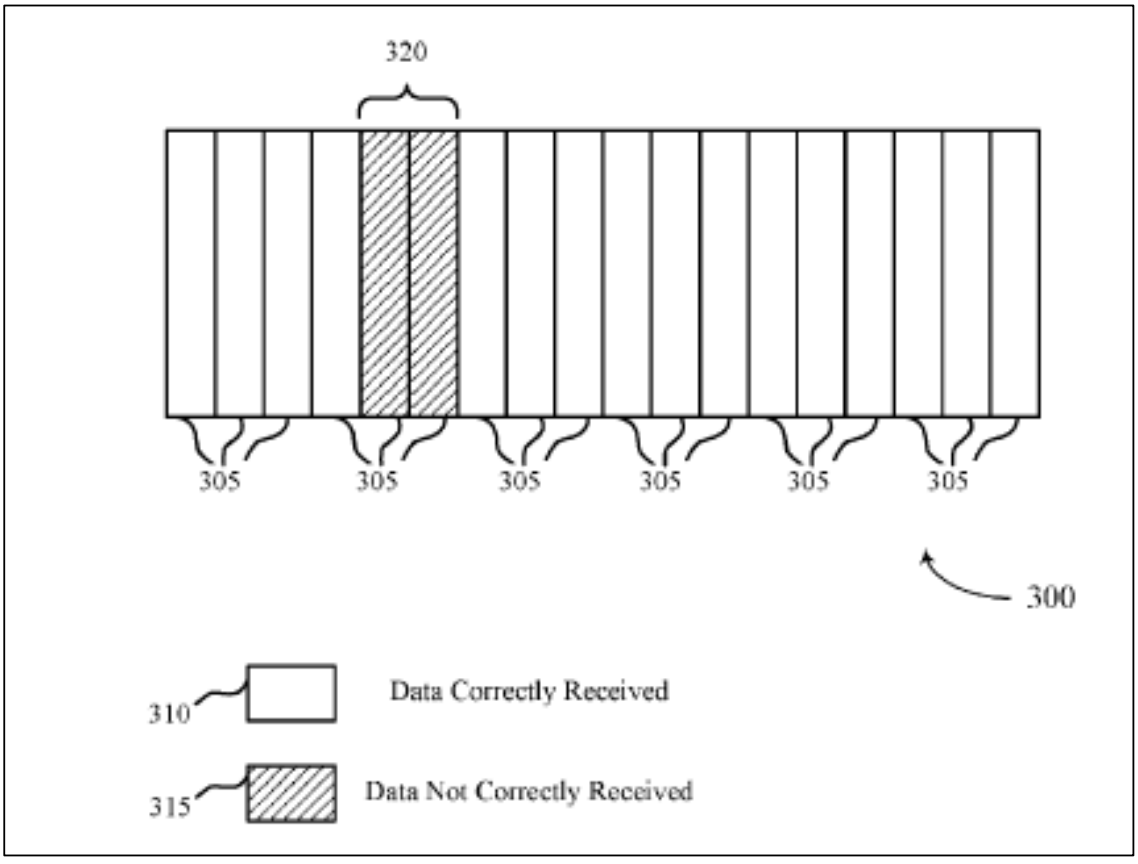
Kannan discloses a method for providing an ACK/NACK response for wireless devices that exchange data using Medium Access Control (MAC) layer units known as transport blocks that may include a number of code blocks (CBs). Ex. 1006, Abstract. According to Kannan, "[a] receiving device may attempt to decode each CB and send acknowledgement (ACK) and negative-acknowledgment (NACK) feedback to the transmitting device based on the [sic] whether each CB was successfully decoded." *Id*. Kannan explains that providing ACK/NACK feedback at the CB level "may be useful for implementations in which channel interference may occur in relatively short bursts that may last only a fraction of the length of a transport block." *Id*., [0052]. Such an implementation may "enhance channel efficiency" because it permits "[r]etransmissions of only the affected CBs, rather than retransmission of the entire transport block." *Id*.

Figure 2 illustrates an example of a wireless communications system 200 for CB level HARQ that may include UE 115-a and base station 105-a:



Id., [0079], Fig. 2. Base station 105-a may transmit data to UE 115-a in a transport block 215, which may be part of downlink 205, and UE 115-a may communicate with base station 105-a via uplink (e.g., uplink 210). *Id*., [0079]. For example, UE 115-a may indicate the status for portions of transport block 215 via acknowledgments (ACKs) and negative acknowledgments (NACKs) (e.g., ACK/NACKs 220). *Id*.

Figure 3 (below) illustrates an example of a transport block **300** for CB level HARQ:



Id., [0084], Fig. 3. Transport block **300** "may include a number of code blocks **305**, that may be evaluated for successful reception by a receiver, such as a UE **115**." *Id*., [0084]. According to Kannan, Figure 3 illustrates "a number of CBs **305** [that] include correctly received data **310**, as well as two CBs **305** that include incorrectly received data **315** (e.g., the data of the CB failed CRC)." *Id*.

The ACK/NACKs associated with CBs 305 may be transmitted according to either a compressed format or an uncompressed format. *Id*., [0085]. For example, Figure 4A illustrates an example of an ACK/NACK format **400** for CB level HARQ that includes "a number of ACK bits **405** and NACK bits **410**, the total number of which correspond to a number of CBs":

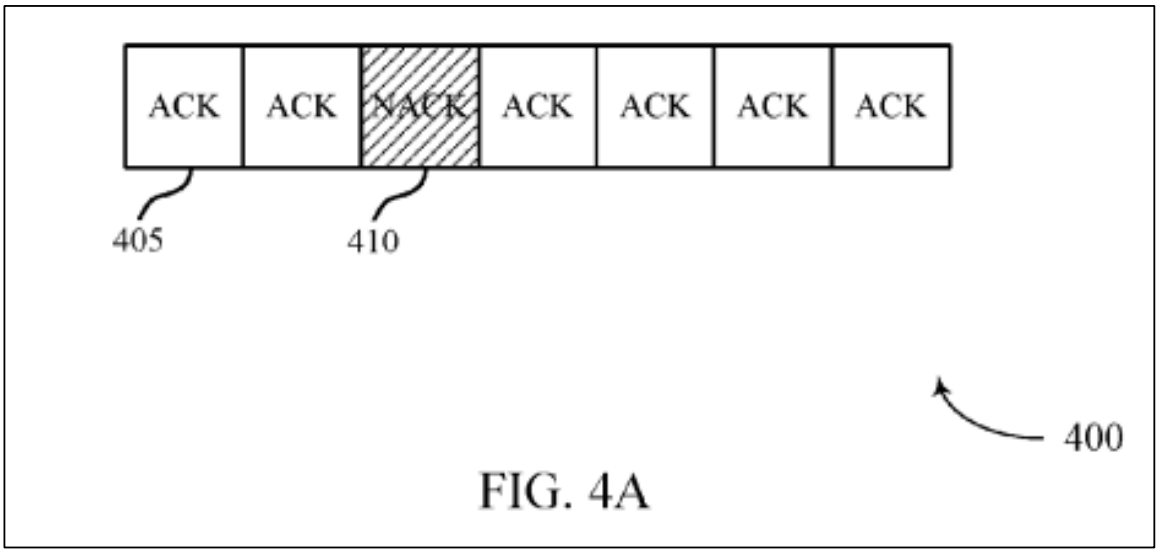


FIG. 4A

Id., [0087], Fig. 4A. "Thus, ACK/NACK format **400** provide a bitmap indicating which CBs are received properly or improperly." *Id*., [0087]. "A determination to use ACK/NACK format **400** may be dynamically performed by a UE based on the

number of CBs and available uplink resources, or may be signaled by a base station (e.g., through RRC signaling)." *Id*.

Figure 4B illustrates an example of a compressed format for transmitting ACK/NACKs from a UE 115 to a base station 105, as described with reference to Figure 2:

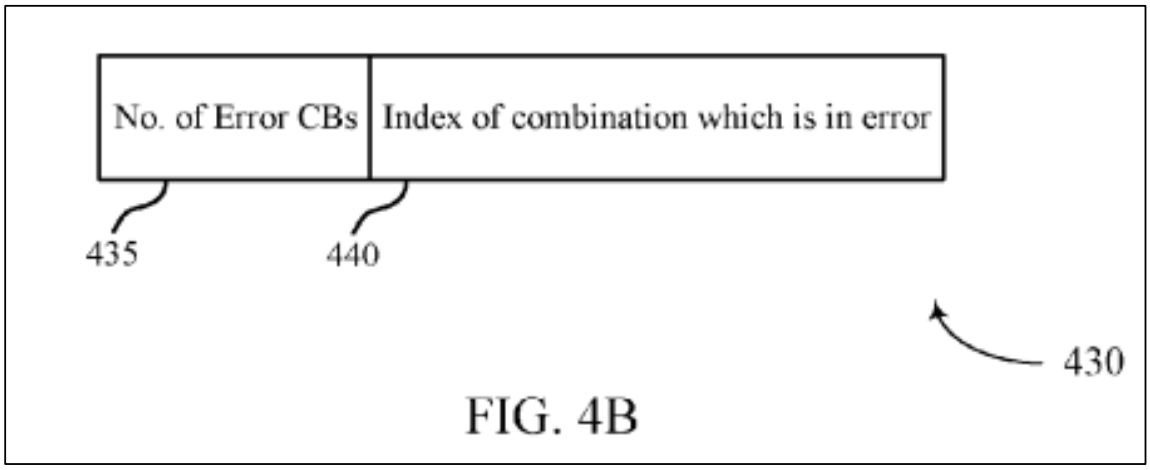


FIG. 4B

Id., [0088], Fig. 4B. "ACK/NACK format 430 may include one or more dedicated bits 435 that indicate a number of CBs that are in error, and a set of bits 440 that provide an index identifying a combination of CBs that are in error, and thus have NACK feedback." *Id*., [0088]. Significantly, the index may be "for example, an index into a lookup table that provides a bitmap of ACK/NACKs for the number of CBs indicated in the set of bits." *Id*. Kannan explains that "ACK/NACK format 430 may be identified for transmitting ACK/NACK feedback based on the number of transmitted CBs (referred to as 'N'), a number of errors (referred to as k′) in the

transmitted CBs, and a predefined threshold of errors (referred to as K*′).” *Id*., [0089].

ACK/NACK format **450** “may be used to indicate bundles of CBs that are in error, and may include one or more dedicated bits **455** that indicate a number of CBs per bundle of CBs, a set of bits that indicate the number of bundles in error **460**, and an index **465** indicating a combination of bundles of CBs that are in error (and thus have NACK feedback):

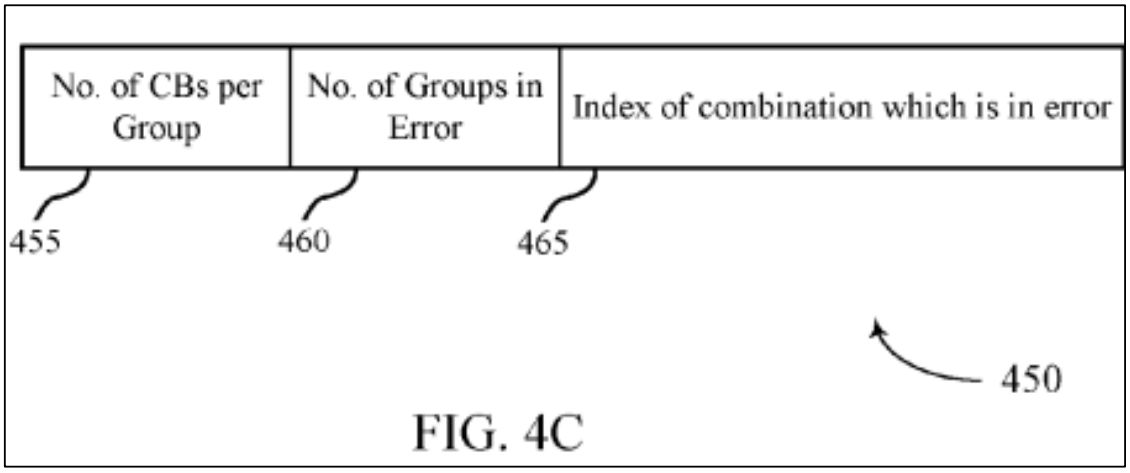


FIG. 4C

Id., [0090], Fig. 4C. As with format 430, “[t]he index may be, for example, an index into a lookup table that provides a bitmap of ACK/NACK bundles for the number of bundles indicated in the set of bits.” *Id*., [0090]. “ACK/NACK format **450** may be identified for transmitting ACK/NACK feedback when the number of CBs in error exceed a threshold, or if a relatively large number of consecutive CBs are in error.” *Id*.

IV. STANDARDS

A. Institution of an IPR

Under 35 U.S.C. § 314(a), Petitioner carries the burden of showing a reasonable likelihood that it would prevail with respect to at least one of the claims challenged in the Petition. Petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1375-77 (Fed. Cir. 2016).

A Petition cannot support institution unless it "identifies, in writing and with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim." 35 U.S.C. § 312(a)(3). The Petition must explain "[h]ow the construed claim is unpatentable" and "must specify where each element of the claim is found in the prior art patents or printed publications relied upon." 37 C.F.R. § 42.104(b)(4); *Google Inc. v. EveryMD.com LLC*, IPR2014-00347, Paper 9, at *9 (PTAB May 22, 2014). "The Board may exclude or give no weight to the evidence where a party has failed to state its relevance or to identify specific portions of the evidence that support the challenge." 37 C.F.R. § 42.104(b)(5).

B. Petitions Based on Anticipation

A petition based on anticipation (such as the instant one), which is the sole ground raised by Petitioner, requires a showing that "each and every element as set

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forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros., Inc. v. Union Oil Co*., 814 F.2d 628, 631 (Fed. Cir. 1987). "If the prior art reference does not expressly set forth a particular element of the claim, that reference still may anticipate if that element is 'inherent' in its disclosure." *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.'" *Id*. (quoting *Continental Can Co. v. Monsanto Co*., 948 F.2d 1264, 1268 (Fed. Cir. 1991)). "Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *Continental Can,* 948 F.2d at 1269 (quotation omitted).

C. Claim Construction

In an *inter partes* review filed on or after November 13, 2018, claim terms are construed based on their ordinary and customary meaning. 37 C.F.R. § 42.100(b). Further, the Board should always construe claims to sustain their validity, if possible. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1329 (Fed. Cir. 2005). The specification is the "best source for understanding a technical term," to be supplemented, "as needed, by the prosecution history." *Id*., at 1315. For purposes of this paper, for all claim terms, Patent Owner requests that the Board adopt the ordinary and customary

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meaning of the claim terms as understood by one of ordinary skill in the art. If trial is instituted, however, and to the extent deemed necessary to resolve any dispute, Patent Owner reserves the right to propose more specific constructions of one or more claim terms.

V. LEVEL OF ORDINARY SKILL IN THE ART

Factors that may be considered in determining the level of a person of ordinary skill in the art ("POSITA") include: (1) the type of problems encountered in the art; (2) prior art solutions to those problems; (3) rapidity with which innovations are made; (4) sophistication of the technology; and (5) educational level of active workers in the field. *In re GPAC*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citation omitted). Petitioner defines a POSITA as having "an undergraduate degree in electrical engineering, computer engineering, computer science or a related field along with at least two years of work experience in the field of wireless communication technology," but "[m]ore education can supplement practical experience and vice versa." Pet. at 4-5.

Because the proposed level of ordinary skill does not affect the ultimate analysis, Patent Owner takes no position with respect to Petitioner's proposed level of ordinary skill in the art.

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VI. PETITIONER'S PROPOSED ANTICIPATION CHALLENGE

Ground	'443 Patent Claims	Type	Reference
1	1-2, 6, 8-11, 15, 17, 18	§ 102	Kannan

Petitioner asserts that Claims 1, 2, 6, 8-11, 15, 17, and 18 are unpatentable under 35 U.S.C. § 102(a) as anticipated by Kannan (U.S. Pat. Pub. No. 2016/0233999) (Ex. 1006).

VII. GROUND 1: PETITIONER HAS FAILED TO SHOW THAT KANNAN ANTICIPATES INDEPENDEDNT CLAIMS 1, 8, 10, AND 17 (AND DEPENDENT CLAIMS 2, 6, 9, 11, 15, AND 18)

Ground 1 exclusively asserts anticipation based on the Kannan reference. Pet. at 2. Petitioner has not shown that "each and every element as set forth in the [Challenged Claims] is found, either expressly or inherently described, in [Kannan]." *Verdegaal Bros.*, 814 F.2d at 631. This Ground will not succeed on the merits because Kannan fails to teach multiple limitations in the independent Challenged Claims. For example, Petitioner's lack of evidence to support either of its "alternative" theories for limitation [1.a] (i.e., whether Kannan's "code block" or its "transport block" is the alleged "N transmission blocks" recited in the claims) merely exemplifies that Petitioner has not met its burden to show that Kannan anticipates each of the Challenged Claims.

As set forth below, Petitioner has not shown a reasonable likelihood that it

would prevail with respect to at least one of the Challenged Claims. The Board thus should not institute review.

A. [Claim 1] Petitioner Failed to Meet Its Burden to Show That Kannan Anticipates Independent Claim 1 and the Respective Dependent Claims (Claims 2 and 6).

1. [a] Kannan does not disclose "detecting, by a first node, N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result"

Petitioner argues that Kannan teaches the "N transmission blocks" element in the Challenged Claims based on Kannan's disclosure of "code blocks." Pet. at 16-17 (citing Ex. 1006, [0079]-[0081]).[2] Kannan makes no mention of "transmission

[2] Petitioner also cites to the '310 Provisional in an attempt to support the disclosures upon which it relies for each of the Challenged Claim limitations and apparently to establish Kannan's priority date. For example, Petitioner cites to [0073]-[0075] in the '310 Provisional to support its contention that Kannan purportedly discloses "a UE 115 (a first node) receives a plurality of code blocks (N transmissions blocks) sent from a base station 105 (second node) and generates ACK/NACK feedback (M bits of HARQ information) based on a detection result." Pet. at 17. As discussed *infra* in Section VIII, and because it also purports to claim priority to the '310 Provisional, the Kannan Pub discloses this and all the other limitations upon which Petitioner relies. *See, e.g.*, Ex. Ex. 1011, [0077]-[0079].

blocks" and instead, refers only to "transport blocks" and "code blocks." *See generally* Ex. 1006; *see also* Ex. 2001, Akl Decl., ¶ 44.

The sole support for Petitioner's contention that Kannan's "code block" is the same as the "N transmission blocks" recited in the Challenged Claims is a conclusory statement that "[a] person of ordinary skill in the art would have understood that a code block is a 'transmission block'" because "there is no definition or description of what constitutes a 'transmission block' in the '443 patent." Pet. at 18. Petitioner's expert merely parrots the Petition's conclusory statements verbatim, providing no substance or rational underpinning of his own or any objective supporting evidence to show this claim element, and thus his testimony in support of the Petition's apparent "inherency" argument should be discarded. Ex. 1003, ¶ 42; *see also Int'l v. Usa*, No. IPR2016-01875, 2018 WL 1582299, at *9 (P.T.A.B. Mar. 27, 2018) (stating that expert testimony that "merely parrots" the petition's attorney argument "without citing a single piece of objective evidence" is "unpersuasive as unsupported"); 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

At best, Petitioner's conclusory argument suggests that a "code block" could *possibly* be a "transmission block," but nothing in the record establishes that it is one. Mere possibilities, however, are insufficient as a matter of law to show that a

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reference anticipates a claim. *See In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) ("Inherency . . . may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient."). Petitioner's lack of evidence on this issue is fatal to the Petition because "N transmission blocks" appears in each of the independent Challenged Claims.

Petitioner argues in the alternative that Kannan's disclosure of a "transport block" meets the "transmission block" limitation in the Challenged Claims because Kannan indicates that "the transport block may be represented by one CB." Pet. at 1 (citing Ex. 1006, ¶ 64). While a POSITA might understand the terms "transport block" and "transmission block" to be synonymous in certain contexts, a POSITA would not understand Kannan's disclosure of a "transport block" to be the "transmission block" recited in the Challenged Claims.[3] *See* Ex. 2001, Akl Decl., ¶ 45-46. Nor has Petitioner presented evidence that the terms are interchangeable.

In particular, nothing in Kannan teaches, nor has Petitioner shown, that Kannan teaches "detecting, by a first node, N transmission blocks received from a second node" as required by the Challenged Claims. *See* Ex. 2001, Akl Decl., ¶ 47.

[3] The Examiner appeared to consider a "transmission block" to be equivalent to a "transport block" in the context of his analysis of a specific prior art reference. Ex. 2002 at 385.

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The stated purpose of Kannan is to implement code-block (CB) level HARQ in order to limit or preclude retransmission of the entire transport block. *See* Ex. 1006, [0007]. Petitioner's "transport block," which contains a single code block, would not meet this objective because the entire transport block would need to be retransmitted if its transmission results in negative-acknowledgement (NACK) feedback. *See* Ex. 2001, Akl Decl., ¶ 48. Moreover, Kannan's technique works on CB-level related to a single transport block and thus is silent as to processing multiple transport blocks (i.e., "N transmission blocks"). *See* Ex. 2001, Akl Decl., ¶ 49.

Indeed, there would be no meaningful benefit in implementing Kannan's CB-level HARQ technique on a transport block that has only a single CB. *See* Ex. 2001, Akl Decl., ¶¶ 48-49. Unlike the '443 Patent, which reduces control signaling overhead regardless of the number of transmission blocks received, implementing Kannan's technique for a transport block that consists of a single CB would effectively increase control signaling overhead. *See* Ex. 2001, Akl Decl., ¶ 50. For example, implementation of ACK/NACK format 430 in this scenario presumably would need "dedicated bits" to identify the number of CBs in error (in Petitioner's hypothetical, the number of CBs is always one) and an index 440 into a lookup table to obtain a bitmap of ACKs/NACKs for Petitioner's single CB—when a single bit of HARQ in this scenario would have sufficed for the single transport block consisting of one CB. *See* Ex. 2001, Akl Decl., ¶ 51.

Although Kannan indicates that a transport block could consist of a single CB, nothing in Kannan discloses how (or whether) its CB level HARQ processing would occur if it did. *See* Ex. 2001, Akl Decl., ¶ 52. Would ACK/NACK format 430, upon which Petitioner relies for many of the challenged independent claim limitations (e.g., Pet. at 19-21), even be chosen given that only a single CB is transmitted? *See* Ex. 2001, Akl Decl., ¶ 53. It is particularly telling that Kannan is silent on these issues, and Petitioner fails to explain how limitation [1.a] and all the other limitations of the Challenged Claims are met by Kannan when implementing Petitioner's single CB scenario. *Id.*

Because Petitioner provides no evidence that Kannan's disclosure of either a "code block" or a "transport block" is the "N transmission blocks" recited in the Challenged Claims, Petitioner has not shown by a preponderance of the evidence that Kannan anticipates this limitation. *See Eli Lilly & Co. v. L.A. Biomedical Research Inst.*, 849 F.3d 1073, 1074 (Fed. Cir. 2017) ("To anticipate a claim, a prior art reference must disclose every limitation of the claimed invention, either expressly or inherently." (citation and quotation marks omitted)); *see also W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1554 (Fed. Cir. 1983) (refusing to find claims anticipated when the prior art references were "unacceptably vague"); *In re Turlay,* 49 C.C.P.A. 1288, 304 F.2d 893, 899 (1962) ("It is well established that an anticipation rejection cannot be predicated on an ambiguous reference.").

2. [1.b] Kannan does not disclose "the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M"

As discussed in Section VII.A.1 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) the "N transmission blocks" element recited in the Challenged Claims. For this reason alone, Petitioner cannot show that Kannan teaches limitation [1.b].

Moreover, Petitioner contends that Kannan teaches "M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks" based on Kannan's disclosure of an "index" (440) shown in red below in Figure 4B:

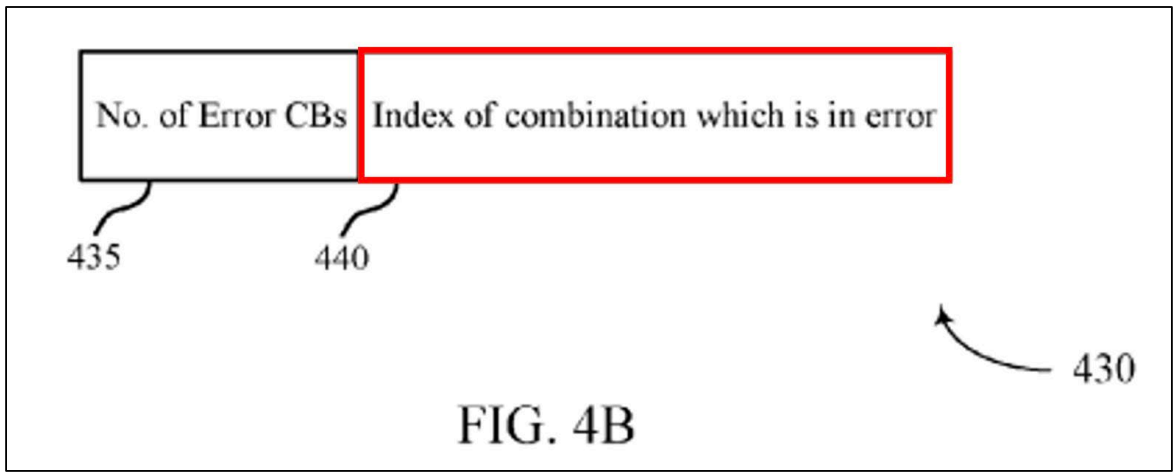


FIG. 4B

See Ex. 1006, Fig. 4B (annotated); *see also* Pet. at 19. But as Petitioner acknowledges, the "index" shown in 440 above "may be, for example, an index into a lookup table that provides a bitmap of ACK/NACKs for the number of CBs indicted in the set of bits." Pet. at 19 (*citing* Ex. 1006, [0088]). A POSITA would

understand that an "index into a lookup table" does not "indicate positions of k erroneous transmission blocks in the N transmission blocks" as required by the Challenged Claims. *See* Ex. 2001, Akl Decl., ¶ 57.

Petitioner has not even attempted to show that Kannan's use of an index in the CB-level HARQ feedback inherently teaches "M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M." Nor could it. The actual bitmap identifying the positions of erroneous CBs in Kannan is stored in a lookup table according to the passage relied upon by Petitioner, and the "index" is used to look up the information in a table. *See* Ex. 2001, Akl Decl., ¶ 58. To meet this claim limitation either explicitly or inherently, however, the bitmap itself would need to be included in the set of bits identified as 440 in Figure 4B above. *Id*.

Petitioner has only alleged a single anticipatory challenge. Thus, any obvious modifications to Kannan to meet the limitations in the Challenged Claims are impermissible as a matter of law. *In re Smith Int'l, Inc*., 871 F.3d 1375, 1381 (Fed. Cir. 2017) ("A patent claim is anticipated 'only if each and every element is found within a single prior art reference, arranged as claimed.'" (quoting *Summit 6, LLC v. Samsung Elecs. Co*., 802 F.3d 1283, 1294 (Fed. Cir. 2015))). Prior art that must be modified to meet the disputed claim limitation—such as including Kannan's bitmap in the HARQ format 430 instead of an index—does not anticipate the claim. *See,*

e.g., Enplas Display Device Corp. v. Seoul Semiconductor Co., Ltd., 909 F.3d 398, 405 (Fed. Cir. 2018); *In re Chudik*, 851 F.3d 1365, 1374 (Fed. Cir. 2017) ("Prior art that 'must be distorted from its obvious design' does not anticipate a new invention." (quoting *In re Wells*, 53 F.2d 537, 539 (CCPA 1931))).

For at least these reasons, in addition to the "N transmission blocks" element, Petitioner has not shown by a preponderance of the evidence that Kannan discloses "the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M" as recited in limitation [1.b]. *See* Ex. 2001, Akl Decl., ¶ 59.

3. [1.c] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and" as required by Claim 1 and the respective dependent claims (Claims 2 and 6) of the '443 Patent

As discussed in Sections VII.A.1 and VII.A.2 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks" or "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M."

As discussed, Kannan does not disclose the "M2 bits being used to indicate positions of k erroneous transmission blocks" because bits 440 shown below in Figure 4B is an index into a lookup table that provides a bitmap of ACK/NACKs for the number of CBs indicated in the set of bits":

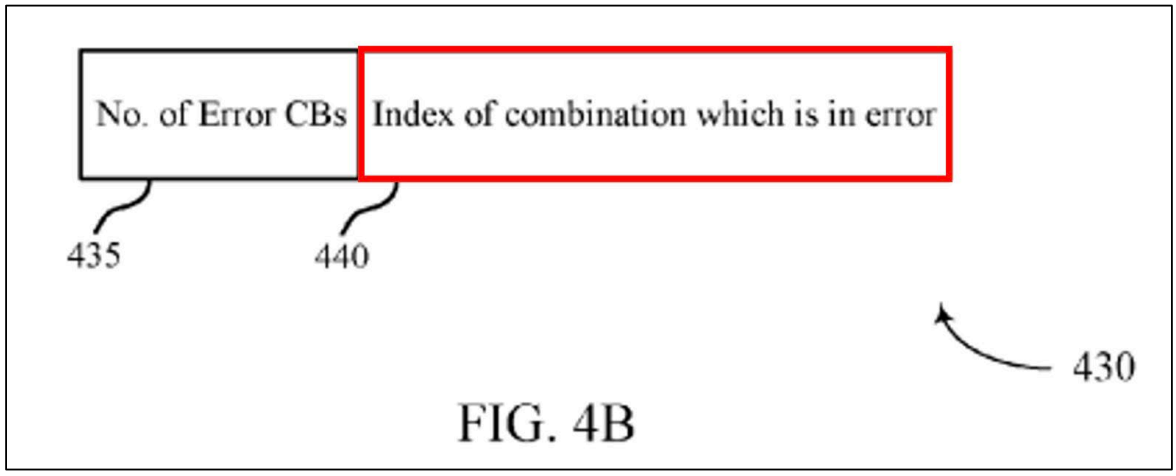
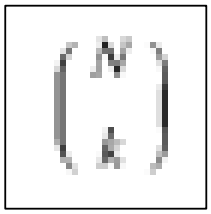


FIG. 4B

See Ex. 1006, Fig. 4B (annotated); Pet. at 19. The "index" shown in 440 above does not "indicate positions of k erroneous transmission blocks in the N transmission blocks" as required by the Challenged Claims. *See* Ex. 2001, Akl Decl., ¶ 61.

Despite this, Petitioner contends erroneously that Kannan discloses that the "second length type of M2 being determined based on k" in [0089]:

> ***In some examples***, a receiver may identify ACK/NACK format 430 when k<K* and the number of bits used to convey the ACK/NACK feedback would be $\log_e$ (K*) bits to indicate the number of errors, and $\log_2$bits to indicate which combination of CBs is in error.



Ex. 1006, [0089] (emphasis added).

As an initial matter, limitation [1.c] requires that a value of M2 is determined based on k. In other words, this limitation is not optional. Yet the above passage in Kannan indicates that *sometimes* k is used to determine the number of bits to indicate which combination of CBs is in error, and nothing in this passage or in Kannan generally teaches that the number of bits used to indicate the combination of CBs in error is always determined based on k for the second length type. This passage thus fails to support an anticipation determination. *See, e.g., In re Facebook, Inc*., 743 F. App'x 998, 1002 (Fed. Cir. 2018) (reversing and remanding Board's anticipation and obviousness determinations based in part on the fact that prior art reference did not disclose an algorithm requiring contiguity in image size even though the claims required it).

Moreover, a POSITA would understand when reading [0089] in Kannan that it is the size of the "bitmap of ACK/NACKs for the number of CBs indicated in the set of bits" that is "sometimes" determined based in part on k—and not the "index" (440) shown in Figure 4B. *See* Ex. 2001, Akl Decl., ¶ 65. Petitioner does not argue that this bitmap of ACK/NACK is any part of the M bits of HARQ information, let

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alone M2 bits. Nor could it. This is so because the bitmap disclosed in Kannan is saved in a lookup table and thus not "transmit[ed] . . . to the second node" as required in limitation [1.d]. *Id*. Nothing in this passage indicates, nor has Petitioner argued, that the index shown as 440 in Figure 4B and used as an index into the lookup table is now something different (i.e., the ACK/NACK bitmap).

Finally, Petitioner appears to argue (without support) that limitation [1.c] requires either a first length type or a second length type and thus Kannan need not be configured to process/determine both types. Pet. at 20, n.4. Petitioner thus makes no attempt to show that Kannan discloses "a first length type."[4] But nothing in the '443 Patent supports Petitioner's assertion that the length types are "optional." Akl Decl., ¶ 66. Rather, Petitioner's assertion is contrary to the disclosures in the '443 Patent and fails to take into account the claim language in light of the specification. The '443 Patent's specification makes clear that both formats are required. For

[4] For limitation [8.d], Petitioner alleges that Kannan discloses "the first condition (M2=M)" based on Kannan's disclosure of ACK/NACK format 400. Pet. at 33. Even so, Petitioner has not shown that Kannan discloses that the "second length type of M2 being determined based on k" as discussed above. Thus, Petitioner has not met its burden to show a reasonable likelihood that Kannan anticipates any of the independent Challenged Claims, including claim 8.

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example, every single embodiment and Figure disclosed in the '443 Patent contemplates the ability to either generate or interpret "M bits of HARQ" with either a first length type or a second length type. *See, e.g.*, Ex. 1001, cls. 1-20; Figs. 1, 2; 10:33-15:8.

This case is thus similar to *Microsoft Corporation v Proxyconn, Inc*., in which the Board rejected the same type of "optional" argument Petitioner makes here. *Microsoft Corp. v. Proxyconn, Inc.*, No. IPR2012-00026 (TLG), 2012 WL 10703131, at *11 (P.T.A.B. Dec. 21, 2012). The claim limitation at issue in *Microsoft* recited: "receiving a response signal from the receiver/computer at said sender/computer, *said response signal containing a positive, partial or negative indication signal for said digital digest*." *Id*. (emphasis in original). Microsoft proposed a broad construction of the italicized claim language "such that the 'partial' and 'positive' signals limitations are entitled to 'no patentable weight' because those signals are 'optional.'" *Id*. Just like in the instant case, the Board noted that Microsoft's "proposed interpretation does not take into account the claim language in light of the specification," and that "[t]he '717 patent specification makes it clear that the signals are not optional; the receiver/computer described must issue a positive, negative and partial signal as required." *Id*. The Board's rationale was based on the fact that Microsoft's proposal was contrary to the disclosures in the dependent claims and in multiple Figures that depicted *inter alia* a flow diagram

illustrating that "the receiver/computer must issue a positive, negative, and partial signal as required." *Id.*

The same rationale applies here. For example, just like the figure cited by the Board in *Microsoft*, Figure 2 of the '443 Patent depicts a flow diagram that confirms both a first length type (M2=M) and a second length type (M2<M) are required:

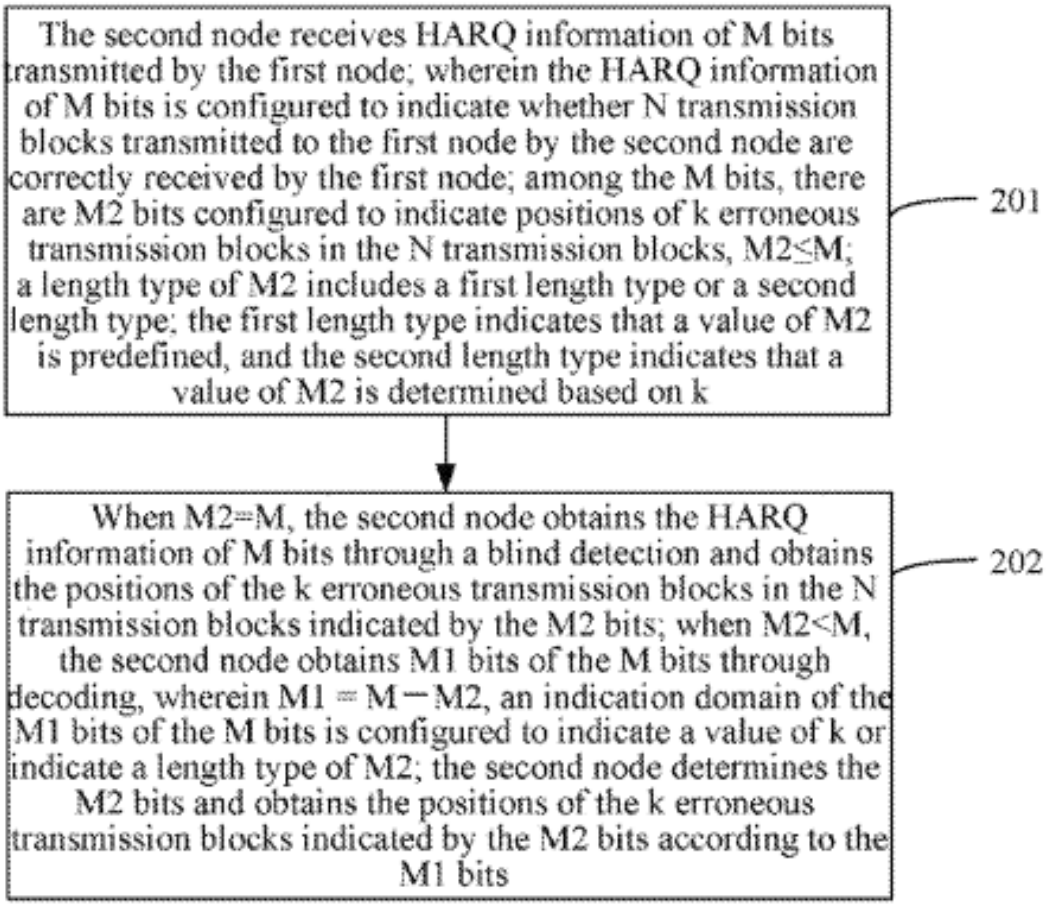


FIG. 2

Ex. 1001, Fig. 2. Moreover, just like the claims in *Microsoft*, the claims of the '443 Patent confirm that the first and second length types are not optional. *See, e.g.*, cls. 3, 4, 6, 7; Akl Decl., ¶ 66-67.

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [1.c]. *See* Ex. 2001, Akl Decl., ¶ 68.

B. [Claim 8] Petitioner Failed to Meet Its Burden to Show That Kannan Anticipates Independent Claim 8 and the Respective Dependent Claims (Claim 9).

1. [8.b] Kannan does not disclose "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M"

As discussed in Sections VII.A.1 and VII.A.2 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks" or "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M." *See* Ex. 2001, Akl Decl., ¶ 69.

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [8.b]. *See* Ex. 2001, Akl Decl., ¶ 70.

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2. [8.c] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k;"

As discussed in Sections VII.A.1-VII.A.3 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks," "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M," or "a length type of M2 including a first length type or a second length type, . . . and the second length type indicating a value of M2 being determined based on k."

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [8.c]. *See* Ex. 2001, Akl Decl., ¶ 71-72.

C. [Claim 10] Petitioner Failed to Meet Its Burden to Show That Kannan Anticipates Independent Claim 10 and the Respective Dependent Claims (Claims 11 and 15).

1. [10.d] Kannan does not disclose "detecting N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result;"

As discussed in Section VII.A.1 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) the "N

transmission blocks" element recited in the Challenged Claims. For at least these reasons, Petitioner has not shown by a preponderance of the evidence that Kannan discloses "detecting N transmission blocks received from a second node and generating M bits of HARQ information according to a detection result;" as recited in limitation [10.d]. *See* Ex. 2001, Akl Decl., ¶ 73.

2. [10.e] Kannan does not disclose "the M bits of HARQ information being used to indicate a receiving status of the N transmission blocks; among the M bits, M2 bits bring used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;"

As discussed in Sections VII.A.1 and VII.A.2 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks" or "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M."

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [10.e]. *See* Ex. 2001, Akl Decl., ¶ 74-75.

3. [10.f] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k; and"

As discussed in Sections VII.A.1-VII.A.3 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks," "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M," or "a length type of M2 including a first length type or a second length type, . . . and the second length type indicating a value of M2 being determined based on k."

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [10.f]. *See* Ex. 2001, Akl Decl., ¶ 76.

D. [Claim 17] Petitioner Failed to Meet Its Burden to Show That Kannan Anticipates Independent Claim 17 and the Respective Dependent Claims (Claim 18).

1. [17.b] Kannan does not disclose "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to another node by the node be correctly received by the another node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M;"

As discussed in Sections VII.A.1 and VII.A.2 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks" or "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be

correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M."

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [17.b]. *See* Ex. 2001, Akl Decl., ¶ 77-78.

2. [17.c] Kannan does not disclose "a length type of M2 including a first length type or a second length type; the first length type indicating a value of M2 being predefined, and the second length type indicating a value of M2 being determined based on k;"

As discussed in Sections VII.A.1-VII.A.3 (incorporated by reference herein), Petitioner has not shown that Kannan teaches (either explicitly or inherently) "N transmission blocks," "the M bits of HARQ information being used to indicate whether N transmission blocks transmitted to the first node by the second node be correctly received by the first node; among the M bits, M2 bits being used to indicate positions of k erroneous transmission blocks in the N transmission blocks, M2≤M," or "a length type of M2 including a first length type or a second length type, . . . and the second length type indicating a value of M2 being determined based on k."

For at least these same reasons, Petitioner has not shown by a preponderance of the evidence that Kannan teaches limitation [17.c]. *See* Ex. 2001, Akl Decl., ¶ 79-80.

VIII. THE BOARD SHOULD EXERCISE ITS DISCRETION TO DENY THE PETITION UNDER 35 U.S.C. § 325(d)

The Board should deny institution under § 325(d) in view of the two-part framework set forth in its precedential decisions in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586,Paper 8 (P.T.A.B. Dec. 15, 2017) (precedential) and *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (P.T.A.B. Feb. 13, 2020) (precedential).

The first part of § 325(d)'s framework considers "whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office." *Advanced Bionics*, IPR2019-01469, Paper 6 at 8. "Previously presented art includes art made of record by the Examiner, and art provided to the Office by an applicant, such as on an Information Disclosure Statement (IDS), in the prosecution history of the challenged patent." *Id*. at 7-8.

Under the second part of § 325(d)'s framework, "if either condition of [the] first part of the framework is satisfied, [the Board determines] whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims." *Id*. at 8. Examples of material errors include "misapprehending

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or overlooking specific teachings of the relevant prior art where those teachings impact patentability of the challenged claims" and "an error of law, such as misconstruing a claim term, where the construction impacts patentability of the challenged claims." *Id*. at 8, n.9. The Board further explained that the petitioner carries the burden of demonstrating material error, stating that "[i]f a condition in the first part of the framework is satisfied and the petitioner fails to make a showing of material error, the Director generally will exercise discretion not to institute *inter partes* review." *Id*. at 8-9.

Both parts of § 325(d)'s two-part framework support denying institution of the Petition. In particular, Petitioner has asserted the same or substantially the same art that was presented to the Patent Office and has failed to demonstrate that the Office erred in any manner—let alone in a manner material to the patentability of the Challenged Claims. In fact, Petitioner fails to even address all the factors that are considered in determining whether to deny institution of a petition under §325(d), and any attempt to cure this deficiency is too late. Denial of institution is thus warranted under § 325(d).

A. The Same or Substantially the Same Prior Art was Previously Presented to the Patent Office

Petitioner argues that the "Board should not exercise its discretion under 35 U.S.C. § 325(d)" because "[a] similar reference, International Publication No. WO 2016/126653 (Ex. 1011) [the 'Kannan Pub'], was cited in an Information Disclosure

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Statement (IDS) during prosecution of the '443 Patent, but was never analyzed in detail by the Examiner during prosecution." Pet. at 3-4. In so doing, Petitioner ignores that the Kannan Pub is nearly identical to Kannan with only minor differences that are not material to the portions of Kannan upon which Petitioner relies. Petitioner further fails to recognize that the Examiner did in fact indicate that he considered the Kannan Pub.

The Kannan Pub appears on the face of the '443 Patent (Ex. 1001 at 2) and was first cited by the applicant in a July 23, 2018 Information Disclosure Statement (Ex. 2002 at 282). The Kannan Pub claims priority to Kannan, and both the Kannan Pub and Kannan purport to claim priority to U.S. Provisional Application No. 62/112,310, filed on February 5, 2015 ("'310 Provisional"). Ex. 1006 at 1, Ex. 1011 at 1. For each paragraph, Figure, and claim in Kannan upon which Petitioner relies, there is the same (if not identical) disclosure in the Kannan Pub:

Kannan Cites (Ex. 1006)	Parallel Kannan Pub Cites (Ex. 1011)	Petition Cites
[0003]	[0004]	9
[0008]-[0009]	[0006]-[0007]	15, 18, 26
[0011]	[0009]	39, 49
[0018]	[0016]	24
[0021]	[0019]	39
[0028]-[0029]	[0026]-[0027]	26
[0038]	[0036]	18
[0052]	[0050]	9, 26, 35, 44
[0056]	[0054]	24
[0058]	[0056]	35
[0064]	[0062]	18

Kannan Cites (Ex. 1006)	Parallel Kannan Pub Cites (Ex. 1011)	Petition Cites
[0075]	[0073]	9
[0078]-[0083]	[0076]-[0081]	10, 17, 18, 24
[0086]-[0090]	[0084]-[0088]	10, 18, 19, 20, 21, 24, 25, 32, 33, 51, 52, 53
[0094]-[0103]	[0092]-[0101]	21, 22, 24, 27-28, 33, 34, 36, 37, 42, 46, 49, 50, 51, 53
[0112]	[0110]	36, 37, 49
[0115]-[0116]	[0113]-[0114]	37, 38, 40, 50
[0119]-[0120]	[0117]-[0119]	37, 38, 50, 51
[0165]-[0166]	[0163]-[0164]	37, 50
Fig. 1	Fig. 1	16, 27, 35, 44, 45
Fig. 2	Fig. 2	17
Fig. 4B	Fig. 4B	10, 19, 25, 32, 53
Fig. 5	Fig. 5	23, 29, 43, 47
Fig. 6	Fig. 6	37, 46, 50
Claim 1	Claim 1	13, 20
Claim 8	Claim 8	31
Claim 10	Claim 10	41

Ex. 2001, Akl. Decl., ¶ 83. For purposes of the Petition, none of the parallel disclosures in the Kannan Pub can be meaningfully distinguished from Kannan. (*id.*)—nor has Petitioner even attempted to do so. *See* Pet. at 3 (stating only that the Kannan Pub is "[a] similar reference").

Rather, Petitioner admits that the '310 Provisional, to which both Kannan and the Kannan Pub purport to claim priority, provides "enabling support for each portion of the Kannan non-provisional being relied on." Pet. at 12-13. But Petitioner ignores that nearly the same exact "enabling support" is also found in the Kannan Pub:

Kannan Claim 1 (Ex. 1006, P. 15)	[Alleged] Support in the '310 Provisional (Ex. 1007)	Parallel Citations in Kannan Pub (1011)
A method of communication at a wireless device comprising	Ex. 1007, [0005]-[0007]; *see also id.*, [0010], [0016], [0072]-[0074], [0076], [0079]-[0080], FIGS. 1, 2, 5, 9, 10-16; claim 1	Ex. 1011, [0006]-[0008], [0011], [0017], [0073], 0078]-[0079], [0080], [0083]-[0084], Figs. 1, 2, 5, 9, 10-16, claim 1
a) receiving a plurality of code blocks (CBs) in a received transmission;	Ex. 1007, [0005]-[0007], [0009]-[0016]; *see also id.*, [0048], [0052], [0054]-[0055], [0072], [0076]-[0085], FIGS. 1-5, 9, 10-16; claim 1	Ex. 1011, [0006]-[0008], [0010]-[0017], [0050], [0054], [0056]-[0057], [0073], [0080]-[0089], Figs. 1-5, 9, 10-16, claim 1
b) determining hybrid automatic repeat request (HARQ) acknowledgment/negative acknowledgment (ACK/NACK) feedback for each CB of the plurality of CBs;	Ex. 1007, [0005]-[0007], [0009]-[0016]; *see also id.*, [0048], [0052], [0054]-[0055], [0072], [0076]-[0085], FIGS. 3-16; claim 1	Ex. 1011, [0006]-[0008], [0010]-[0017], [0050], [0054], [0056]-[0057], [0073], [0080]-[0089], Figs. 3-16, claim 1
c) identifying a format, from two or more available formats, for transmitting the HARQ ACK/NACK feedback; and	Ex. 1007, [0005]-[0007]; *see also id.*, [0033]-[0035], [0058]-[0068], [0075]-[0085], [0090], FIGS. 5-16; claim 1	Ex. 1011, [0006]-[0008], [0035]-[0037], [0060]-[0069], [0079]-[0089], [0096], Figs. 5-16, claim 1
d) transmitting the HARQ ACK/NACK feedback using the identified format.	Ex. 1007, [0005]-[0007]; *see also id.*, [0033]-[0035], [0058]-[0068], [0075]-[0085], [0090], [0097], FIGS. 5-16; claim 1	Ex. 1011, [0006]-[0008], [0035]-[0037], [0060]-[0069], [0079]-[0089], [0096], [0103], Figs. 5-16, claim 1

Ex. 2001, Akl. Decl., ¶ 84.

Indeed, the figures in all three references are identical, and claims 1, 8, and 10[5] are also identical in all three references, except that the '310 Patent recites "one or more groups of CBs" in claim 8 and "two or more groups of CBs in claim 10, and Kannan and the Kannan Pub recite "one or more bundles of CBs" in claim 8 and "two or more bundles of CBs" in claim 10. Ex. 2001, Akl. Decl., ¶ 85. Kannan is thus "the same or substantially the same art previously was presented to the Office." *Advanced Bionics*, IPR2019-01469, Paper 6 at 8. Petitioner should not be able to rely on disclosures in the '310 Patent to establish Kannan's priority while ignoring the nearly identical disclosures in the Kannan Pub for purposes of § 325(d).

As a matter of law, Petitioner is also wrong that "Kannan was not considered during prosecution of the '443 Patent." Pet. at 3. Under *Advanced Bionics*, "[p]reviously presented art includes art made of record by the Examiner, and art provided to the Office by an applicant, such as on an Information Disclosure Statement (IDS), in the prosecution history of the challenged patent." *Advanced Bionics*, No. IPR2019-01469, Paper 6 at 7-8; *see also Johnson & Johnson Surgical Vision, Inc. v. Alcon Inc.*, No. IPR2021-01069, 2021 WL 6339059, at *6 (P.T.A.B. Dec. 10, 2021) (finding that the same or substantially the same art was previously

[5] Claims 1, 8, and 10 of Kannan are the only claims cited in the Petition. Pet. at 13, 20, 31, 41.

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presented including a reference that was cited in an IDS during prosecution); *Biocon Pharma Ltd. v. Novartis Pharms. Corp*., No. IPR2020-01263, 2021 WL 608300, at *4 (P.T.A.B. Feb. 16, 2021) (exercising discretion to deny institution: "the Examiner considered [the reference] because it is listed on the IDS and the Examiner signed the IDS").

The intrinsic evidence indicates that the Kannan Pub was considered by the Examiner. Ex. 2002 at 401 ("ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.N/"); *see also Nespresso Usa, Inc. v. K-Fee Sys. Gmbh*, No. IPR2021-01223, 2022 WL 214445, at *6 (P.T.A.B. Jan. 18, 2022) (rejecting petitioner's argument that references disclosed in an IDS but not discussed in any office action were not considered by the Examiner because Examiner indicated that "all references" submitted in the IDSs were "considered except where lined through" and references in question were not "lined through"). Indeed, in compliance with 37 C.F.R. § 1.98(a)(2)(i) and (ii), the applicant submitted the Kannan Pub to the Patent Office, and the Kannan Pub is thus included in its entirety in the '443 Patent's file history. Ex. 2002 at 298-375; *id*. at 286-88; Ex. 2001, Akl Decl., ¶ 86.

Moreover, pursuant to 37 C.F.R. 1.97(e)(1), the applicant disclosed that the Kannan Pub "was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this

Information Disclosure Statement" (Ex. 2002 at 287), and included a copy of a nine-page European Extended Supplementary Search Report dated June 25, 2018 received in European Patent Application No. 16 83 2167.7 ("European Report") (Ex. 2002 at 289-97).[6] The "counterpart foreign application" referenced in the IDS is European Application No. EP 3 327 968 A1, which, like the '443 Patent, is based on PCT Application No. PCT/CN2016/089016 and thus has nearly identical disclosures. Ex. 2001, Akl. Decl., ¶ 87. As such, not only did the Examiner have the benefit of the Kannan Pub (as it was included in full in the '443 Patent's file history), but the Examiner also had the benefit of a European office action that relied on the Kannan Pub during prosecution of a nearly identical sibling patent application. Just like he did for the Kannan Pub, the Examiner indicated that he considered the European Report because that reference was not "lined through." Ex. 2002 at 402.

Based on this evidence, Petitioner's contention that the Examiner did not consider the Kannan Pub during prosecution of the '443 Patent lacks merit. *See Juniper Networks, Inc. v. Mobile Telecommunications Techs., LLC*, No. IPR2017-00642, 2018 WL 1358386, at *7 (P.T.A.B. Mar. 14, 2018) ("In essence, an Examiner

[6] The file history submitted with the Petition as Ex. 1005 does not include the nine-page European Report. The full file history for the '443 Patent is included herewith as Ex. 2002.

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is tasked with applying the prior art he considers the best to all the pending claims in order to avoid multiplicity of rejections and to produce as streamlined an Office Action as possible."). Moreover, just like in *Nespresso*, Petitioner improperly focuses its argument on whether the "same or substantially the same" arguments were presented to the Office and ignores the conjunctive "or" that appears in the statute. *Nespresso*, 2022 WL 214445, at *6 ("***Where either the prior art references advanced*** **or** the arguments raised in a petition previously were presented to the Office, the inquiry shifts to whether the petitioner establishes a material error.") (emphasis added).

Because Petitioner has not shown that the Kannan Pub is materially different than Kannan, the first part of the *Advanced Bionics* framework is satisfied. *Advanced Bionics*, 2020 WL 740292, at *8; *Biocon*, 2021 WL 608300, at *4 n.4.

B. Petitioner Has Not Established the Patent Office Materially Erred in Allowing the Challenged Claims

If the first part of the *Advanced Bionics* "framework is satisfied and the petitioner fails to make a showing of material error, the Director generally will exercise discretion not to institute *inter partes* review." 2020 WL 740292, at *3. The Board should do exactly that here. Petitioner provides no evidence, or even argument, warranting reconsideration of the substantially same Kannan reference that was included in full in the '443 Patent file history along with the nine-page European Report. *See* Pet. at 2-4; *see also Splunk Inc. v. Sable Networks, Inc.*, No.

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IPR2022-00003, 2022 WL 1151410, at *5 (P.T.A.B. Apr. 14, 2022) (exercising discretion to deny institution where petitioner presented no arguments regarding the second part of the *Advanced Bionics* framework). As discussed, the Kannan Pub was considered and relied upon during prosecution of a nearly identical foreign counterpart to the '443 Patent. Ex. 2002 at 289-97. The European Report details this consideration, and Petitioner does not even address this—let alone explain how the Examiner erred. Rather, Petitioner relies on an incomplete intrinsic record that does not even include the European Report. Compare Ex. 1005 with Ex. 2002.

Moreover, Petitioner's contention that the Office did not have the benefit of "expert testimony now before the Board" does not negate the foregoing, nor does it establish that the Office materially erred in allowing the Challenged Claims. *See Biocon Pharma Ltd. v. Novartis Pharms. Corp*., No. IPR2020-01263, 2021 WL 608300, at *8 (P.T.A.B. Feb. 16, 2021) (stating fact that "the Examiner did not have the benefit of expert declaration of Dr. Lam explaining the art from the perspective of a [person having ordinary skill in the art]" does not "outweigh Petitioner's failure in this proceeding to show material error in the Examiner's consideration of the Webb Declaration, as *Advanced Bionics* requires").

As discussed, the differences between the two Kannan disclosures are immaterial and trivial when viewed in the context of the Challenged Claims. Ex. 2001, Akl Decl., ¶ 88. Because these processes are the same in Kannan and the

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Kannan Pub and the Kannan Pub was previously presented to the Office and considered by the Examiner, and because Petitioner makes no attempt to demonstrate that the Office erred in any manner material to the patentability of the Challenged Claims, the Board should exercise its discretion and deny the Petition under § 325(d).

IX. THE BOARD SHOULD DENY INSITUTION OF THIS PETITION UNDER 35 U.S.C. § 314(a)

Under § 314(a), the Director has discretion to deny institution. *NHK Spring Co. v. Intri-Plex Technologies, Inc.*, IPR2018-00752, Paper 8 (PTAB Sept. 12, 2018) (precedential). *Fintiv* sets forth six non-exclusive factors for determining "whether efficiency, fairness, and the merits support the exercise of authority to deny institution in view of an earlier trial date in the parallel proceeding." *Apple Inc. v. Fintiv Inc.*, IPR2020-00019, Paper 11 at 6 (PTAB Mar. 20, 2020) (precedential). These factors include:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court's trial date to the Board's projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;
4. overlap between issues raised in the petition and in the parallel proceeding;

5. whether the petitioner and the defendant in the parallel proceeding are the same party; and

6. other circumstances that impact the Board's exercise of discretion, including the merits grounds raised in the Petition.

Id.

According to the Memorandum from Director Vidal dated June 21, 2022, "compelling, meritorious challenges will be allowed to proceed at the PTAB even where district court litigation is proceeding in parallel. Compelling, meritorious challenges are those in which the evidence, if unrebutted in trial, would plainly lead to a conclusion that one or more claims are unpatentable by a preponderance of the evidence." Ex. 1008 at 4. Moreover, "[w]hen a petitioner stipulates not to pursue in a parallel district court proceeding the same grounds as in the petition or any grounds that could have reasonably been raised in the petition, it mitigates concerns of potentially conflicting decisions and duplicative efforts between the district court and the PTAB." *Id*. at 7 (citation omitted).

Here, the *Fintiv* factors favor denial of institution of this Petition, and Petitioner has not presented compelling evidence of unpatentability. Nor has Petitioner provided a sufficient stipulation that it will not pursue in the Texas litigation "any grounds that could have reasonably been raised in the petition." *Id*.

As such, the Board should deny institution of this Petition under § 314(a).

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A. Factor 1 is Neutral as No Court Has Granted a Stay and No Evidence Exists That a Stay May Be Granted

Regarding Factor 1, the parallel district court proceeding has not been stayed and no evidence exists that a stay may be granted if trial is instituted. The parallel district court proceeding includes four other U.S. patents besides the '443 Patent. Petitioner has never moved for a stay. All of the issues raised in the Petition are already presented, and are already being litigated, in the United States District Court for the Eastern District of Texas in Case No. 2:19-CV-225-JRG. Factor 1 is thus neutral at best. *See, e.g., Cisco Sys., Inc. v. Ramot at Tel Aviv Univ. Ltd.*, No. IPR2020-00123, 2020 WL 2511247, at *3 (P.T.A.B. May 15, 2020) (finding factor 1 to be neutral were "there is little evidence to suggest that the district court will grant a stay, should another one be requested").

B. Factors 2 and 5 Weigh in Favor of Denying Institution

As to factors 2 and 5, Petitioner is the defendant in the Texas litigation (Pet. at 1), and jury selection is scheduled to begin Monday, November 13, 2023 (Ex. 1014). Thus, the district court's trial is scheduled to precede the Board's anticipated final written decision on the same asserted art by more than five months.

This timing is similar to that in *NHK* where the Board noted a six-month difference between a scheduled trial date and the deadline for the Board's written decision. *NHK*, IPR2018-00752, Paper 8 at 20; *see also GlobalFoundries Inc. v. UNM Rainforest Innovations*, IPR2020-00984, Paper 11, at *11-16 (PTAB Dec. 9,

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2020) (finding that a scheduled trial date four months before the statutory deadline for a final written decision was a factor weighing in favor of discretionary denial); *NanoCellect Biomedical, Inc. v. Cytonome/ST, LLC*, IPR2020-00551, Paper 19, at *16 (PTAB Aug. 27, 2020) (same); *Intel Corp. v. LLC*, No. IPR2020-00583, 2021 WL 531706, at *2 (P.T.A.B. Feb. 11, 2021) ("Thus, at this time, it appears likely that trial will occur many months before any final written decision would likely issue in this proceeding. Therefore, we maintain our finding that *Fintiv* Factor 2 (proximity of the court's trial date to the Board's projected statutory deadline for a final written decision) weighs in favor of exercising our discretion to deny institution pursuant to 35 U.S.C. § 314(a).").

Just like in *NHK*, instituting trial under the facts and circumstances here would be an inefficient use of Board resources. *See NHK*, IPR2018-00752, Paper 8 at 20 (finding under similar circumstances that institution "would not be consistent with 'an objective of the AIA . . . to provide an effective and efficient alternative to district court litigation'").

Petitioner's contention that Factor 2 "weighs strongly against denial" based on the median time-to-trial statistics for the Eastern District of Texas lacks merit. Pet. at 55. The Memorandum from Director Vidal dated June 21, 2022, instructs only that "the proximity to trial should not alone outweigh" other factors. Ex. 1008 at 8. As shown herein, other factors besides Factor 2 weigh in favor of denial, such as

Factors 3, 4, 5, and 6, and no factors favor declining to exercise the Board's discretion to deny institution. Moreover, based on the median time-to-trial in the Eastern District of Texas (24.5 months), trial would take place on March 29, 2024 (March 14, 2022 + 24.5 months). Trial would thus still occur prior to the expected April 25, 2024, final written decision.

Factors 2 and 5 thus weigh in favor of denying institution.

C. Factor 3 Weighs in Favor of Denying Institution, as the Parties and the District Court in the Eastern District of Texas Litigation Have Already Invested Significant Time and Resources

By the time the Board's institution decision is likely to issue in late April 2023, the Parties and the district court will have already expended considerable time and resources into the claim construction process and discovery, and preparing for Judge Gilstrap's May 24, 2023, *Markman* hearing. Ex. 1010 at 3. For example, the parties have already exchanged infringement and invalidity contentions, and by the time of the expected institution decision, will have already completed claim construction discovery, served opening claim construction briefs, and substantially completed document production. Ex. 1010 at 3-4. Expert discovery is expected to be completed just three months after the institution decision, and the deadline to file dispositive motions follows shortly thereafter. Ex. 1010 at 3.

Moreover, the District Court has already ruled on one substantive motion to dismiss (Ex. 2003), and by the expected institution date will likely have ruled on

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another pending substantive motion. In *Fintiv*, the Board stated "if, at the time of the institution decision, the district court has issued substantive orders related to the patent at issue in the petition, this fact favors denial." *Id*. at 9-10. Further, "[t]his investment factor is related to the trial date factor, in that more work completed by the parties and court in the parallel proceeding tends to support the arguments that the parallel proceeding is more advanced, a stay may be less likely, and instituting would lead to duplicative costs." *Id*. at 10.

Based on the significant time and resources the parties have already expended and will likely have expended by the time of the expected decision on institution, Factor 3 weighs in favor of denying institution.

D. Factor 4 Weighs in Favor of Denying Institution Given the Overlap in Arguments Presented in the Petition and in the Texas Litigation and Because Petitioner has not Adequately Mitigated Concerns of Potentially Conflicting Decisions and Duplication of Efforts

As to factor 4, Petitioner presents overlapping arguments in the Texas litigation and in the Petition. Petitioner's invalidity contentions in the Texas litigation contain similar proposed grounds for invalidity as are presented in the Petition for the Challenged Claims. Compare Pet. at 2 (asserting claims 1-2, 6, 8-11, 15, 17, and 18 are unpatentable under 35 U.S.C. § 102(a) as anticipated by Kannan) with Ex. 2004 (asserting claims 1-2, 6, 8-11, 15, 17, and 18 are unpatentable "under at least 35 U.S.C. §§ 102 and/or 103" based on Kannan).

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Despite this overlap, Petitioner claims that "[t]here is no overlap with arguments made in the district court" and purports to stipulate that "if the IPR is instituted, Petitioner will not pursue the IPR grounds in the district court litigation." Pet. at 55. Petitioner is clearly incorrect, and Petitioner's "stipulation" is insufficient to alleviate any concerns of potentially conflicting decisions and duplicative efforts between the district court and the PTAB because Petitioner fails to stipulate that it will not pursue "any grounds that could have reasonably been raised in the petition."[7] Ex. 1008 at 7 (emphasis added).

Factor 4 thus weighs in favor of denying institution.

E. Factor 6 Weighs Against Institution as Petitioner Has Not Shown a Reasonable Likelihood That It Would Prevail on Ground 1

Factor 6 considers other circumstances that impact the Board's exercise of discretion. According to Petitioner, Factor 6 weighs against denial "as the merits of Petitioner's arguments are strong." Pet. at 56. But as shown above, Petitioner has failed to show a reasonable likelihood that it would prevail on Ground 1.

Thus, to the extent Factor 6 takes into account the merits of Petitioner's claims, Factor 6 weighs in favor of denial.

[7] Even if it did, Factors 2, 3, 5, and 6 would still favor denial.

X. CONCLUSION

For the reasons stated above, Patent Owner respectfully requests the Board to deny institution of IPR2022-01598.

Dated: January 25, 2023 Respectfully submitted,

/Bradley D. Liddle/

CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. § 42.24(b)(1)

I, the undersigned, do hereby certify that the foregoing Patent Owner Preliminary Response, including footnotes, contains no more than 14,000 words, as measured by the Word Count function of Microsoft Word as specified by 37 C.F.R. § 42.24(b)(1).

/Bradley D. Liddle/

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CERTIFICATE OF SERVICE

I hereby certify that on this 25th day of January 2023, a true and correct copy of the foregoing PATENT OWNER'S PRELIMINARY RESPONSE was served by electronic mail upon the following counsel of record for Petitioners:

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