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

| | |
|---|---|
| **OPTIS WIRELESS TECHNOLOGY, LLC,**<br>**OPTIS CELLULAR TECHNOLOGY, LLC,**<br>**UNWIRED PLANET, LLC,**<br>**UNWIRED PLANET INTERNATIONAL LIMITED, AND**<br>**PANOPTIS PATENT MANAGEMENT, LLC**<br><br>**Plaintiffs,**<br><br>**v.**<br><br>**APPLE INC.,**<br><br>**Defendant.** | **Civil Action No. 2:19-cv-66**<br><br>**JURY TRIAL REQUESTED** |

**ORIGINAL COMPLAINT**

APPLE 1009

Plaintiffs Optis Wireless Technology, LLC, Optis Cellular Technology, LLC, Unwired Planet, LLC, Unwired Planet International Limited, and PanOptis Patent Management, LLC (collectively and/or individually referred to as the "Plaintiff(s)" herein) file this Complaint against Apple Inc. ("Apple"), and allege as follows:

**NATURE OF THE ACTION**

1. The Plaintiffs have repeatedly negotiated with Apple to reach an agreement for a global FRAND license to the Plaintiffs' patent portfolios which Apple is infringing. For example, Apple has infringed and continues to infringe, contribute to the infringement of, and/or actively induce others to infringe U.S. Patent Nos. 8,005,154 ("the '154 patent"), 8,019,332 ("the '332 patent"), 8,385,284 ("the '284 patent"), 8,411,557 ("the '557 patent"), 9,001,774 ("the '774 patent"), 8,102,833 ("the '833 patent"), and 8,989,290 ("the '290 patent") (collectively, "the Asserted Patents" or "the Patents-in-Suit").

2. The negotiations have been unsuccessful because Apple refuses to pay a FRAND royalty for a license to the Plaintiffs' patents. Therefore, the Plaintiffs file this Complaint seeking a judgment of and relief for patent infringement by Apple.

**PARTIES**

3. Plaintiff Optis Wireless Technology, LLC ("Optis Wireless") is a limited liability company organized and existing under the laws of the State of Delaware, and maintains its principal place of business at 7160 Dallas Parkway, Suite 250, Plano, TX 75024.

4. Plaintiff Optis Cellular Technology, LLC ("Optis Cellular") is a limited liability company organized and existing under the laws of the State of Delaware, and maintains its principal place of business at 7160 Dallas Parkway, Suite 250, Plano, TX 75024.

5. Plaintiff PanOptis Patent Management, LLC ("PPM") is a limited liability company organized and existing under the laws of the State of Delaware, and maintains its principal place of business at 7160 Dallas Parkway, Suite 250, Plano, TX 75024.

6. Plaintiff Unwired Planet, LLC ("Unwired Planet") is a limited liability company organized and existing under the laws of Nevada, and is located at 7160 Dallas Pkwy., Ste. 250, Plano, TX 75024.

7. Plaintiff Unwired Planet International Limited ("Unwired Planet International") is a company organized under the laws of Ireland, and is located at Unit 32, Hyde Bldg., The Park, Carrickmines, Dublin 18, Ireland.

8. Defendant Apple Inc. is a California corporation with its principal place of business at 1 Infinite Loop, Cupertino, California 95014. Apple designs, manufactures, uses, imports into the United States, sells, and/or offers for sale in the United States smartphones, tablets, smartwatches, and other mobile computing devices that operate over the 4G (LTE) cellular standard. Apple's devices are marketed, offered for sale, and/or sold throughout the United States, including within this District.

## JURISDICTION AND VENUE

9. Within the United States, this Court has subject matter jurisdiction over this case under 28 U.S.C. §§ 1331, 1332, 1338, and 1367.

10. The amount in controversy exceeds $75,000.

11. Venue is proper in this Court pursuant to 28 U.S.C. §§ 1391 and 1400(b).

12. This Court has personal jurisdiction over Apple. Apple has continuous and systematic business contacts with the State of Texas. Apple, directly or through subsidiaries or intermediaries (including distributors, retailers, and others), conducts its business extensively

throughout Texas, by shipping, distributing, offering for sale, selling, and advertising (including the provision of interactive web pages) its products and services in the State of Texas and the Eastern District of Texas. Apple, directly and through subsidiaries or intermediaries (including distributors, retailers, and others), has purposefully and voluntarily placed its infringing products and services into this District and into the stream of commerce with the intention and expectation that they will be purchased and used by consumers in this District. Apple has offered and sold and continues to offer and sell these infringing products and services in this District, including at physical Apple stores located within this District. Apple has also directed communications in connection with negotiations with the Plaintiffs into the Eastern District of Texas. Apple has committed acts of infringement in this judicial district and has a regular and established place of business in this judicial district.

## THE ASSERTED PATENTS

13. On August 23, 2011, the ’154 patent was duly and legally issued for an invention titled, “Method and Apparatus for Transmitting and Receiving Shared Control Channel Message in a Wireless Communication System Using Orthogonal Frequency Division Multiple Access.” The Plaintiffs own all rights to the ’154 patent necessary to bring this action.

14. On September 13, 2011, the ’332 patent was duly and legally issued for an invention titled, “Method for Transmitting and Receiving Control Information through PDCCH.” The Plaintiffs own all rights to the ’332 patent necessary to bring this action.

15. On February 26, 2013, the ’284 patent was duly and legally issued for an invention titled, “Control Channel Signaling Using a Common Signaling Field for Transport Format and Redundancy Version.” The Plaintiffs own all rights to the ’284 patent necessary to bring this action.

16. On April 2, 2013, the ’557 patent was duly and legally issued for an invention titled, “Mobile Station Apparatus and Random Access Method.” The Plaintiffs own all rights to the ’557 patent necessary to bring this action.

17. On April 7, 2015, the ’774 patent was duly and legally issued for an invention titled, “System and Method for Channel Estimation in a Delay Diversity Wireless Communication System.” The Plaintiffs own all rights to the ’744 patent necessary to bring this action.

18. On January 24, 2012, the ’833 patent was duly and legally issued for an invention titled, “Method for Transmitting Uplink Signals.” The Plaintiffs own all rights to the ’833 patent necessary to bring this action.

19. On March 24, 2015, the ’290 patent was duly and legally issued for an invention titled, “Mode switching between SU-MIMO and MU-MIMO.” The Plaintiffs own all rights to the ’290 patent necessary to bring this action.

20. The Plaintiffs exclusively own all rights, title, and interest in the Patents-in-Suit necessary to bring this action, including the right to recover past and future damages. Apple is not currently licensed to practice the Patents-in-Suit.

21. The Patents-in-Suit are valid and enforceable.

## COMPLIANCE WITH FRAND

22. In the telecommunications industry, global standards are fundamental to ubiquitous connectivity and enable any company—even a company like Apple with no history in the wireless communication development—to enter the market and sell smartphones.

23. The European Telecommunications Standards Institute (ETSI) is an independent, non-profit standard setting organization (SSO) that produces globally-accepted standards in the

telecommunications industry. In addition to its own activities, ETSI is also one of several SSOs that are organization partners of the Third Generation Partnership Project (3GPP), which maintains and develops globally applicable technical specifications, including for 4G (LTE) mobile systems. Together, ETSI and its members have developed open standards that ensure worldwide interoperability between networks, devices and network operators.

24. ETSI has developed and promulgated an IPR Policy, which is intended to strike a balance between the need for open standards on the one hand, and the rights of IPR owners on the other hand. Clause 15.6 of the ETSI IPR Policy defines the term "ESSENTIAL" to mean that "it is not possible on technical (but not commercial) grounds, taking into account normal technical practice and the state of the art generally available at the time of standardization, to make, sell, lease, otherwise dispose of, repair, use or operate EQUIPMENT or METHODS which comply with a STANDARD without infringing that IPR."

25. Optis Wireless is the assignee of numerous patents, many originally assigned to Panasonic Corporation ("Panasonic"), that are, and remain, essential (as that term is defined by ETSI) to practicing the LTE Standard.

26. Optis Cellular is the assignee of numerous patents, many originally assigned to LG Electronics Inc. ("LG"), that are, and remain, essential (as that term is defined by ETSI) to practicing the LTE Standard.

27. Unwired Planet International is the assignee of numerous patents, many originally assigned to Samsung Electronics Co., Ltd. ("Samsung"), that are, and remain, essential (as that term is defined by ETSI) to practicing the LTE Standard.

28. Unwired Planet is the assignee of numerous patents, many originally assigned to Telefonaktiebolaget L M Ericsson ("Ericsson"), that are, and remain, essential (as that term is defined by ETSI) to practicing the LTE Standard.

29. Each of the Patents-in-Suit has been declared to ETSI, by its original assignee, as essential to practicing the LTE Standard.

30. The Plaintiffs, in conformance with ETSI's IPR Policy, have informed Apple that they are prepared to grant Apple an irrevocable license to their standard essential patents, including the Patents-in-Suit, on terms that are Fair, Reasonable, and Non-Discriminatory ("FRAND").

31. Apple requires a license to one or more essential patents owned by Optis Cellular, Optis Wireless, Unwired Planet International, and Unwired Planet.

32. Not later than January 6, 2017, the Plaintiffs sent Apple correspondence initiating Plaintiffs' good faith efforts to license their essential patents to Apple on FRAND terms.

33. Over the following months, the Plaintiffs' representatives routinely corresponded with and met in-person with Apple representatives on several occasions. During those meetings, the Plaintiffs' representatives presented, in good faith, material concerning their LTE essential patents and technical details evidencing the essentiality of the Plaintiffs' LTE essential patents. The Plaintiffs' representatives also provided Apple with multiple license offers made on FRAND terms.

34. To date, Apple has not reciprocated the Plaintiffs' good faith efforts. Apple has failed to negotiate in good faith. Apple has instead declined to take a license to the Plaintiffs' valuable intellectual property, including the Patents-in-Suit.

35. Apple has been operating and continues to operate without a license to the Plaintiffs' essential patents. Given Apple's unwillingness to license the Plaintiffs' essential patents, or to cease its infringement, the Plaintiffs have filed this lawsuit for the purpose of protecting their patent rights in the United States.

36. The parties' licensing negotiations have been unsuccessful for the simple reason that Apple refuses to pay FRAND royalties for the Plaintiffs' valuable patent portfolios. Apple is failing to honor that FRAND licensing is a two-way street, requiring not only that the licensor is fair and reasonable in providing licensing terms, but also that the licensee is fair and reasonable in accepting them when they are offered.

## GENERAL PATENT INFRINGEMENT ALLEGATIONS

37. Apple has imported/exported into/from the United States, manufactured, used, marketed, offered for sale, and/or sold in the United States, smartphones, smartwatches and tablets that infringe the Patents-in-Suit. Apple's accused devices ("the Apple Accused Products") which infringe one or more claims of the Patents-in-Suit, are all Apple products capable of implementing the LTE standard, including, but not necessarily limited to, all LTE-capable models in Apple's iPhone, iPad and Watch lines of products.

38. For example, as shown below, Apple advertises that each of its iPhone models beginning with the iPhone 5 supports the LTE standard.

iPhone XS:

| | | |
|---|---|---|
| **Cellular and Wireless** | **Model A1920*** | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 46)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | **Model A1921*** | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41, 46)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |

Source: https://www.apple.com/iphone-xs/specs/

iPhone XR:

| | | |
|---|---|---|
| **Cellular and Wireless** | **Model A1984*** | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 29, 30, 32, 66, 71)<br>TD-LTE (Bands 34, 38, 39, 40, 41)<br>CDMA EV-DO Rev. A (800, 1900 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |

Source: https://www.apple.com/iphone-xr/specs/

iPhone X:

| Cellular and Wireless | Model A1865* | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28, 29, 30, 66)<br>TD-LTE (Bands 34, 38, 39, 40, 41)<br>TD-SCDMA 1900 (F), 2000 (A)<br>CDMA EV-DO Rev. A (800, 1900, 2100 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
|---|---|---|
| | Model A1901*<br>Model A1901 does not support CDMA networks, such as those used by Verizon and Sprint. | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28, 29, 30, 66)<br>TD-LTE (Bands 34, 38, 39, 40, 41)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |

Source: https://support.apple.com/kb/SP770?locale=en_US

iPhone 8:

| Cellular and Wireless | Model A1863*<br>Model A1864* | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28, 29, 30, 66)<br>TD-LTE (Bands 34, 38, 39, 40, 41)<br>TD-SCDMA 1900 (F), 2000 (A)<br>CDMA EV-DO Rev. A (800, 1900, 2100 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
|---|---|---|
| | Model A1905*<br>Model A1897*<br>Models A1905 and A1897 do not support CDMA networks, such as those used by Verizon and Sprint. | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28, 29, 30, 66)<br>TD-LTE (Bands 34, 38, 39, 40, 41)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |

Source: https://www.apple.com/iphone-8/specs/

iPhone 7:

| Cellular and Wireless | | |
|---|---|---|
| | Model A1660*<br>Model A1661* | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 27, 28, 29, 30)<br>TD-LTE (Bands 38, 39, 40, 41)<br>TD-SCDMA 1900 (F), 2000 (A)<br>CDMA EV-DO Rev. A (800, 1900, 2100 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | Model A1778*<br>Model A1784*<br>Models A1778 and A1784 do not support CDMA networks, such as those used by Verizon and Sprint. | FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 27, 28, 29, 30)<br>TD-LTE (Bands 38, 39, 40, 41)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | All models | 802.11ac Wi-Fi with MIMO<br>Bluetooth 4.2 wireless technology<br>NFC |

Source: https://www.apple.com/iphone-7/specs/

iPhone 6s:

| Cellular and Wireless | | |
|---|---|---|
| | Model A1633*<br>Model A1634* | LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 27, 28, 29, 30)<br>TD-LTE (Bands 38, 39, 40, 41)<br>TD-SCDMA 1900 (F), 2000 (A)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>CDMA EV-DO Rev. A (800, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | Model A1688*<br>Model A1687* | LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 27, 28, 29)<br>TD-LTE (Bands 38, 39, 40, 41)<br>TD-SCDMA 1900 (F), 2000 (A)<br>CDMA EV-DO Rev. A (800, 1700/2100, 1900, 2100 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |

Source: https://support.apple.com/kb/SP726?locale=en_US

iPhone SE:

| | | |
|---|---|---|
| Cellular and Wireless | Model A1662* | LTE (Bands 1, 2, 3, 4, 5, 8, 12, 13, 17, 18, 19, 20, 25, 26, 29)<br>CDMA EV-DO Rev. A (800, 1700/2100, 1900, 2100 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |
| | Model A1723* | LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 17, 18, 19, 20, 25, 26, 28)<br>TD-LTE (Bands 38, 39, 40, 41)<br>TD-SCDMA 1900 (F), 2000 (A)<br>CDMA EV-DO Rev. A (800, 1700/2100, 1900, 2100 MHz)<br>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)<br>GSM/EDGE (850, 900, 1800, 1900 MHz) |

Source: https://support.apple.com/kb/SP738?locale=en_US

iPhone 6:

**Cellular and Wireless**

- **Model A1549 (GSM)*/ Model A1522 (GSM)***
  - UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
  - GSM/EDGE (850, 900, 1800, 1900 MHz)
  - LTE (Bands 1, 2, 3, 4, 5, 7, 8, 13, 17, 18, 19, 20, 25, 26, 28, 29)
- **Model A1549 (CDMA)*/ Model A1522 (CDMA)***
  - CDMA EV-DO Rev. A and Rev. B (800, 1700/2100, 1900, 2100 MHz)
  - UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
  - GSM/EDGE (850, 900, 1800, 1900 MHz)
  - LTE (Bands 1, 2, 3, 4, 5, 7, 8, 13, 17, 18, 19, 20, 25, 26, 28, 29)

**Model A1586*/ Model A1524***

- CDMA EV-DO Rev. A and Rev. B (800, 1700/2100, 1900, 2100 MHz)
- UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
- TD-SCDMA 1900 (F), 2000 (A)
- GSM/EDGE (850, 900, 1800, 1900 MHz)
- FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 13, 17, 18, 19, 20, 25, 26, 28, 29)
- TD-LTE (Bands 38, 39, 40, 41)

Source: https://support.apple.com/kb/SP705?locale=en_US

iPhone 5s:

**Cellular and Wireless**

- Model A1533 (GSM)*: UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 1, 2, 3, 4, 5, 8, 13, 17, 19, 20, 25)
- Model A1533 (CDMA)*: CDMA EV-DO Rev. A and Rev. B (800, 1700/2100, 1900, 2100 MHz); UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 1, 2, 3, 4, 5, 8, 13, 17, 19, 20, 25)
- Model A1453*: CDMA EV-DO Rev. A and Rev. B (800, 1700/2100, 1900, 2100 MHz); UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 1, 2, 3, 4, 5, 8, 13, 17, 18, 19, 20, 25, 26)
- Model A1457*: UMTS/HSPA+/DC-HSDPA (850, 900, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 1, 2, 3, 5, 7, 8, 20)
- Model A1530*: UMTS/HSPA+/DC-HSDPA (850, 900, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); FDD-LTE (Bands 1, 2, 3, 5, 7, 8, 20); TD-LTE (Bands 38, 39, 40)

Source: https://support.apple.com/kb/SP685?locale=en_US

iPhone 5:

**Cellular and Wireless**

- GSM model A1428*: UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 4 and 17)
- CDMA model A1429*: CDMA EV-DO Rev. A and Rev. B (800, 1900, 2100 MHz); UMTS/HSPA+/DC-HSDPA (850, 900, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 1, 3, 5, 13, 25)
- GSM model A1429*: UMTS/HSPA+/DC-HSDPA (850, 900, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz); LTE (Bands 1, 3, 5)

Source: https://support.apple.com/kb/SP655?locale=en_US

39. Similarly, Apple advertises that each of its current cellular-capable iPad models supports the LTE Standard.

iPad Pro:

**Wi-Fi + Cellular models**

UMTS/HSPA/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz)

Gigabit-class LTE (Models A2013 and A2014: bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 29, 30, 34, 38, 39, 40, 41, 46, 66, 71)[4]

Source: https://www.apple.com/ipad-pro/specs/

**Wi-Fi + Cellular models**

UMTS/HSPA/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz)

CDMA EV-DO Rev. A and Rev. B (800, 1900 MHz)

LTE Advanced (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 17, 18, 19, 20, 21, 25, 26, 27, 28, 29, 30, 38, 39, 40, 41)[4]

Source: https://support.apple.com/kb/SP762?viewlocale=en_US&locale=en_US

**9.7-inch iPad Pro Wi-Fi + Cellular models**

UMTS/HSPA/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz)

CDMA EV-DO Rev. A and Rev. B (800, 1900 MHz)

LTE Advanced (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 27, 28, 29, 30, 38, 39, 40, 41)[4]

Source: https://support.apple.com/kb/SP739?locale=en_US

iPad (Fifth Generation):

**Wi-Fi + Cellular model**

Wi-Fi (802.11a/b/g/n/ac); dual band (2.4GHz and 5GHz); HT80 with MIMO

Bluetooth 4.2 technology

UMTS/HSPA/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz)

CDMA EV-DO Rev. A and Rev. B (800, 1900 MHz)

LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 17, 18, 19, 20, 25, 26, 28, 29, 38, 39, 40, 41)[4]

Source: https://www.apple.com/ipad-9.7/specs/

iPad Mini 4:

**Wi-Fi + Cellular models**

Wi-Fi (802.11a/b/g/n/ac); dual band (2.4GHz and 5GHz); HT80 with MIMO
Bluetooth 4.2 technology
UMTS/HSPA/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz); GSM/EDGE (850, 900, 1800, 1900 MHz)
CDMA EV-DO Rev. A and Rev. B (800, 1900 MHz)
LTE (Bands 1, 2, 3, 4, 5, 7, 8, 13, 17, 18, 19, 20, 25, 26, 28, 29, 38, 39, 40, 41)[4]

Source: https://www.apple.com/ipad-mini-4/specs/

40. The Plaintiffs understand that each cellular-capable iPad model released during or after 2012 also supported the LTE standard, including at least iPad model numbers A1454, A1455, A1459, A1460, A1475, A1476, A1490, A1491, A1550, A1567, A1600, A1652, A1671, A1674, A1675, A1709, and A1823.[1]

41. Further, as shown below, Apple advertises that each of its cellular-capable Apple Watch models supports the LTE standard.

| Model Number | Band Support | Country or Region | Supported Carriers |
|---|---|---|---|
| **Apple Watch Series 4**<br>Model A1975 (40mm)<br>Model A1976 (44mm) | **LTE**<br>**2** (1900 MHz)<br>**4** (AWS)<br>**5** (850 MHz)<br>**12** (700 MHz)<br>**13** (700c MHz)<br>**17** (700b MHz)<br>**18** (800 MHz)<br>**19** (800 MHz)<br>**25** (1900 MHz)<br>**26** (800 MHz)<br>**41** (TD 2500)<br>**UMTS**<br>850 MHz<br>1700 MHz<br>1900 MHz | United States | AT&T ↗<br>C Spire[3] ↗<br>Sprint Wireless[3] ↗<br>T-Mobile USA ↗<br>US Cellular[3] ↗<br>Verizon Wireless[3] ↗ |
| | | Canada | Bell[3]<br>Cellular service available in all Canadian provinces except Saskatchewan.<br>Telus<br>Rogers |
| | | Mexico | AT&T<br>Telcel |
| | | Puerto Rico | AT&T<br>Sprint Wireless[3]<br>T-Mobile USA |

[1] https://support.apple.com/en-us/HT201471

Source: https://www.apple.com/watch/cellular/

| Model Number | Band Support | Country or Region | Supported Carriers |
|---|---|---|---|
| **Apple Watch Series 3**<br>Model A1860 (38mm)<br>Model A1861 (42mm) | **LTE**<br>**2** (1900 MHz)<br>**4** (AWS)<br>**5** (850 MHz)<br>**12** (700 MHz)<br>**13** (700c MHz)<br>**17** (700b MHz)<br>**18** (800 MHz)<br>**19** (800 MHz)<br>**25** (1900 MHz)<br>**26** (800 MHz)<br>**41** (TD 2500)<br>**UMTS**<br>800 MHz<br>850 MHz<br>1700 MHz<br>1900 MHz | United States | AT&T ↗<br>Sprint Wireless[3] ↗<br>T-Mobile USA ↗<br>Verizon Wireless[3] ↗ |
| | | Canada | Bell[3] ↗<br>Cellular service available in all Canadian provinces except Saskatchewan.<br>Telus ↗ |
| | | Puerto Rico | AT&T ↗<br>Sprint Wireless[3] ↗<br>T-Mobile USA ↗ |

Source: https://www.apple.com/watch/cellular/

42. In accordance with 35 U.S.C. § 287, Apple has had actual notice and knowledge of all of the Patents-in-Suit no later than the filing of this Complaint and/or the date this Complaint was served upon Apple. On information and belief, Apple continues without license to make, use, import/export into/from, market, offer for sale, and/or sell in the United States products that infringe the Patents-in-Suit.

43. Apple has directly and indirectly infringed and continues to directly and indirectly infringe each of the Patents-in-Suit by engaging in acts constituting infringement under 35 U.S.C. § 271(a), (b), and/or (c), including but not necessarily limited to one or more of making, using, selling and offering to sell, in this District and elsewhere in the United States, and importing into and exporting from the United States, the Apple Accused Products or components thereof.

44. Apple provides instruction manuals that instruct the users of the Accused Products to use the Accused Products in a manner that infringes the Patents-in-Suit. For example, Apple advertises the compatibility of the iPhone, iPad, and Apple Watch models identified above with LTE.

45. Further, Apple tests each of the LTE Accused Products in the United States and thereby directly performs the claimed method and/or uses the claimed apparatus, thus infringing the Patents-in-Suit.

46. Apple's acts of infringement have caused damage to the Plaintiffs. The Plaintiffs are entitled to recover from Apple the damages sustained by the Plaintiffs as a result of Apple's wrongful acts in an amount subject to proof at trial.

47. Apple's infringement of the Patents-in-Suit is willful. Apple continues to commit acts of infringement despite a high likelihood that its actions constitute infringement, and Apple knew or should have known that its actions constituted an unjustifiably high risk of infringement.

48. In the interest of providing detailed averments of infringement, the Plaintiffs have identified below at least one claim per patent to demonstrate infringement. However, the selection of claims should not be considered limiting, and additional claims of the Patents-in-Suit that are infringed by Apple will be disclosed in compliance with the Court's rules related to infringement contentions.

## COUNT I: PATENT INFRINGEMENT OF THE '154 PATENT

49. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

50. Apple infringes, contributes to the infringement of, and/or induces infringement of the '154 Patent by making, using, selling, offering for sale, exporting from, and/or importing

into the United States products and/or methods covered by one or more claims of the '154 Patent including, but not limited to, at least the Apple Accused Products.

51. For example and as shown below, the Apple Accused Products infringe at least claim 37 of the '154 patent by virtue of their compatibility with and practice of the LTE Standard. For example, and to the extent the preamble is limiting, each of the Apple Accused Products comprises an apparatus for receiving a downlink shared channel in Orthogonal Frequency Division Multiple Access (OFDMA) wireless communication systems. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.201 section 4 and 3GPP TS 36.211 section 6.

## 4.2 General description of Layer 1

### 4.2.1 Multiple Access

The multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink. To support transmission in paired and unpaired spectrum, two duplex modes

### 6.1.1 Physical channels

A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers and is the interface defined between 36.212 and 36.211. The following downlink physical channels are defined:

- Physical Downlink Shared Channel, PDSCH

52. The accused products further comprise a reception unit for receiving a downlink control channel comprising transmission scheme information for downlink shared channel data and downlink shared channel data from a base station. As shown below, this functionality is described in the LTE standard, including but not limited to 3GPP TS 36.212 sections 4.2 and 5.3.

## 4.2 Downlink

Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

**Table 4.2-1**

| TrCH | Physical Channel |
|---|---|
| DL-SCH | PDSCH |
| BCH | PBCH |
| PCH | PDSCH |
| MCH | PMCH |

**Table 4.2-2**

| Control information | Physical Channel |
|---|---|
| CFI | PCFICH |
| HI | PHICH |
| DCI | PDCCH |

## 5.3.2 Downlink shared channel, Paging channel and Multicast channel

Figure 5.3.2-1 shows the processing structure for the DL-SCH, PCH and MCH transport channels. Data arrives to the coding unit in the form of a maximum of one transport block every transmission time interval (TTI). The following coding steps can be identified:

## 5.3.3 Downlink control information

A DCI transports downlink or uplink scheduling information, or uplink power control commands for one RNTI. The RNTI is implicitly encoded in the CRC.

### 5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

Format 1A is used for random access procedure initiated by a PDCCH order only if format 1A CRC is scrambled with C-RNTI and all the remaining fields are set as follows:

- Localized/Distributed VRB assignment flag – 1 bit is set to '0'

- Resource block assignment – $\left\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \right\rceil$ bits, where all bits shall be set to 1

5.3.3.1.5A Format 2A

The following information is transmitted by means of the DCI format 2A:

- Resource allocation header (resource allocation type 0 / type 1) – 1 bit as defined in section 7.1.6 of [3]

53. The accused products further comprise a control information extractor for configuring transmission information for the downlink control channel via higher layer signaling. As shown below, this functionality is described in the LTE standard, including but not limited to 3GPP TS 36.331 sections 4.4 and 5.4 and 3GPP TS 36.213 section 7.1.

## 4.4 Functions

The RRC protocol includes the following main functions:

- Broadcast of system information:
  - Including NAS common information;
  - Information applicable for UEs in RRC_IDLE, e.g. cell (re-)selection parameters, neighbouring cell information and information (also) applicable for UEs in RRC_CONNECTED, e.g. common channel configuration information.
  - Including ETWS notification;
- RRC connection control:
  - Paging;
  - Establishment/ modification/ release of RRC connection, including e.g. assignment/ modification of UE identity (C-RNTI), establishment/ modification/ release of SRB1 and SRB2, access class barring;

### 5.4.2 Handover to E-UTRA

#### 5.4.2.1 General

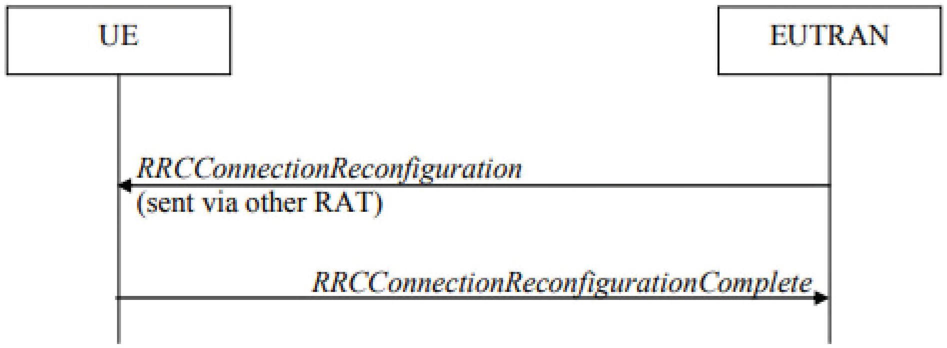


**Figure 5.4.2.1-1: Handover to E-UTRA, successful**

#### 5.4.2.3 Reception of the *RRCConnectionReconfiguration* by the UE

If the UE is able to comply with the configuration included in the *RRCConnectionReconfiguration* message, the UE shall:

1> set the C-RNTI to the value of the *newUE-Identity*;

### 7.1 UE procedure for receiving the physical downlink shared channel

The UE is semi-statically configured via higher layer signalling to receive PDSCH data transmissions signalled via PDCCH UE specific search spaces, according to one of seven transmission modes, denoted mode 1 to mode 7.

If a UE is configured by higher layers to decode PDCCH with CRC scrambled by the C-RNTI, the UE shall decode the PDCCH and any corresponding PDSCH according to the respective combinations defined in table 7.1-5. The scrambling initialization of PDSCH corresponding to these PDCCHs is by C-RNTI.

54. The accused products further comprise a demodulator for demodulating the downlink shared channel data. As shown below, the downlink shared channel data in LTE is modulated and must be demodulated by the UE. This functionality is described in the LTE standard, including but not limited to 3GPP TS 36.211 sections 6.3 and 6.4 and 3GPP TS 36.212 section 5.3.3.

## 6.3 General structure for downlink physical channels

This section describes a general structure, applicable to more than one physical channel.

The baseband signal representing a downlink physical channel is defined in terms of the following steps:

- scrambling of coded bits in each of the code words to be transmitted on a physical channel
- modulation of scrambled bits to generate complex-valued modulation symbols
- mapping of the complex-valued modulation symbols onto one or several transmission layers
- precoding of the complex-valued modulation symbols on each layer for transmission on the antenna ports
- mapping of complex-valued modulation symbols for each antenna port to resource elements
- generation of complex-valued time-domain OFDM signal for each antenna port

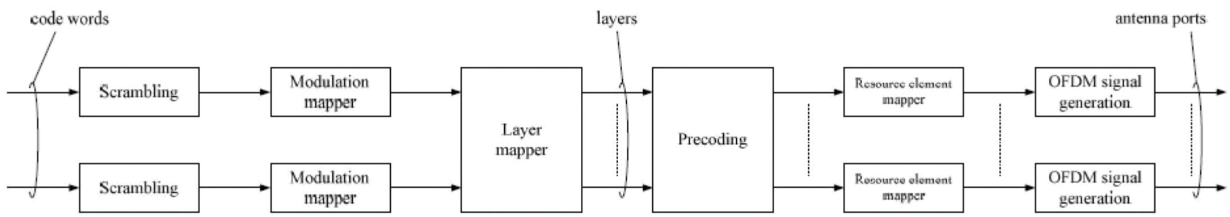


**Figure 6.3-1: Overview of physical channel processing.**

### 6.3.2 Modulation

For each code word $q$, the block of scrambled bits $\tilde{b}^{(q)}(0),...,\tilde{b}^{(q)}(M_{\text{bit}}^{(q)}-1)$ shall be modulated as described in Section 7.1 using one of the modulation schemes in Table 6.3.2-1, resulting in a block of complex-valued modulation symbols $d^{(q)}(0),...,d^{(q)}(M_{\text{symb}}^{(q)}-1)$.

**Table 6.3.2-1: Modulation schemes**

| Physical channel | Modulation schemes |
|---|---|
| **PDSCH** | **QPSK, 16QAM, 64QAM** |
| **PMCH** | **QPSK, 16QAM, 64QAM** |

## 6.4 Physical downlink shared channel

The physical downlink shared channel shall be processed and mapped to resource elements as described in Section 6.3 with the following exceptions:

- In resource blocks in which UE-specific reference signals are not transmitted, the PDSCH shall be transmitted on the same set of antenna ports as the PBCH, which is one of $\{0\}$, $\{0,1\}$, or $\{0,1,2,3\}$
- In resource blocks in which UE-specific reference signals are transmitted, the PDSCH shall be transmitted on antenna port $\{5\}$

#### 5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

#### 5.3.3.1.5A Format 2A

The following information is transmitted by means of the DCI format 2A:

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

55. The accused products further comprise a controller for controlling the aforementioned reception unit to receive the downlink control channel with a format

corresponding to the transmission information and the demodulator to demodulate the downlink shared channel data according to the transmission scheme information included in the format. This functionality is described in the LTE standard, including but not limited to 3GPP TS 36.213 section 7.1 and 3GPP TS 36.212 section 5.3.3.

## 7.1 UE procedure for receiving the physical downlink shared channel

A UE shall upon detection of a PDCCH with DCI format 1, 1A, 1B, 1C, 1D, 2 or 2A intended for the UE in a subframe, decode the corresponding PDSCH in the same subframe with the restriction of the number of transport blocks defined in the higher layers.

If a UE is configured by higher layers to decode PDCCH with CRC scrambled by the C-RNTI, the UE shall decode the PDCCH and any corresponding PDSCH according to the respective combinations defined in table 7.1-5. The scrambling initialization of PDSCH corresponding to these PDCCHs is by C-RNTI.

**Table 7.1-5: PDCCH and PDSCH configured by C-RNTI**

| Transmission mode | DCI format | Search Space | Transmission scheme of PDSCH corresponding to PDCCH |
|---|---|---|---|
| Mode 1 | DCI format 1A | Common and UE specific by C-RNTI | Single-antenna port, port 0 (see subclause 7.1.1) |
| | DCI format 1 | UE specific by C-RNTI | Single-antenna port, port 0 (see subclause 7.1.1) |
| Mode 2 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1 | UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| Mode 3 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 2A | UE specific by C-RNTI | Large delay CDD (see subclause 7.1.3) or Transmit diversity (see subclause 7.1.2) |
| Mode 4 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 2 | UE specific by C-RNTI | Closed-loop spatial multiplexing (see subclause 7.1.4)or Transmit diversity (see subclause 7.1.2) |
| Mode 5 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1D | UE specific by C-RNTI | Multi-user MIMO (see subclause 7.1.5) |
| Mode 6 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1B | UE specific by C-RNTI | Closed-loop spatial multiplexing (see subclause 7.1.4) using a single transmission layer |
| Mode 7 | DCI format 1A | Common and UE specific by C-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see subclause 7.1.1), otherwise Transmit diversity (see subclause 7.1.2) |
| | DCI format 1 | UE specific by C-RNTI | Single-antenna port; port 5 (see subclause 7.1.1) |

5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

5.3.3.1.5A Format 2A

The following information is transmitted by means of the DCI format 2A:

In addition, for transport block 1:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

In addition, for transport block 2:

- Modulation and coding scheme – 5 bits as defined in section 7.1.7 of [3]
- New data indicator – 1 bit
- Redundancy version – 2 bits

56. In the accused products, the transmission scheme information referenced above indicates that a transmit diversity or open loop spatial multiplexing is used for transmitting the downlink shared channel data. This functionality is described in the LTE standard, including but not limited to 3GPP TS 36.213 section 7.1 and 3GPP TS 36.212 section 5.3.3.

## 7.1 UE procedure for receiving the physical downlink shared channel

A UE shall upon detection of a PDCCH with DCI format 1, 1A, 1B, 1C, 1D, 2 or 2A intended for the UE in a subframe, decode the corresponding PDSCH in the same subframe with the restriction of the number of transport blocks defined in the higher layers.

If a UE is configured by higher layers to decode PDCCH with CRC scrambled by the C-RNTI, the UE shall decode the PDCCH and any corresponding PDSCH according to the respective combinations defined in table 7.1-5. The scrambling initialization of PDSCH corresponding to these PDCCHs is by C-RNTI.

**Table 7.1-5: PDCCH and PDSCH configured by C-RNTI**

| Transmission mode | DCI format | Search Space | Transmission scheme of PDSCH corresponding to PDCCH |
|---|---|---|---|
| Mode 1 | DCI format 1A | Common and UE specific by C-RNTI | Single-antenna port, port 0 (see subclause 7.1.1) |
| | DCI format 1 | UE specific by C-RNTI | Single-antenna port, port 0 (see subclause 7.1.1) |
| Mode 2 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1 | UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| Mode 3 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 2A | UE specific by C-RNTI | Large delay CDD (see subclause 7.1.3) or Transmit diversity (see subclause 7.1.2) |
| Mode 4 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 2 | UE specific by C-RNTI | Closed-loop spatial multiplexing (see subclause 7.1.4)or Transmit diversity (see subclause 7.1.2) |
| Mode 5 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1D | UE specific by C-RNTI | Multi-user MIMO (see subclause 7.1.5) |
| Mode 6 | DCI format 1A | Common and UE specific by C-RNTI | Transmit diversity (see subclause 7.1.2) |
| | DCI format 1B | UE specific by C-RNTI | Closed-loop spatial multiplexing (see subclause 7.1.4) using a single transmission layer |
| Mode 7 | DCI format 1A | Common and UE specific by C-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see subclause 7.1.1), otherwise Transmit diversity (see subclause 7.1.2) |
| | DCI format 1 | UE specific by C-RNTI | Single-antenna port; port 5 (see subclause 7.1.1) |

**Table 5.3.3.1.5A-1: Number of bits for precoding information**

| Number of antenna ports at eNode-B | Number of bits for precoding information |
|---|---|
| 2 | 0 |
| 4 | 2 |

**Table 5.3.3.1.5A-2: Content of precoding information field for 4 antenna ports**

| One codeword: Codeword 0 enabled, Codeword 1 disabled | | Two codewords: Codeword 0 enabled, Codeword 1 enabled | |
|---|---|---|---|
| Bit field mapped to index | Message | Bit field mapped to index | Message |
| 0 | 4 layers: Transmit diversity | 0 | 2 layers: precoder cycling with large delay CDD |
| 1 | 2 layers: precoder cycling with large delay CDD | 1 | 3 layers: precoder cycling with large delay CDD |
| 2 | reserved | 2 | 4 layers: precoder cycling with large delay CDD |
| 3 | reserved | 3 | reserved |

57. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’154 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’154 Patent.

58. Apple has had knowledge and notice of the ’154 Patent at least as of the filing of the Complaint.

59. Apple indirectly infringes the ’154 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’154 patent. Apple induces this direct

infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple's inducement, Apple's customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the '154 Patent. Apple performs these affirmative acts with knowledge of the '154 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '154 Patent.

60. Apple also indirectly infringes the '154 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple's affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple's customers and end-users use of the Apple Accused Products, such that the '154 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the '154 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the '154 Patent. Apple performs these affirmative acts with knowledge of the '154 Patent and with intent, or willful blindness, that they cause the direct infringement of the '154 Patent.

61. Apple's infringement of the '154 Patent has damaged and will continue to damage the Plaintiffs.

**COUNT II: PATENT INFRINGEMENT OF THE ’332 PATENT**

62. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

63. Apple infringes, contributes to the infringement of, and/or induces infringement of the ’332 Patent by making, using, selling, offering for sale, exporting from, and/or importing into the United States products and/or methods covered by one or more claims of the ’332 Patent including, but not limited to, at least the Apple Accused Products.

64. For example and as shown below, the LTE Accused Products infringe claim 6 of the ’332 patent by virtue of their compatibility with and practice of the LTE Standard. For example, and to the extent the preamble is limiting, the Accused Products comprise user equipment (UE) for decoding control information. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.201 sections 1 and 4.

# 1 Scope

The present document describes a general description of the physical layer of the E-UTRA radio interface. The present document also describes the document structure of the 3GPP physical layer specifications, i.e. TS 36.200 series. The TS 36.200 series specifies the Uu point for the 3G LTE mobile system, and defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

# 4 General description of LTE Layer 1

## 4.1 Relation to other layers

### 4.1.1 General Protocol Architecture

The radio interface described in this specification covers the interface between the User Equipment (UE) and the network. The radio interface is composed of the Layer 1, 2 and 3. The TS 36.200 series describes the Layer 1 (Physical Layer) specifications. Layers 2 and 3 are described in the 36.300 series.

65. The Accused Products further comprise a receiver for receiving Physical Downlink Control Channel (PDCCH) from a base station at subframe k. As shown below, this

functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 section 9.1.1.

## 9.1 UE procedure for determining physical downlink control channel assignment

### 9.1.1 PDCCH Assignment Procedure

The control region consists of a set of CCEs, numbered from 0 to $N_{\mathrm{CCE},k}-1$ according to Section 6.8.2 in [3], where $N_{\mathrm{CCE},k}$ is the total number of CCEs in the control region of subframe $k$. The UE shall monitor a set of PDCCH candidates for control information in every non-DRX subframe, where monitoring implies attempting to decode each of the PDCCHs in the set according to all the monitored DCI formats.

The set of PDCCH candidates to monitor are defined in terms of search spaces, where a search space $S_k^{(L)}$ at aggregation level $L \in \{1,2,4,8\}$ is defined by a set of PDCCH candidates. The CCEs corresponding to PDCCH

66. The Accused Products further comprise a decoder for decoding a set of PDCCH candidates within a search space of the PDCCH at the subframe k. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 section 9.1.1.

## 9.1 UE procedure for determining physical downlink control channel assignment

### 9.1.1 PDCCH Assignment Procedure

The control region consists of a set of CCEs, numbered from 0 to $N_{\mathrm{CCE},k}-1$ according to Section 6.8.2 in [3], where $N_{\mathrm{CCE},k}$ is the total number of CCEs in the control region of subframe $k$. The UE shall monitor a set of PDCCH candidates for control information in every non-DRX subframe, where monitoring implies attempting to decode each of the PDCCHs in the set according to all the monitored DCI formats.

The set of PDCCH candidates to monitor are defined in terms of search spaces, where a search space $S_k^{(L)}$ at aggregation level $L \in \{1,2,4,8\}$ is defined by a set of PDCCH candidates. The CCEs corresponding to PDCCH

67. The Accused Products further comprise a decoder wherein each of the set of PDCCH candidates comprises ‘L’ control channel elements (CCEs), wherein the ‘L’ CCEs corresponding to a specific PDCCH candidate among the set of PDCCH candidates of the search space at the sub frame k are contiguously located from a position given by using a variable of $Y_k$

for the subframe k and a modulo 'C' operation. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 section 9.1.1.

## 9.1.1 PDCCH Assignment Procedure

***

The set of PDCCH candidates to monitor are defined in terms of search spaces, where a search space $S_k^{(L)}$ at aggregation level $L \in \{1,2,4,8\}$ is defined by a set of PDCCH candidates. The CCEs corresponding to PDCCH candidate $m$ of the search space $S_k^{(L)}$ are given by

$$L \cdot \{(Y_k + m) \bmod \lfloor N_{\mathrm{CCE},k} / L \rfloor\} + i$$

where $Y_k$ is defined below, $i = 0,\cdots,L-1$ and $m = 0,\cdots,M^{(L)}-1$. $M^{(L)}$ is the number of PDCCH candidates to monitor in the given search space.

***

For the UE-specific search space $S_k^{(L)}$ at aggregation level $L$, the variable $Y_k$ is defined by

$$Y_k = (A \cdot Y_{k-1}) \bmod D$$

where $Y_{-1} = n_{\mathrm{RNTI}} \neq 0$, $A = 39827$, $D = 65537$ and $k = \lfloor n_s / 2 \rfloor$, $n_s$ is the slot number within a radio frame.. The RNTI value used for $n_{\mathrm{RNTI}}$ is defined in section 7.1 in downlink and section 8 in uplink.

68. The Accused Products further comprise a decoder wherein 'C' is determined as 'floor(N/L)', wherein 'N' represents a total number of CCEs in the sub frame k, and wherein $Y_k$ is defined by: $Y_k=(A*Y_{k-1})\text{mod } D$, wherein A and D are predetermined constant values. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 section 9.1.1.

## 9.1.1 PDCCH Assignment Procedure

The control region consists of a set of CCEs, numbered from 0 to $N_{\mathrm{CCE},k} - 1$ according to Section 6.8.2 in [3], where $N_{\mathrm{CCE},k}$ is the total number of CCEs in the control region of subframe $k$. The UE shall monitor a set of PDCCH

***

of PDCCH candidates. The CCEs corresponding to PDCCH candidate $m$ of the search space $S_k^{(L)}$ are given by

$$L \cdot \{(Y_k + m) \bmod \lfloor N_{\mathrm{CCE},k} / L \rfloor\} + i$$

***

For the UE-specific search space $S_k^{(L)}$ at aggregation level $L$, the variable $Y_k$ is defined by

$$Y_k = (A \cdot Y_{k-1}) \bmod D$$

where $Y_{-1} = n_{RNTI} \neq 0$, $A = 39827$, $D = 65537$ and $k = \lfloor n_s/2 \rfloor$, $n_s$ is the slot number within a radio frame.. The RNTI value used for $n_{RNTI}$ is defined in section 7.1 in downlink and section 8 in uplink.

69. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’332 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’332 Patent.

70. Apple has had knowledge and notice of the ’332 Patent at least as of the filing of this Complaint.

71. Apple indirectly infringes the ’332 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’332 patent. Apple induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple’s inducement, Apple’s customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the ’332 Patent. Apple performs these affirmative acts with knowledge of the ’332 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’332 Patent.

72. Apple also indirectly infringes the ’332 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple’s affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple’s customers and end-users use of the Apple Accused Products, such that the ’332 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the ’332 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the ’332 Patent. Apple performs these affirmative acts with knowledge of the ’332 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’332 Patent.

73. Apple’s infringement of the ’332 Patent has damaged and will continue to damage the Plaintiffs.

## COUNT III: PATENT INFRINGEMENT OF THE ’284 PATENT

74. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

75. Apple infringes, contributes to the infringement of, and/or induces infringement of the ’284 Patent by making, using, selling, offering for sale, exporting from, and/or importing into the United States products and/or methods covered by one or more claims of the ’284 Patent including, but not limited to, at least the Apple Accused Products.

76. For example and as shown below, the Accused Products infringe claim 1 of the ’284 patent by virtue of their compatibility with and practice of the LTE standard. For example,

the Accused Products are mobile terminals for use in a mobile communications system. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.201 §§ 1, 4.1.

# 1 Scope

The present document describes a general description of the physical layer of the E-UTRA radio interface. The present document also describes the document structure of the 3GPP physical layer specifications, i.e. TS 36.200 series. The TS 36.200 series specifies the Uu point for the 3G LTE mobile system, and defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

# 4 General description of LTE Layer 1

## 4.1 Relation to other layers

### 4.1.1 General Protocol Architecture

The radio interface described in this specification covers the interface between the User Equipment (UE) and the network. The radio interface is composed of the Layer 1, 2 and 3. The TS 36.200 series describes the Layer 1 (Physical Layer) specifications. Layers 2 and 3 are described in the 36.300 series.

77. The Accused Products further comprise a receiver unit for receiving a sub-frame of physical radio resources comprising a control channel signal destined to the mobile terminal. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8.

# 8 Physical uplink shared channel related procedures

For FDD, there shall be 8 HARQ processes in the uplink for non-subframe bundling operation, i.e. normal HARQ operation, and 4 HARQ processes in the uplink for subframe bundling operation. The subframe bundling operation is configured by the parameter *ttiBundling* provided by higher layers.

In case higher layers configure the use of subframe bundling for FDD and TDD, the subframe bundling operation is only applied to UL-SCH, such that four consecutive uplink subframes are used.

For FDD and normal HARQ operation, the UE shall upon detection of a PDCCH with DCI format 0 and/or a PHICH transmission in subframe $n$ intended for the UE, adjust the corresponding PUSCH transmission in subframe $n+4$ according to the PDCCH and PHICH information.

[…]

> If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the PDCCH according to the combination defined in table 8-3 and transmit the corresponding PUSCH. The scrambling initialization of this PUSCH corresponding to these PDCCHs and the PUSCH retransmission for the same transport block is by C-RNTI.

78. The Accused Products further comprise a processing unit for determining based on the received control channel signal a transport format of and a redundancy version for an initial transmission or a retransmission of a protocol data unit conveying user data. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8, TS 36.212 § 5.3.

# 8 Physical uplink shared channel related procedures

For FDD, there shall be 8 HARQ processes in the uplink for non-subframe bundling operation, i.e. normal HARQ operation, and 4 HARQ processes in the uplink for subframe bundling operation. The subframe bundling operation is configured by the parameter *ttiBundling* provided by higher layers.

In case higher layers configure the use of subframe bundling for FDD and TDD, the subframe bundling operation is only applied to UL-SCH, such that four consecutive uplink subframes are used.

For FDD and normal HARQ operation, the UE shall upon detection of a PDCCH with DCI format 0 and/or a PHICH transmission in subframe *n* intended for the UE, adjust the corresponding PUSCH transmission in subframe *n+4* according to the PDCCH and PHICH information.

[…]

If a UE is configured by higher layers to decode PDCCHs with the CRC scrambled by the C-RNTI, the UE shall decode the PDCCH according to the combination defined in table 8-3 and transmit the corresponding PUSCH. The scrambling initialization of this PUSCH corresponding to these PDCCHs and the PUSCH retransmission for the same transport block is by C-RNTI.

### 5.3.3.1.1 Format 0

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil$ bits

- For PUSCH hopping:
  - $N_{UL\_hop}$ MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]
  - $\left(\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil - N_{UL\_hop}\right)$ bits provide the resource allocation of the first slot in the UL subframe
- For non-hopping PUSCH:
  - $\left(\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil\right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]
- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit

79. The Accused Products further comprise a transmitter unit for transmitting the protocol data unit on at least one physical radio resource using the transport format and the redundancy version of the protocol data unit indicated in the received control channel signal. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8, TS 36.212 § 5.3.

# 8 Physical uplink shared channel related procedures

For FDD, there shall be 8 HARQ processes in the uplink for non-subframe bundling operation, i.e. normal HARQ operation, and 4 HARQ processes in the uplink for subframe bundling operation. The subframe bundling operation is configured by the parameter *ttiBundling* provided by higher layers.

In case higher layers configure the use of subframe bundling for FDD and TDD, the subframe bundling operation is only applied to UL-SCH, such that four consecutive uplink subframes are used.

For FDD and normal HARQ operation, the UE shall upon detection of a PDCCH with DCI format 0 and/or a PHICH transmission in subframe *n* intended for the UE, adjust the corresponding PUSCH transmission in subframe *n+4* according to the PDCCH and PHICH information.

5.3.3.1.1 Format 0

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil$ bits

- For PUSCH hopping:
  - $N_{UL\_hop}$ MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]
  - $\left( \left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil - N_{UL\_hop} \right)$ bits provide the resource allocation of the first slot in the UL subframe
- For non-hopping PUSCH:
  - $\left( \left\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \right\rceil \right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]
- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit

80. The Accused Products further comprise a mobile terminal wherein the control channel signal received within said sub-frame comprises a control information field, in which the transport format and the redundancy version of the protocol data unit are jointly encoded. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8.6.

## 8.6 Modulation order, redundancy version and transport block size determination

To determine the modulation order, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme and redundancy version" field ( $I_{MCS}$ ) in the DCI, and
- check the "CQI request" bit in DCI, and
- compute the total number of allocated PRBs ( $N_{PRB}$ ) based on the procedure defined in Section 8.1, and
- compute the number of coded symbols for control information..

81. The Accused Products further comprise a mobile terminal wherein the processing unit is further configured for the determination of the control information field, which consists of a number of bits representing a range of values that can be represented in the control information field. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8.6.


## 8.6 Modulation order, redundancy version and transport block size determination

To determine the modulation order, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme and redundancy version" field ( $I_{MCS}$ ) in the DCI, and
- check the "CQI request" bit in DCI, and
- compute the total number of allocated PRBs ( $N_{PRB}$ ) based on the procedure defined in Section 8.1, and
- compute the number of coded symbols for control information..


82. The Accused Products further comprise a mobile terminal wherein a first subset of the values is reserved for indicating the transport format of the protocol data unit and a second subset of the values, different from the first subset of the values, is reserved for indicating the redundancy version for transmitting the user data. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8.6.

## 8.6.1 Modulation order and redundancy version determination

For $0 \le I_{MCS} \le 28$, the modulation order ($Q_m$) is determined as follows:

- If the UE is capable of supporting 64QAM in PUSCH and has not been configured by higher layers to transmit only QPSK and 16QAM, the modulation order is given by $Q_m^{'}$ in Table 8.6.1-1.
- If the UE is not capable of supporting 64QAM in PUSCH or has been configured by higher layers to transmit only QPSK and 16QAM, $Q_m^{'}$ is first read from Table 8.6.1-1. The modulation order is set to $Q_m = \min(4, Q_m^{'})$.
- If the parameter *ttiBundling* provided by higher layers is set to *TRUE*, then the resource allocation size is restricted to $N_{PRB} \le 3$ and the modulation order is set to $Q_m = 2$.

For $29 \le I_{MCS} \le 31$, if $I_{MCS} = 29$, the "CQI request" bit in DCI format 0 is set to 1 and $N_{PRB} \le 4$, the modulation order is set to $Q_m = 2$. Otherwise, the modulation order shall be determined from the DCI transported in the latest PDCCH with DCI format 0 for the same transport block using $0 \le I_{MCS} \le 28$. If there is no PDCCH with DCI format 0 for the same transport block using $0 \le I_{MCS} \le 28$, the modulation order shall be determined from

- the most recent semi-persistent scheduling assignment PDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,
- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

The UE shall use $I_{MCS}$ and Table 8.6.1-1 to determine the redundancy version ($rv_{idx}$) to use in the physical uplink shared channel.

**Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH**

| MCS Index $I_{MCS}$ | Modulation Order $Q'_m$ | TBS Index $I_{TBS}$ | Redundancy Version $rv_{idx}$ |
|---|---|---|---|
| 0 | 2 | 0 | 0 |
| 1 | 2 | 1 | 0 |
| 2 | 2 | 2 | 0 |
| 3 | 2 | 3 | 0 |
| 4 | 2 | 4 | 0 |
| 5 | 2 | 5 | 0 |
| 6 | 2 | 6 | 0 |
| 7 | 2 | 7 | 0 |
| 8 | 2 | 8 | 0 |
| 9 | 2 | 9 | 0 |
| 10 | 2 | 10 | 0 |
| 11 | 4 | 10 | 0 |
| 12 | 4 | 11 | 0 |
| 13 | 4 | 12 | 0 |
| 14 | 4 | 13 | 0 |
| 15 | 4 | 14 | 0 |
| 16 | 4 | 15 | 0 |
| 17 | 4 | 16 | 0 |
| 18 | 4 | 17 | 0 |
| 19 | 4 | 18 | 0 |
| 20 | 4 | 19 | 0 |
| 21 | 6 | 19 | 0 |
| 22 | 6 | 20 | 0 |
| 23 | 6 | 21 | 0 |
| 24 | 6 | 22 | 0 |
| 25 | 6 | 23 | 0 |
| 26 | 6 | 24 | 0 |
| 27 | 6 | 25 | 0 |
| 28 | 6 | 26 | 0 |
| 29 | reserved | | 1 |
| 30 | | | 2 |
| 31 | | | 3 |

83. The Accused Products further comprise a mobile terminal wherein the first subset of the values contains more values than the second subset of the values. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 8.6.

**Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH**

| MCS Index $I_{MCS}$ | Modulation Order $Q'_m$ | TBS Index $I_{TBS}$ | Redundancy Version $rv_{idx}$ |
|---|---|---|---|
| 0 | 2 | 0 | 0 |
| 1 | 2 | 1 | 0 |
| 2 | 2 | 2 | 0 |
| 3 | 2 | 3 | 0 |
| 4 | 2 | 4 | 0 |
| 5 | 2 | 5 | 0 |
| 6 | 2 | 6 | 0 |
| 7 | 2 | 7 | 0 |
| 8 | 2 | 8 | 0 |
| 9 | 2 | 9 | 0 |
| 10 | 2 | 10 | 0 |
| 11 | 4 | 10 | 0 |
| 12 | 4 | 11 | 0 |
| 13 | 4 | 12 | 0 |
| 14 | 4 | 13 | 0 |
| 15 | 4 | 14 | 0 |
| 16 | 4 | 15 | 0 |
| 17 | 4 | 16 | 0 |
| 18 | 4 | 17 | 0 |
| 19 | 4 | 18 | 0 |
| 20 | 4 | 19 | 0 |
| 21 | 6 | 19 | 0 |
| 22 | 6 | 20 | 0 |
| 23 | 6 | 21 | 0 |
| 24 | 6 | 22 | 0 |
| 25 | 6 | 23 | 0 |
| 26 | 6 | 24 | 0 |
| 27 | 6 | 25 | 0 |
| 28 | 6 | 26 | 0 |
| 29 | reserved | | 1 |
| 30 | | | 2 |
| 31 | | | 3 |

84. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’284 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’284 Patent.

85. Apple has had knowledge and notice of the ’284 Patent at least as of the filing of this Complaint.

86. Apple indirectly infringes the ’284 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’284 patent. Apple induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple’s inducement, Apple’s customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the ’284 Patent. Apple performs these affirmative acts with knowledge of the ’284 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’284 Patent.

87. Apple also indirectly infringes the ’284 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple’s affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple’s customers and end-users use of the Apple Accused Products, such that the ’284 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the ’284 Patent, are not staple articles or commodities of

commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the ’284 Patent. Apple performs these affirmative acts with knowledge of the ’284 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’284 Patent.

88. Apple’s infringement of the ’284 Patent has damaged and will continue to damage the Plaintiffs.

**COUNT IV: PATENT INFRINGEMENT OF THE ’557 PATENT**

89. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

90. Apple infringes, contributes to the infringement of, and/or induces infringement of the ’557 Patent by making, using, selling, offering for sale, exporting from, and/or importing into the United States products and/or methods covered by one or more claims of the ’557 Patent including, but not limited to, at least the Apple Accused Products.

91. For example and as shown below, the Accused Products infringe claim 1 of the ’557 patent by virtue of their compatibility with and practice of the LTE standard. For example, the Accused Products are mobile station apparatuses. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.201 sections 1 and 4.

## 1 Scope

The present document describes a general description of the physical layer of the E-UTRA radio interface. The present document also describes the document structure of the 3GPP physical layer specifications, i.e. TS 36.200 series. The TS 36.200 series specifies the Uu point for the 3G LTE mobile system, and defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

# 4 General description of LTE Layer 1

## 4.1 Relation to other layers

### 4.1.1 General Protocol Architecture

The radio interface described in this specification covers the interface between the User Equipment (UE) and the network. The radio interface is composed of the Layer 1, 2 and 3. The TS 36.200 series describes the Layer 1 (Physical Layer) specifications. Layers 2 and 3 are described in the 36.300 series.

92. The Accused Products include a receiving unit configured to receive control information. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.321 section 5.1, 3GPP TS 36.331 sections 5.1, 5.2, and 6.3.

# 5 MAC procedures

## 5.1 Random Access procedure

### 5.1.1 Random Access Procedure initialization

The Random Access procedure described in this subclause is initiated by a PDCCH order or by the MAC sublayer itself. If a UE receives a PDCCH transmission consistent with a PDCCH order [5] masked with its C-RNTI, it shall initiate a Random Access procedure. The PDCCH order or RRC optionally indicate *ra-PreambleIndex* and *ra-PRACH-MaskIndex*.

# 5 Procedures

## 5.1 General

### 5.1.1 Introduction

The procedural requirements are structured according to the main functional areas: system information (5.2), connection control (5.3), inter-RAT mobility (5.4) and measurements (5.5). In addition there is a sub-clause other (5.6) that covers e.g. NAS dedicated information transfer, UE capability transfer. Finally, sub-clause 5.7 specifies the generic error handling.

### 5.1.2 General requirements

The UE shall:

1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;

#### 5.2.2.9 Actions upon reception of *SystemInformationBlockType2*

Upon receiving *SystemInformationBlockType2*, the UE shall:

1> if upper layers indicate that a (UE specific) paging cycle is configured:

2> Apply the shortest of the (UE specific) paging cycle and the *defaultPagingCycle* included in the *radioResourceConfigCommon*;

1> else:

2> Apply the *defaultPagingCycle* included in the *radioResourceConfigCommon*;

1> if the *mbsfn-SubframeConfigList* is included:

2> consider that no other DL assignments occur in the MBSFN subframes indicated in the IE *mbsfn-SubframeConfigList*:

1> apply the configuration included in the *radioResourceConfigCommon*;

1> apply the specified PCCH configuration defined in 9.1.1.3;

1> not apply the *timeAlignmentTimerCommon*;

1> if in RRC_CONNECTED while T311 is not running; and the UE supports multi-band cells as defined by bit 31 in *featureGroupIndicators*:

2> disregard the *additionalSpectrumEmission* and *ul-CarrierFreq*, if received, while in RRC_CONNECTED;

# 6.3 RRC information elements

## 6.3.1 System information blocks

### – *SystemInformationBlockType2*

The IE *SystemInformationBlockType2* contains radio resource configuration information that is common for all UEs.

NOTE: UE timers and constants related to functionality for which parameters are provided in another SIB are included in the corresponding SIB.

***SystemInformationBlockType2* information element**

```
-- ASN1START

SystemInformationBlockType2 ::=     SEQUENCE {
    ac-BarringInfo                      SEQUENCE {
        ac-BarringForEmergency              BOOLEAN,
        ac-BarringForMO-Signalling          AC-BarringConfig                OPTIONAL,   -- Need OP
        ac-BarringForMO-Data                AC-BarringConfig                OPTIONAL    -- Need OP
    }                                                                       OPTIONAL,   -- Need OP
    radioResourceConfigCommon           RadioResourceConfigCommonSIB,
    ue-TimersAndConstants               UE-TimersAndConstants,
```

### – *RadioResourceConfigCommon*

The IE *RadioResourceConfigCommonSIB* and IE *RadioResourceConfigCommon* are used to specify common radio resource configurations in the system information and in the mobility control information, respectively, e.g., the random access parameters and the static physical layer parameters.

***RadioResourceConfigCommon* information element**

```
-- ASN1START

RadioResourceConfigCommonSIB ::=    SEQUENCE {
    rach-ConfigCommon                   RACH-ConfigCommon,
```

### – *RACH-ConfigCommon*

The IE *RACH-ConfigCommon* is used to specify the generic random access parameters.

***RACH-ConfigCommon* information element**

```
-- ASN1START

RACH-ConfigCommon ::=       SEQUENCE {
    preambleInfo                        SEQUENCE {
        numberOfRA-Preambles                ENUMERATED {
                                                n4, n8, n12, n16 ,n20, n24, n28,
                                                n32, n36, n40, n44, n48, n52, n56,
                                                n60, n64},
        preamblesGroupAConfig               SEQUENCE {
            sizeOfRA-PreamblesGroupA            ENUMERATED {
                                                    n4, n8, n12, n16 ,n20, n24, n28,
                                                    n32, n36, n40, n44, n48, n52, n56,
                                                    n60},
            messageSizeGroupA                   ENUMERATED {b56, b144, b208, b256},
            messagePowerOffsetGroupB            ENUMERATED {
                                                    minusinfinity, dB0, dB5, dB8, dB10, dB12,
                                                    dB15, dB18},
```

| RACH-ConfigCommon field descriptions |
|---|
| ***numberOfRA-Preambles***<br>Number of non-dedicated random access preambles in TS 36.321 [6]. Value is an integer. Value n4 corresponds to 4, n8 corresponds to 8 and so on. |
| ***preamblesGroupAConfig***<br>Provides the configuration for preamble grouping in TS 36.321 [6]. If the field is not signalled, the size of the random access preambles group A [6] is equal to *numberOfRA-Preambles*. |
| ***sizeOfRA-PreamblesGroupA***<br>Size of the random access preambles group A in TS 36.321 [6]. Value is an integer. Value n4 corresponds to 4, n8 corresponds to 8 and so on. |
| ***messageSizeGroupA***<br>Threshold for preamble selection in TS 36.321 [6]. Value in bits. Value b56 corresponds to 56 bits, b144 corresponds to 144 bits and so on. |

93. The Accused Products further include a selecting unit configured to randomly select a sequence from a plurality of sequences contained in one group of a plurality of groups, into which a predetermined number of sequences that are generated from a plurality of base sequences are grouped and which are respectively associated with different amounts of data or reception qualities, wherein the predetermined number of sequences are grouped by partitioning the predetermined number of sequences, in which sequences generated from the same base sequence and having different cyclic shifts are arranged in an increasing order of the cyclic shifts. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.300 section 10.1.5, 3GPP TS 36.321 section 5.1, and 3GPP TS 36.211 section 5.7.2.

> The four steps of the contention based random access procedures are:
>
> 1) Random Access Preamble on RACH in uplink:
>
> - There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.

# 5 MAC procedures

## 5.1 Random Access procedure

### 5.1.1 Random Access Procedure initialization

The Random Access procedure described in this subclause is initiated by a PDCCH order or by the MAC sublayer itself. If a UE receives a PDCCH transmission consistent with a PDCCH order [5] masked with its C-RNTI, it shall initiate a Random Access procedure. The PDCCH order or RRC optionally indicate *ra-PreambleIndex* and *ra-PRACH-MaskIndex*.

Before the procedure can be initiated, the following information is assumed to be available [8]:

- the available set of PRACH resources for the transmission of the Random Access Preamble, *prach-ConfigIndex*.
- the groups of Random Access Preambles and the set of available Random Access Preambles in each group:

  The preambles that are contained in Random Access Preambles group A and Random Access Preambles group B are calculated from the parameters *numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*:

  If *sizeOfRA-PreamblesGroupA* is equal to *numberOfRA-Preambles* then there is no Random Access Preambles group B. The preambles in Random Access Preamble group A are the preambles 0 to *sizeOfRA-PreamblesGroupA* – 1 and, if it exists, the preambles in Random Access Preamble group B are the preambles *sizeOfRA-PreamblesGroupA* to *numberOfRA-Preambles* – 1 from the set of 64 preambles as defined in [7].

- if Random Access Preambles group B exists, the thresholds, *messagePowerOffsetGroupB* and *messageSizeGroupA*, the configured UE transmitted power, $P_{CMAX}$ [10], and the offset between the preamble and Msg3, *deltaPreambleMsg3*, that are required for selecting one of the two groups of Random Access Preambles.
- the RA response window size *ra-ResponseWindowSize*.

> ### 5.1.2 Random Access Resource selection
>
> The Random Access Resource selection procedure shall be performed as follows:
>
> - If *ra-PreambleIndex* (Random Access Preamble) and *ra-PRACH-MaskIndex* (PRACH Mask Index) have been explicitly signalled and *ra-PreambleIndex* is not 000000:
>   - the Random Access Preamble and the PRACH Mask Index are those explicitly signalled.
> - else the Random Access Preamble shall be selected by the UE as follows:
>   - If Msg3 has not yet been transmitted, the UE shall:
>     - if Random Access Preambles group B exists and if the potential message size (data available for transmission plus MAC header and, where required, MAC control elements) is greater than *messageSizeGroupA* and if the pathloss is less than $P_{CMAX}$ – *preambleInitialReceivedTargetPower* – *deltaPreambleMsg3* – *messagePowerOffsetGroupB*, then:
>       - select the Random Access Preambles group B;
>     - else:
>       - select the Random Access Preambles group A.
>   - else, if Msg3 is being retransmitted, the UE shall:
>     - select the same group of Random Access Preambles as was used for the preamble transmission attempt corresponding to the first transmission of Msg3.
>   - randomly select a Random Access Preamble within the selected group. The random function shall be such that each of the allowed selections can be chosen with equal probability;

> ### 5.7.2 Preamble sequence generation
>
> The random access preambles are generated from Zadoff-Chu sequences with zero correlation zone, generated from one or several root Zadoff-Chu sequences. The network configures the set of preamble sequences the UE is allowed to use.
>
> There are 64 preambles available in each cell. The set of 64 preamble sequences in a cell is found by including first, in the order of increasing cyclic shift, all the available cyclic shifts of a root Zadoff-Chu sequence with the logical index RACH_ROOT_SEQUENCE, where RACH_ROOT_SEQUENCE is broadcasted as part of the System Information. Additional preamble sequences, in case 64 preambles cannot be generated from a single root Zadoff-Chu sequence, are obtained from the root sequences with the consecutive logical indexes until all the 64 sequences are found. The logical root sequence order is cyclic: the logical index 0 is consecutive to 837. The relation between a logical root sequence index and physical root sequence index $u$ is given by Tables 5.7.2-4 and 5.7.2-5 for preamble formats 0 – 3 and 4, respectively.

94. The Accused Products further include a transmitting unit configured to transmit the selected sequence, wherein a position at which the predetermined number of sequences are partitioned is determined based on the control information, and a number of sequences contained in each of the plurality of groups varies in accordance with the control information. As shown

below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.300 section 10.1.5.1, 3GPP TS 36.321 section 5.1, 3GPP TS 36.213 section 6.1, and 3GPP TS 36.331 section 6.3.2.

### 10.1.5.1 Contention based random access procedure

The contention based random access procedure is outlined on Figure 10.1.5.1-1 below:

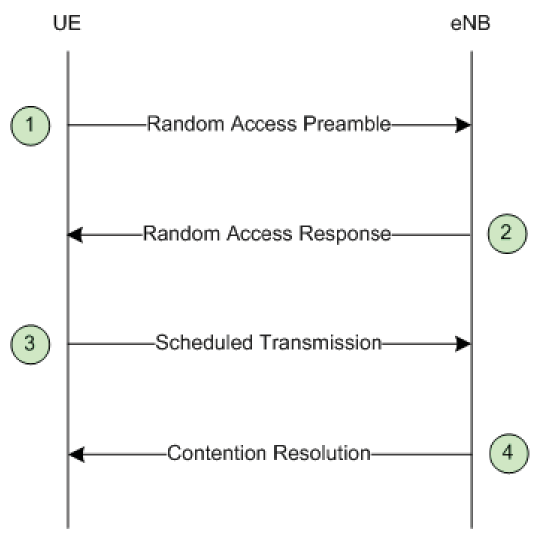


**Figure 10.1.5.1-1: Contention based Random Access Procedure**

The four steps of the contention based random access procedures are:

1) Random Access Preamble on RACH in uplink:

- There are two possible groups defined and one is optional. If both groups are configured the size of message 3 and the pathloss are used to determine which group a preamble is selected from. The group to which a preamble belongs provides an indication of the size of the message 3 and the radio conditions at the UE. The preamble group information along with the necessary thresholds are broadcast on system information.

# 5 MAC procedures

## 5.1 Random Access procedure

### 5.1.1 Random Access Procedure initialization

The Random Access procedure described in this subclause is initiated by a PDCCH order or by the MAC sublayer itself. If a UE receives a PDCCH transmission consistent with a PDCCH order [5] masked with its C-RNTI, it shall initiate a Random Access procedure. The PDCCH order or RRC optionally indicate *ra-PreambleIndex* and *ra-PRACH-MaskIndex*.

Before the procedure can be initiated, the following information is assumed to be available [8]:

- the available set of PRACH resources for the transmission of the Random Access Preamble, *prach-ConfigIndex*.
- the groups of Random Access Preambles and the set of available Random Access Preambles in each group:

  The preambles that are contained in Random Access Preambles group A and Random Access Preambles group B are calculated from the parameters *numberOfRA-Preambles* and *sizeOfRA-PreamblesGroupA*:

  If *sizeOfRA-PreamblesGroupA* is equal to *numberOfRA-Preambles* then there is no Random Access Preambles group B. The preambles in Random Access Preamble group A are the preambles 0 to *sizeOfRA-PreamblesGroupA* – 1 and, if it exists, the preambles in Random Access Preamble group B are the preambles *sizeOfRA-PreamblesGroupA* to *numberOfRA-Preambles* – 1 from the set of 64 preambles as defined in [7].
- if Random Access Preambles group B exists, the thresholds, *messagePowerOffsetGroupB* and *messageSizeGroupA*, the configured UE transmitted power, $P_{CMAX}$ [10], and the offset between the preamble and Msg3, *deltaPreambleMsg3*, that are required for selecting one of the two groups of Random Access Preambles.
- the RA response window size *ra-ResponseWindowSize*.

### 5.1.3 Random Access Preamble transmission

The random-access procedure shall be performed as follows:

- set PREAMBLE_RECEIVED_TARGET_POWER to *preambleInitialReceivedTargetPower* + DELTA_PREAMBLE + (PREAMBLE_TRANSMISSION_COUNTER – 1) * *powerRampingStep*;
- instruct the physical layer to transmit a preamble using the selected PRACH, corresponding RA-RNTI, preamble index and PREAMBLE_RECEIVED_TARGET_POWER.

## 6.1 Physical non-synchronized random access procedure

From the physical layer perspective, the L1 random access procedure encompasses the transmission of random access preamble and random access response. The remaining messages are scheduled for transmission by the higher layer on the shared data channel and are not considered part of the L1 random access procedure. A random access channel occupies 6 resource blocks in a subframe or set of consecutive subframes reserved for random access preamble transmissions. The eNodeB is not prohibited from scheduling data in the resource blocks reserved for random access channel preamble transmission.

The following steps are required for the L1 random access procedure:

1. Layer 1 procedure is triggered upon request of a preamble transmission by higher layers.
2. A preamble index, a target preamble received power (PREAMBLE_RECEIVED_TARGET_POWER), a corresponding RA-RNTI and a PRACH resource are indicated by higher layers as part of the request.
3. A preamble transmission power $P_{PRACH}$ is determined as $P_{PRACH} = \min\{P_{CMAX}, \text{PREAMBLE_RECEIVED_TARGET_POWER} + PL\}$_[dBm], where $P_{CMAX}$ is the configured UE transmitted power defined in [6] and PL is the downlink pathloss estimate calculated in the UE.
4. A preamble sequence is selected from the preamble sequence set using the preamble index.
5. A single preamble is transmitted using the selected preamble sequence with transmission power $P_{PRACH}$ on the indicated PRACH resource.
6. Detection of a PDCCH with the indicated RA-RNTI is attempted during a window controlled by higher layers (see [8], clause 5.1.4). If detected, the corresponding PDSCH transport block is passed to higher layers. The higher layers parse the transport block and indicate the 20-bit UL-SCH grant to the physical layer, which is processed according to section 6.2.

### – *RACH-ConfigCommon*

The IE *RACH-ConfigCommon* is used to specify the generic random access parameters.

***RACH-ConfigCommon* information element**

```
-- ASN1START

RACH-ConfigCommon ::=        SEQUENCE {
    preambleInfo                        SEQUENCE {
        numberOfRA-Preambles                ENUMERATED {
                                                n4, n8, n12, n16 ,n20, n24, n28,
                                                n32, n36, n40, n44, n48, n52, n56,
                                                n60, n64},
        preamblesGroupAConfig               SEQUENCE {
            sizeOfRA-PreamblesGroupA            ENUMERATED {
                                                    n4, n8, n12, n16 ,n20, n24, n28,
                                                    n32, n36, n40, n44, n48, n52, n56,
                                                    n60},
            messageSizeGroupA                   ENUMERATED {b56, b144, b208, b256},
            messagePowerOffsetGroupB            ENUMERATED {
                                                    minusinfinity, dB0, dB5, dB8, dB10, dB12,
                                                    dB15, dB18},
```

| **RACH-ConfigCommon field descriptions** |
|---|
| ***numberOfRA-Preambles***<br>Number of non-dedicated random access preambles in TS 36.321 [6]. Value is an integer. Value n4 corresponds to 4, n8 corresponds to 8 and so on. |
| ***preamblesGroupAConfig***<br>Provides the configuration for preamble grouping in TS 36.321 [6]. If the field is not signalled, the size of the random access preambles group A [6] is equal to *numberOfRA-Preambles*. |
| ***sizeOfRA-PreamblesGroupA***<br>Size of the random access preambles group A in TS 36.321 [6]. Value is an integer. Value n4 corresponds to 4, n8 corresponds to 8 and so on. |
| ***messageSizeGroupA***<br>Threshold for preamble selection in TS 36.321 [6]. Value in bits. Value b56 corresponds to 56 bits, b144 corresponds to 144 bits and so on. |

*See also* 3GPP TS 36.300 section 22, 3GPP TS 36.902 section 4.7, 3GPP TS 36.314 section 4.1.2, and 3GPP TS 32.425 sections 4.5.5 and A.5.

# 22 Support for self-configuration and self-optimisation

## 22.4.3 Support for RACH Optimisation

The setting of RACH parameters that can be optimized are:

- RACH configuration (resource unit allocation);
- RACH preamble split (among dedicated, group A, group B);
- RACH backoff parameter value;
- RACH transmission power control parameters.

RACH optimization is supported by UE reported information and by PRACH parameters exchange between eNBs.

UEs which receive polling signalling shall report the below information:

- Number of RACH preambles sent until the successful RACH completion;
- Contention resolution failure.

## 4.7 RACH Optimisation

### 4.7.1 Use Case description

The RACH configuration has critical impacts to system performance:

The RACH collision probability is significantly affected by the RACH settings, making this a critical factor for call setup delays; data resuming delays from the UL unsynchronized state, and handover delays. It also affects the call setup success rate and handover success rate.Since UL resource units need to be reserved exclusively for RACH, the amount of reserved resources has impacts on the system capacity.A poorly configured RACH may also result in low preamble detection probability and limited coverage. Therefore, RACH parameter optimisation provides significant benefits to the deployed network. The setting of RACH parameters depends on a multitude of factors, e.g.:

- the uplink inter-cell interference from the Physical Uplink Shared Channel (PUSCH),
- RACH load (call arrival rate, HO rate, tracking area update, traffic pattern and population under the cell coverage as it affects the UL synchronization states and hence the need to use random access),
- PUSCH load,
- the cubic metric of the preambles allocated to a cell,
- whether the cell is in high-speed mode or not,

### 4.7.2 Objective

The primary objectives of a RACH optimization function are:

a.) Minimize access delays for all UEs in the system

- Incoming probe must have sufficient power for the eNB to detect.

b.) Minimize UL interference due to RACH

- Too high power causes unnecessary interference to other eNBs.

Secondary objective is furthermore:

c.) Minimize interference among RACH attempts

- Configure neighbouring cells to minimize sequence/frequency overlaps.
- Choose call parameters to account for mobile velocity (high speed [$\geq$ 300kph] vs. Normal).

Consequently, the RACH optimization function will attempt to automatically set several parameters related to the performance of RACH, for example:

- PRACH configuration index (resource unit allocation and format) (TS 36.211 [3]);
- RACH preamble split (among dedicated, random-high, random-low) (TS 36.331 [5]);
- RACH backoff parameter value (TS 36.321 [6]);
- PRACH transmission power control parameters (TS 36.213 [8]).

The exact set of parameters to be optimized by the RACH Optimization function is outside the scope of this technical report.

### 4.7.3 Expected results

Reduction in access delay, which results into:

- short call setup delays
- short data resuming delays from UL unsynchronized state
- short handover delays
- high call setup success rate
- high handover success rate

Optimisation on the amount of UL resource unit reserved for RACH which brings a positive System Capacity impact.

#### 4.7.4.2 Output, influenced entities and parameters

Potential output parameters are:

- PRACH configuration index (resource unit allocation and format);
- RACH preamble split (among dedicated, random-high, random-low);
- RACH backoff timer parameter;
- PRACH transmission power control parameters;
- Root sequence index.

#### 4.7.4.3 Impacted specifications, procedure interactions and interfaces

UE and eNB measurements are provided to the SON entity, which resides in the eNB. Details on UE measurements are specified in TS 36.331 [5].

An eNB exchanges information over the X2 interface with its neighbors for the purpose of RACH optimisation. The PRACH Configuration is exchanged via the X2 Setup and eNB Configuration Update procedures.

An eNB may also need to communicate with the O&M in order to perform RACH optimization.

## 4.7.5 O&M requirements

Operators may be able to configure the initial planned RACH configuration. The related parameters may be modified based on operator's policies. The RACH performance target may also be set via O&M.

While algorithms for RACH optimization are located in the eNB, in order to enable RACH optimization:

- The relevant RACH parameters should be autoconfigurable by the eNB.
- OAM should be able to configure value ranges for these parameters,
- eNB should be able to operate within the configured ranges using proprietary algorithms for RACH optimisation.

While the exact list of parameters is FFS because it may be more optimal to keep certain entities within the eNB, the following are candidates for this set:

- preambleInitialReceivedTargetPower
- powerRampingStep
- preambleTransMax
- ContentionResolutionTimer

How eNB makes use of the list of values of the above parameters to affect the used value of these parameters will be subject to eNB implementation.

Any specified OAM mechanism shall make sure that the optimization function residing in the eNB is not constrained by the configured parameters in a way that performance of the SON mechanism is jeopardized or limited.

Note: Any specified OAM mechanism shall make sure that the range of values provided are adequate for the efficient performance of the optimization function residing in the eNB.

## 4.1.2 Received Random Access Preambles

A use case for this measurement is RACH configuration optimization, where Received Random Access Preambles is signaled across an OAM interface.

Protocol Layer: MAC

| | |
|---|---|
| **Definition** | Received Random Access Preambles. This measurement is applicable to PRACH. The reference point is the Service Access Point between MAC and L1. The measured quantity is the number of received Random Access preambles during a time period over all PRACHs configured in a cell. The measurement is done separately for:<br>- Dedicated preambles<br>- Randomly selected preambles in the low range<br>- Randomly selected preambles in the high range.<br><br>The unit of the measured value is [/s]. |

### 4.5.5 RACH Usage

a) This measurement provides the mean number of RACH preambles received in a cell in one second. Separate counts are provided for dedicated preambles, randomly chosen preambles in group A (aka "low range") and randomly chosen preambles in group B (aka "high range").

b) CC

c) This measurement is obtained according to the definition in 36.314 [11].

d) Each measurement is an integer value.

e) RRU.RachPreambleDedMean

RRU.RachPreambleAMean

RRU.RachPreambleBMean

f) EUtranCellFDD
EUtranCellTDD

g) Valid for packet switched traffic

h) EPS

## A.5 Monitor of cell level QoS and radio resource utilisation

### RACH Usage

The RACH plays a vital role in the following procedures:

- Initial access from RRC_IDLE;
- Initial access after radio link failure;
- Handover requiring random access procedure;
- DL data arrival during RRC_CONNECTED requiring random access procedure;
- UL data arrival during RRC_CONNECTED requiring random access procedure;

Furthermore, the random access procedure takes two distinct forms:

- Contention based using a randomly selected preamble (applicable to all five events);
- Non-contention based using a dedicated preamble (applicable to only handover and DL data arrival).

In the use-case of RACH configuration optimization, received Random Access Preambles are signaled across an OAM interface.

Monitoring of the preamble usage in a cell allows the operator to determine if the resources allocated to the RACH by the eNodeB are appropriate for the number of random access attempts. If the resources are underutilised then the operator may reconfigure the eNodeB (via CM) to allocate less resource to RACH thereby freeing up resource for other uplink transmissions. Alternatively, if the resources are heavily utilised then this is indicative of RACH congestion leading to increased latency for the procedures listed above.

95. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’557 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’557 Patent.

96. Apple has had knowledge and notice of the ’557 Patent at least as of the filing of this Complaint.

97. Apple indirectly infringes the ’557 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’557 patent. Apple induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple’s inducement, Apple’s customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the ’557 Patent. Apple performs these affirmative acts with knowledge of the ’557 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’557 Patent.

98. Apple also indirectly infringes the ’557 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple’s affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products

and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple's customers and end-users use of the Apple Accused Products, such that the '557 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the '557 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the '557 Patent. Apple performs these affirmative acts with knowledge of the '557 Patent and with intent, or willful blindness, that they cause the direct infringement of the '557 Patent.

99. Apple's infringement of the '557 Patent has damaged and will continue to damage the Plaintiffs.

**COUNT V: PATENT INFRINGEMENT OF THE '774 PATENT**

100. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

101. Apple infringes, contributes to the infringement of, and/or induces infringement of the '774 Patent by making, using, selling, offering for sale, exporting from, and/or importing into the United States products and/or methods covered by one or more claims of the '774 Patent including, but not limited to, at least the Apple Accused Products.

102. For example and as shown below, the Accused Products infringe claim 6 of the '744 patent by virtue of their compatibility with and practice of the LTE standard. For example, the Accused Products practice a method comprising receiving a processing parameter for transmission of data on two antenna ports, the processing parameter including at least one of a time delay, a phase rotation, and a gain determined based on a received uplink signal. As shown

below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 section 7.2, 3GPP TS 36.211 section 6.3.4, and 3GPP TS 36.331 section 6.3.2.

## 7.2 UE procedure for reporting Channel State Information (CSI)

The time and frequency resources that can be used by the UE to report CSI which consists of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), precoding type indicator (PTI), and/or rank indication (RI) are controlled by the eNB. For spatial multiplexing, as given in [3], the UE shall determine a RI corresponding to the number of useful transmission layers. For transmit diversity as given in [3], RI is equal to one.

A UE in transmission mode 8 or 9 is configured with or without PMI/RI reporting by the higher layer parameter *pmi-RI-Report*.

A UE in transmission mode 10 can be configured with one or more CSI processes per serving cell by higher layers. Each CSI process is associated with a CSI-RS resource (defined in subclause 7.2.5) and a CSI-interference measurement (CSI-IM) resource (defined in subclause 7.2.6). A UE can be configured with up to two CSI-IM resources for a CSI process if the UE is configured with CSI subframe sets $C_{\text{CSI,0}}$ and $C_{\text{CSI,1}}$ by the higher layer parameter *csi-SubFramePatternConfig-r12* for the CSI process. A CSI reported by the UE corresponds to a CSI process configured by higher layers. Each CSI process can be configured with or without PMI/RI reporting by higher layer signalling.

A UE is configured with resource-restricted CSI measurements if the subframe sets $C_{\text{CSI,0}}$ and $C_{\text{CSI,1}}$ are configured by higher layers.

For a serving cell with frame structure type 1, a UE is not expected to be configured with *csi-SubframePatternConfig-r12*.

CSI reporting is periodic or aperiodic.

If the UE is configured with more than one serving cell, it transmits CSI for activated serving cell(s) only.

If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUCCH as defined hereafter in subframes with no PUSCH allocation.

If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUSCH of the serving cell with smallest *ServCellIndex* as defined hereafter in subframes with a PUSCH allocation, where the UE shall use the same PUCCH-based periodic CSI reporting format on PUSCH.

A UE shall transmit aperiodic CSI reporting on PUSCH if the conditions specified hereafter are met. For aperiodic CQI/PMI reporting, RI reporting is transmitted only if the configured CSI feedback type supports RI reporting.

### 6.3.4 Precoding

The precoder takes as input a block of vectors $x(i) = \left[x^{(0)}(i) \quad \ldots \quad x^{(\upsilon-1)}(i)\right]^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{layer}} - 1$ from the layer mapping and generates a block of vectors $y(i) = \left[\ldots \quad y^{(p)}(i) \quad \ldots\right]^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$ to be mapped onto resources on each of the antenna ports, where $y^{(p)}(i)$ represents the signal for antenna port $p$.

#### 6.3.4.1 Precoding for transmission on a single antenna port

For transmission on a single antenna port, precoding is defined by

$$y^{(p)}(i) = x^{(0)}(i)$$

where $p \in \{0,4,5\}$ is the number of the single antenna port used for transmission of the physical channel and $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$, $M_{\text{symb}}^{\text{ap}} = M_{\text{symb}}^{\text{layer}}$.

#### 6.3.4.2 Precoding for spatial multiplexing

Precoding for spatial multiplexing is only used in combination with layer mapping for spatial multiplexing as described in Section 6.3.3.2. Spatial multiplexing supports two or four antenna ports and the set of antenna ports used is $p \in \{0,1\}$ or $p \in \{0,1,2,3\}$, respectively.

**Table 6.3.4.2.2-1: Large-delay cyclic delay diversity**

| Number of layers $\upsilon$ | $U$ | $D(i)$ |
|---|---|---|
| 2 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1 & 1\\ 1 & e^{-j2\pi/2}\end{bmatrix}$ | $\begin{bmatrix}1 & 0\\ 0 & e^{-j2\pi i/2}\end{bmatrix}$ |
| 3 | $\frac{1}{\sqrt{3}}\begin{bmatrix}1 & 1 & 1\\ 1 & e^{-j2\pi/3} & e^{-j4\pi/3}\\ 1 & e^{-j4\pi/3} & e^{-j8\pi/3}\end{bmatrix}$ | $\begin{bmatrix}1 & 0 & 0\\ 0 & e^{-j2\pi i/3} & 0\\ 0 & 0 & e^{-j4\pi i/3}\end{bmatrix}$ |
| 4 | $\frac{1}{2}\begin{bmatrix}1 & 1 & 1 & 1\\ 1 & e^{-j2\pi/4} & e^{-j4\pi/4} & e^{-j6\pi/4}\\ 1 & e^{-j4\pi/4} & e^{-j8\pi/4} & e^{-j12\pi/4}\\ 1 & e^{-j6\pi/4} & e^{-j12\pi/4} & e^{-j18\pi/4}\end{bmatrix}$ | $\begin{bmatrix}1 & 0 & 0 & 0\\ 0 & e^{-j2\pi i/4} & 0 & 0\\ 0 & 0 & e^{-j4\pi i/4} & 0\\ 0 & 0 & 0 & e^{-j6\pi i/4}\end{bmatrix}$ |

#### 6.3.4.2.3 Codebook for precoding

For transmission on two antenna ports, $p \in \{0,1\}$, the precoding matrix $W(i)$ shall be selected from Table 6.3.4.2.3-1 or a subset thereof. For the closed-loop spatial multiplexing transmission mode defined in [4], the codebook index 0 is not used when the number layers is $\upsilon = 2$.

**Table 6.3.4.2.3-1: Codebook for transmission on antenna ports $\{0,1\}$.**

| Codebook index | Number of layers $\upsilon$ | |
|---|---|---|
| | 1 | 2 |
| 0 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\1\end{bmatrix}$ | $\frac{1}{\sqrt{2}}\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$ |
| 1 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\-1\end{bmatrix}$ | $\frac{1}{2}\begin{bmatrix}1 & 1\\1 & -1\end{bmatrix}$ |
| 2 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\j\end{bmatrix}$ | $\frac{1}{2}\begin{bmatrix}1 & 1\\j & -j\end{bmatrix}$ |
| 3 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\-j\end{bmatrix}$ | - |

### 6.3.4.3 Precoding for transmit diversity

Precoding for transmit diversity is only used in combination with layer mapping for transmit diversity as described in Section 6.3.3.3. The precoding operation for transmit diversity is defined for two and four antenna ports.

For transmission on two antenna ports, $p \in \{0,1\}$, the output $y(i) = \begin{bmatrix} y^{(0)}(i) & y^{(1)}(i) \end{bmatrix}^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$ of the precoding operation is defined by

$$\begin{bmatrix} y^{(0)}(2i) \\ y^{(1)}(2i) \\ y^{(0)}(2i+1) \\ y^{(1)}(2i+1) \end{bmatrix} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 0 & j & 0 \\ 0 & -1 & 0 & j \\ 0 & 1 & 0 & j \\ 1 & 0 & -j & 0 \end{bmatrix} \begin{bmatrix} \text{Re}\left(x^{(0)}(i)\right) \\ \text{Re}\left(x^{(1)}(i)\right) \\ \text{Im}\left(x^{(0)}(i)\right) \\ \text{Im}\left(x^{(1)}(i)\right) \end{bmatrix}$$

for $i = 0,1,\ldots,M_{\text{symb}}^{\text{layer}} - 1$ with $M_{\text{symb}}^{\text{ap}} = 2M_{\text{symb}}^{\text{layer}}$.

For transmission on four antenna ports, $p \in \{0,1,2,3\}$, the output $y(i) = \begin{bmatrix} y^{(0)}(i) & y^{(1)}(i) & y^{(2)}(i) & y^{(3)}(i) \end{bmatrix}^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$ of the precoding operation is defined by

## 6.3.2 Radio resource control information elements

### – AntennaInfo

The IE *AntennaInfoCommon* and the *AntennaInfoDedicated* are used to specify the common and the UE specific antenna configuration respectively.

***AntennaInfo information elements***

```
-- ASN1START

AntennaInfoCommon ::=          SEQUENCE {
    antennaPortsCount          ENUMERATED {an1, an2, an4, spare1}
}

AntennaInfoDedicated ::=       SEQUENCE {
    transmissionMode           ENUMERATED {
                               tm1, tm2, tm3, tm4, tm5, tm6,
                               tm7, tm8-v920},
    codebookSubsetRestriction  CHOICE {
        n2TxAntenna-tm3            BIT STRING (SIZE (2)),
        n4TxAntenna-tm3            BIT STRING (SIZE (4)),
        n2TxAntenna-tm4            BIT STRING (SIZE (6)),
        n4TxAntenna-tm4            BIT STRING (SIZE (64)),
        n2TxAntenna-tm5            BIT STRING (SIZE (4)),
        n4TxAntenna-tm5            BIT STRING (SIZE (16)),
        n2TxAntenna-tm6            BIT STRING (SIZE (4)),
        n4TxAntenna-tm6            BIT STRING (SIZE (16))
    }   OPTIONAL,                                   -- Cond TM
    ue-TransmitAntennaSelection    CHOICE{
        release                NULL,
        setup                  ENUMERATED {closedLoop, openLoop}
    }
}
```

| ***AntennaInfo* field descriptions** |
| --- |
| ***alternativeCodebookEnabledFor4TX***<br>Indicates whether code book in TS 36.213 [23] Table 7.2.4-0A to Table 7.2.4-0D is being used for deriving CSI feedback and reporting. E-UTRAN only configures the field if the UE is configured with a) *tm8* or *tm9*, b) PMI/RI reporting and c) 4 CRS ports. |
| ***antennaPortsCount***<br>Parameter represents the number of cell specific antenna ports where an1 corresponds to 1, an2 to 2 antenna ports etc. see TS 36.211 [21, 6.2.1]. |
| ***codebookSubsetRestriction***<br>Parameter: *codebookSubsetRestriction*, see TS 36.213 [23, 7.2] and TS 36.211 [21, 6.3.4.2.3]. The number of bits in the *codebookSubsetRestriction* for applicable transmission modes is defined in TS 36.213 [23, Table 7.2-1b]. If the UE is configured with *transmissionMode* tm8, E-UTRAN configures the field *codebookSubsetRestriction* if PMI/RI reporting is configured. If the UE is configured with *transmissionMode* tm9, E-UTRAN configures the field *codebookSubsetRestriction* if PMI/RI reporting is configured and if the number of CSI-RS ports is greater than 1. E-UTRAN does not configure the field *codebookSubsetRestriction* in other cases where the UE is configured with *transmissionMode* tm8 or tm9. |
| ***maxLayersMIMO***<br>Indicates the maximum number of layers for spatial multiplexing used to determine the rank indication bit width and Kc determination of the soft buffer size for the corresponding serving cell according to TS 36.212 [22]. EUTRAN configures this field only when *transmissionMode* is set to *tm3*, *tm4*, *tm9* or *tm10* for the corresponding serving cell. When configuring the field for a serving cell which *transmissionMode* is set to *tm3* or *tm4*, EUTRAN only configures value *fourLayers*. For a serving cell which *transmissionMode* is set to *tm9* or *tm10*, EUTRAN only configures the field only if *intraBandContiguousCC-InfoList* is indicated for the band and the band combination of the corresponding serving cell. |
| ***transmissionMode***<br>Points to one of Transmission modes defined in TS 36.213 [23, 7.1] where tm1 refers to transmission mode 1, tm2 to transmission mode 2 etc. |
| ***ue-TransmitAntennaSelection***<br>For value *setup* the field indicates whether UE transmit antenna selection control is closed-loop or open-loop as described in TS 36.213 [23, 8.7]. EUTRAN configures the same value for all serving cells. |

103. The Accused Products further practice a method comprising receiving a first pilot, a second pilot, a first data symbol and a second data symbol transmitted on the two antenna ports. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.211 section 6.10.

## 6.10 Reference signals

Three types of downlink reference signals are defined:

- Cell-specific reference signals, associated with non-MBSFN transmission
- MBSFN reference signals, associated with MBSFN transmission
- UE-specific reference signals

There is one reference signal transmitted per downlink antenna port.

### 6.10.1 Cell-specific reference signals

Cell-specific reference signals shall be transmitted in all downlink subframes in a cell supporting non-MBSFN transmission. In case the subframe is used for transmission with MBSFN, only the first two OFDM symbols in a subframe can be used for transmission of cell-specific reference symbols.

Cell-specific reference signals are transmitted on one or several of antenna ports 0 to 3.

Cell-specific reference signals are defined for $\Delta f = 15\,\text{kHz}$ only.

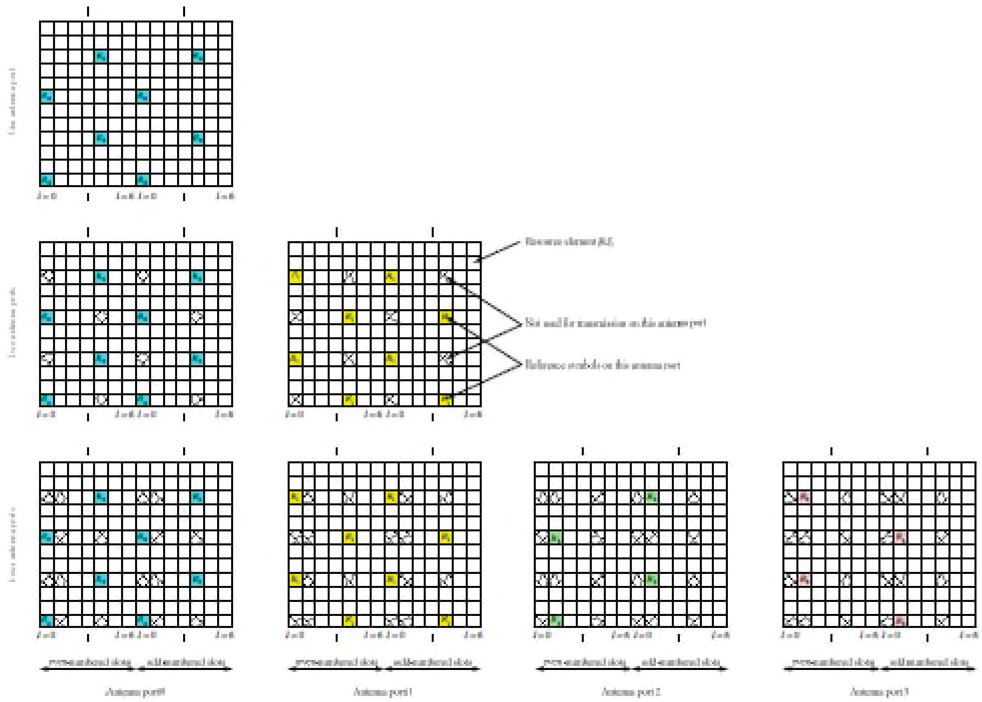

**Figure 6.10.1.2-1. Mapping of downlink reference signals (normal cyclic prefix).**

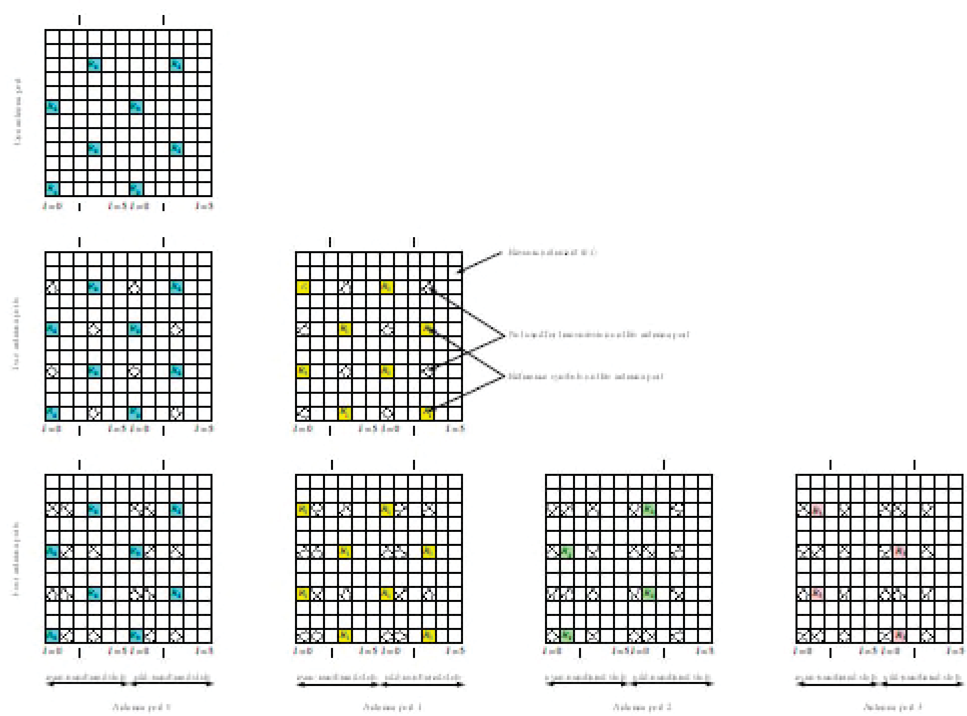

**Figure 6.10.1.2-2. Mapping of downlink reference signals (extended cyclic prefix).**

104. The Accused Products further practice a method comprising demodulating the first data symbol and the second data symbol based on the processing parameter, the first pilot, and the second pilot. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 section 7.2, 3GPP TS 36.211 sections 6.3.4 and 6.10.

## 7.2 UE procedure for reporting Channel State Information (CSI)

The time and frequency resources that can be used by the UE to report CSI which consists of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), precoding type indicator (PTI), and/or rank indication (RI) are controlled by the eNB. For spatial multiplexing, as given in [3], the UE shall determine a RI corresponding to the number of useful transmission layers. For transmit diversity as given in [3], RI is equal to one.

A UE in transmission mode 8 or 9 is configured with or without PMI/RI reporting by the higher layer parameter *pmi-RI-Report*.

A UE in transmission mode 10 can be configured with one or more CSI processes per serving cell by higher layers. Each CSI process is associated with a CSI-RS resource (defined in subclause 7.2.5) and a CSI-interference measurement (CSI-IM) resource (defined in subclause 7.2.6). A UE can be configured with up to two CSI-IM resources for a CSI process if the UE is configured with CSI subframe sets $C_{CSI,0}$ and $C_{CSI,1}$ by the higher layer parameter *csi-SubFramePatternConfig-r12* for the CSI process. A CSI reported by the UE corresponds to a CSI process configured by higher layers. Each CSI process can be configured with or without PMI/RI reporting by higher layer signalling.

A UE is configured with resource-restricted CSI measurements if the subframe sets $C_{CSI,0}$ and $C_{CSI,1}$ are configured by higher layers.

For a serving cell with frame structure type 1, a UE is not expected to be configured with *csi-SubframePatternConfig-r12*.

CSI reporting is periodic or aperiodic.

If the UE is configured with more than one serving cell, it transmits CSI for activated serving cell(s) only.

If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUCCH as defined hereafter in subframes with no PUSCH allocation.

If a UE is not configured for simultaneous PUSCH and PUCCH transmission, it shall transmit periodic CSI reporting on PUSCH of the serving cell with smallest *ServCellIndex* as defined hereafter in subframes with a PUSCH allocation, where the UE shall use the same PUCCH-based periodic CSI reporting format on PUSCH.

A UE shall transmit aperiodic CSI reporting on PUSCH if the conditions specified hereafter are met. For aperiodic CQI/PMI reporting, RI reporting is transmitted only if the configured CSI feedback type supports RI reporting.

### 6.3.4 Precoding

The precoder takes as input a block of vectors $x(i) = \begin{bmatrix} x^{(0)}(i) & \ldots & x^{(\upsilon-1)}(i) \end{bmatrix}^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{layer}} - 1$ from the layer mapping and generates a block of vectors $y(i) = \begin{bmatrix} \ldots & y^{(p)}(i) & \ldots \end{bmatrix}^T$, $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$ to be mapped onto resources on each of the antenna ports, where $y^{(p)}(i)$ represents the signal for antenna port $p$.

#### 6.3.4.1 Precoding for transmission on a single antenna port

For transmission on a single antenna port, precoding is defined by

$$y^{(p)}(i) = x^{(0)}(i)$$

where $p \in \{0,4,5\}$ is the number of the single antenna port used for transmission of the physical channel and $i = 0,1,\ldots,M_{\text{symb}}^{\text{ap}} - 1$, $M_{\text{symb}}^{\text{ap}} = M_{\text{symb}}^{\text{layer}}$.

#### 6.3.4.2 Precoding for spatial multiplexing

Precoding for spatial multiplexing is only used in combination with layer mapping for spatial multiplexing as described in Section 6.3.3.2. Spatial multiplexing supports two or four antenna ports and the set of antenna ports used is $p \in \{0,1\}$ or $p \in \{0,1,2,3\}$, respectively.

**Table 6.3.4.2.2-1: Large-delay cyclic delay diversity**

| Number of layers $\upsilon$ | $U$ | $D(i)$ |
|---|---|---|
| 2 | $\frac{1}{\sqrt{2}}\begin{bmatrix} 1 & 1 \\ 1 & e^{-j2\pi/2} \end{bmatrix}$ | $\begin{bmatrix} 1 & 0 \\ 0 & e^{-j2\pi i/2} \end{bmatrix}$ |
| 3 | $\frac{1}{\sqrt{3}}\begin{bmatrix} 1 & 1 & 1 \\ 1 & e^{-j2\pi/3} & e^{-j4\pi/3} \\ 1 & e^{-j4\pi/3} & e^{-j8\pi/3} \end{bmatrix}$ | $\begin{bmatrix} 1 & 0 & 0 \\ 0 & e^{-j2\pi i/3} & 0 \\ 0 & 0 & e^{-j4\pi i/3} \end{bmatrix}$ |
| 4 | $\frac{1}{2}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & e^{-j2\pi/4} & e^{-j4\pi/4} & e^{-j6\pi/4} \\ 1 & e^{-j4\pi/4} & e^{-j8\pi/4} & e^{-j12\pi/4} \\ 1 & e^{-j6\pi/4} & e^{-j12\pi/4} & e^{-j18\pi/4} \end{bmatrix}$ | $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & e^{-j2\pi i/4} & 0 & 0 \\ 0 & 0 & e^{-j4\pi i/4} & 0 \\ 0 & 0 & 0 & e^{-j6\pi i/4} \end{bmatrix}$ |

### 6.3.4.2.3 Codebook for precoding

For transmission on two antenna ports, $p \in \{0,1\}$, the precoding matrix $W(i)$ shall be selected from Table 6.3.4.2.3-1 or a subset thereof. For the closed-loop spatial multiplexing transmission mode defined in [4], the codebook index 0 is not used when the number layers is $\upsilon = 2$.

**Table 6.3.4.2.3-1: Codebook for transmission on antenna ports $\{0,1\}$.**

| Codebook index | Number of layers $\upsilon$ | |
|---|---|---|
| | 1 | 2 |
| 0 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\1\end{bmatrix}$ | $\frac{1}{\sqrt{2}}\begin{bmatrix}1&0\\0&1\end{bmatrix}$ |
| 1 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\-1\end{bmatrix}$ | $\frac{1}{2}\begin{bmatrix}1&1\\1&-1\end{bmatrix}$ |
| 2 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\j\end{bmatrix}$ | $\frac{1}{2}\begin{bmatrix}1&1\\j&-j\end{bmatrix}$ |
| 3 | $\frac{1}{\sqrt{2}}\begin{bmatrix}1\\-j\end{bmatrix}$ | - |

### 6.3.4.3 Precoding for transmit diversity

Precoding for transmit diversity is only used in combination with layer mapping for transmit diversity as described in Section 6.3.3.3. The precoding operation for transmit diversity is defined for two and four antenna ports.

For transmission on two antenna ports, $p \in \{0,1\}$, the output $y(i) = \begin{bmatrix}y^{(0)}(i) & y^{(1)}(i)\end{bmatrix}^T$, $i = 0,1,\ldots,M_{\mathrm{symb}}^{\mathrm{ap}} - 1$ of the precoding operation is defined by

$$\begin{bmatrix}y^{(0)}(2i)\\y^{(1)}(2i)\\y^{(0)}(2i+1)\\y^{(1)}(2i+1)\end{bmatrix} = \frac{1}{\sqrt{2}}\begin{bmatrix}1&0&j&0\\0&-1&0&j\\0&1&0&j\\1&0&-j&0\end{bmatrix}\begin{bmatrix}\mathrm{Re}\left(x^{(0)}(i)\right)\\\mathrm{Re}\left(x^{(1)}(i)\right)\\\mathrm{Im}\left(x^{(0)}(i)\right)\\\mathrm{Im}\left(x^{(1)}(i)\right)\end{bmatrix}$$

for $i = 0,1,\ldots,M_{\mathrm{symb}}^{\mathrm{layer}} - 1$ with $M_{\mathrm{symb}}^{\mathrm{ap}} = 2M_{\mathrm{symb}}^{\mathrm{layer}}$.

For transmission on four antenna ports, $p \in \{0,1,2,3\}$, the output $y(i) = \begin{bmatrix}y^{(0)}(i) & y^{(1)}(i) & y^{(2)}(i) & y^{(3)}(i)\end{bmatrix}^T$, $i = 0,1,\ldots,M_{\mathrm{symb}}^{\mathrm{ap}} - 1$ of the precoding operation is defined by

## 6.10 Reference signals

Three types of downlink reference signals are defined:

- Cell-specific reference signals, associated with non-MBSFN transmission
- MBSFN reference signals, associated with MBSFN transmission
- UE-specific reference signals

There is one reference signal transmitted per downlink antenna port.

### 6.10.1 Cell-specific reference signals

Cell-specific reference signals shall be transmitted in all downlink subframes in a cell supporting non-MBSFN transmission. In case the subframe is used for transmission with MBSFN, only the first two OFDM symbols in a subframe can be used for transmission of cell-specific reference symbols.

Cell-specific reference signals are transmitted on one or several of antenna ports 0 to 3.

Cell-specific reference signals are defined for $\Delta f = 15\,\text{kHz}$ only.

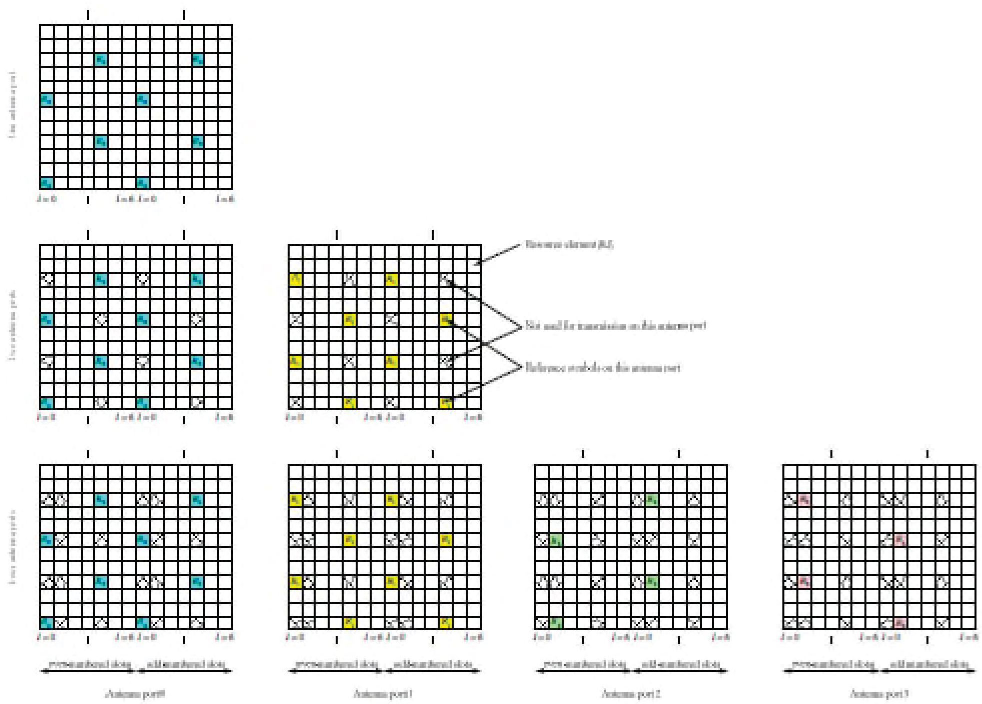

**Figure 6.10.1.2-1. Mapping of downlink reference signals (normal cyclic prefix).**

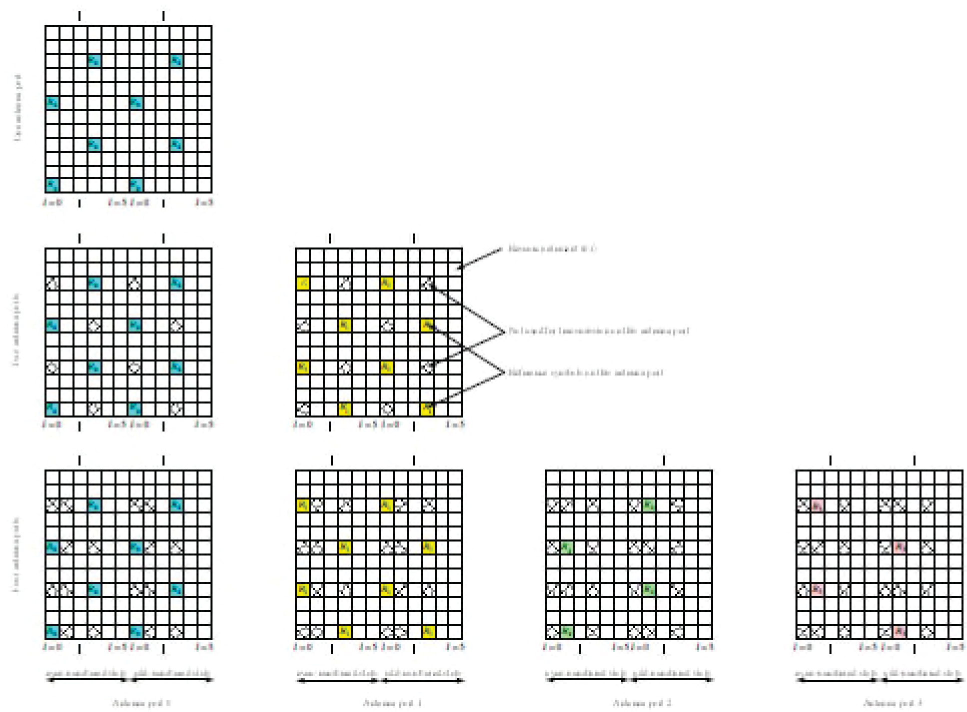

Figure 6.10.1.2-2. Mapping of downlink reference signals (extended cyclic prefix).

105. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’774 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’774 Patent.

106. Apple has had knowledge and notice of the ’774 Patent at least as of the filing of this Complaint.

107. Apple indirectly infringes the ’774 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’774 patent. Apple induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and

other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple's inducement, Apple's customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the '774 Patent. Apple performs these affirmative acts with knowledge of the '774 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '774 Patent.

108. Apple also indirectly infringes the '774 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple's affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple's customers and end-users use of the Apple Accused Products, such that the '774 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the '774 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the '774 Patent. Apple performs these affirmative acts with knowledge of the '774 Patent and with intent, or willful blindness, that they cause the direct infringement of the '774 Patent.

109. Apple's infringement of the '774 Patent has damaged and will continue to damage the Plaintiffs.

**COUNT VI: PATENT INFRINGEMENT OF THE '833 PATENT**

110. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

111. Apple infringes, contributes to the infringement of, and/or induces infringement of the '833 Patent by making, using, selling, offering for sale, exporting from, and/or importing into the United States products and/or methods covered by one or more claims of the '833 Patent including, but not limited to, at least the Apple Accused Products.

112. For example and as shown below, the Accused Products infringe claim 1 of the '833 patent by virtue of their compatibility with and practice of the LTE standard. For example, and to the extent the preamble is limiting, the Accused Products practice a method for transmitting uplink signals comprising control signals and data signals in a wireless communication system. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.201 sections 1 and 4, and 3GPP TS 36.212 section 5.2.2.

# 1 Scope

The present document describes a general description of the physical layer of the E-UTRA radio interface. The present document also describes the document structure of the 3GPP physical layer specifications, i.e. TS 36.200 series. The TS 36.200 series specifies the Uu point for the 3G LTE mobile system, and defines the minimum level of specifications required for basic connections in terms of mutual connectivity and compatibility.

# 4 General description of LTE Layer 1

## 4.1 Relation to other layers

### 4.1.1 General Protocol Architecture

The radio interface described in this specification covers the interface between the User Equipment (UE) and the network. The radio interface is composed of the Layer 1, 2 and 3. The TS 36.200 series describes the Layer 1 (Physical Layer) specifications. Layers 2 and 3 are described in the 36.300 series.

# 5.2.2 Uplink shared channel

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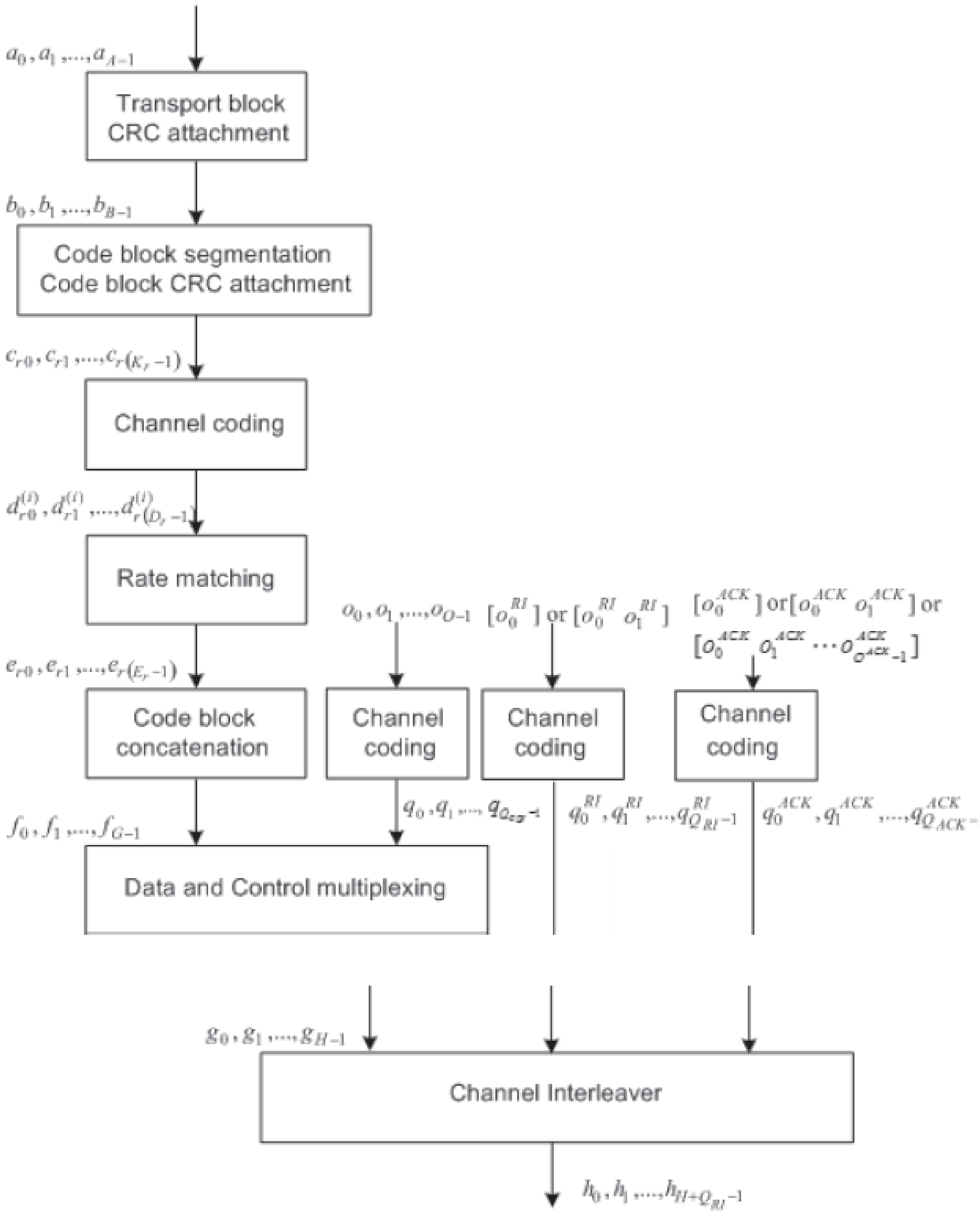


**Figure 5.2.2-1: Transport channel processing for UL-SCH**

113. The Accused Products further practice a method comprising serially multiplexing first control signals and data signals in a mobile station, wherein the first control signals are placed at a front part of the multiplexed signals and the data signals are placed at a rear part of the multiplexed signals. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.212 section 5.2.2.

## 5.2.2 Uplink shared channel

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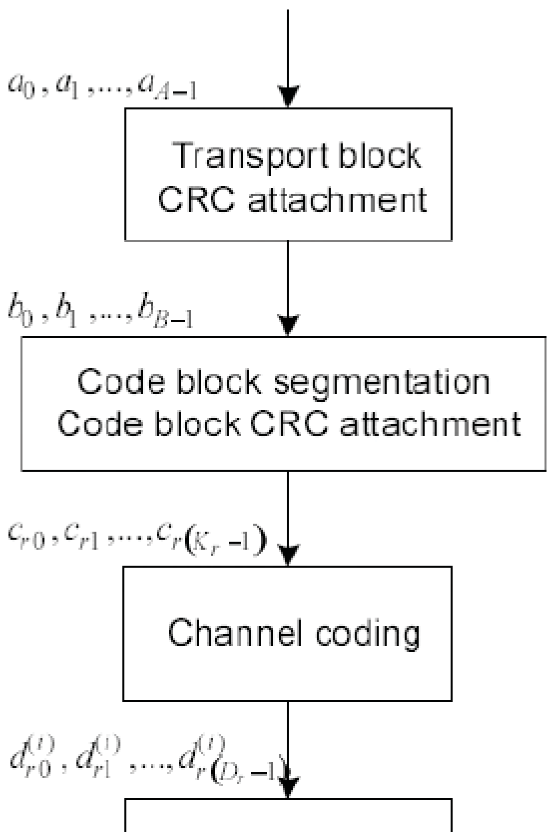
The coding steps for UL-SCH transport channel are shown in the figure below.



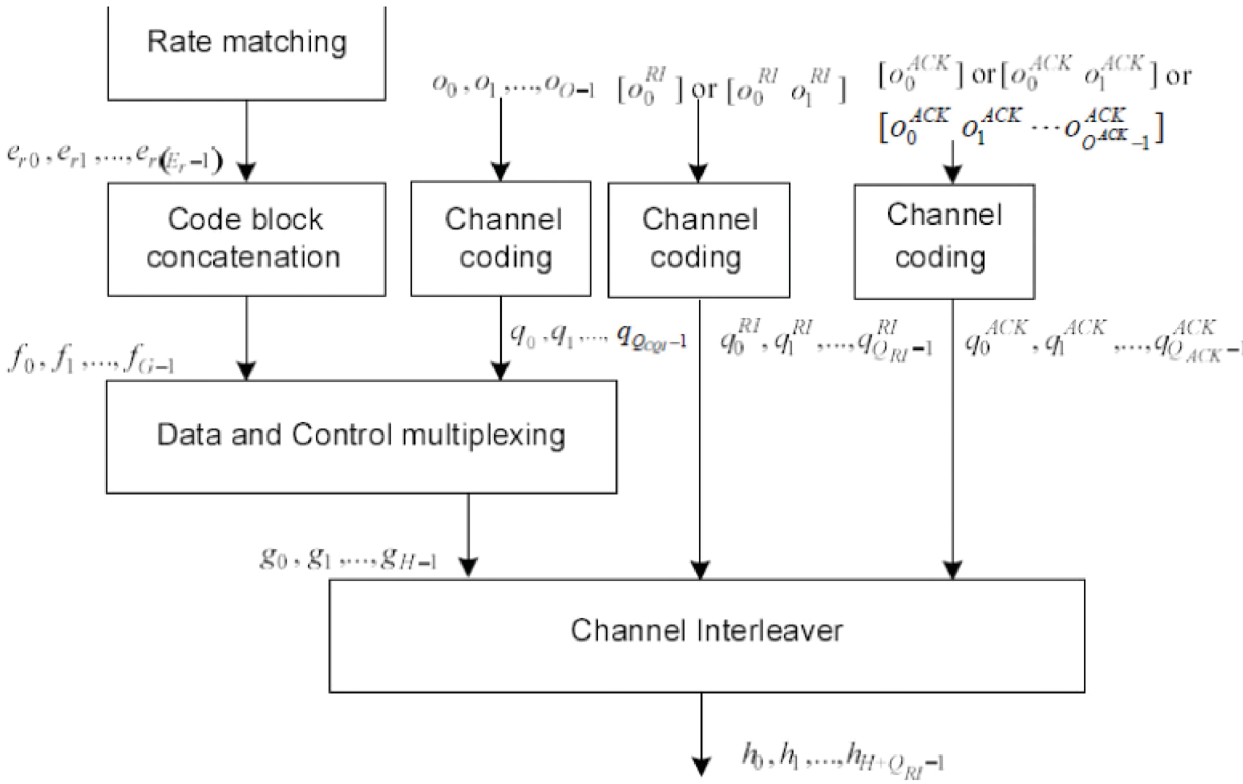



**Figure 5.2.2-1: Transport channel processing for UL-SCH**

### 5.2.2.7 Data and control multiplexing

The inputs to the data and control multiplexing are the coded bits of the control information denoted by $q_0, q_1, q_2, q_3, \ldots, q_{Q_{CQI}-1}$ and the coded bits of the UL-SCH denoted by $f_0, f_1, f_2, f_3, \ldots, f_{G-1}$. The output of the data and control multiplexing operation is denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, \underline{g}_3, \ldots, \underline{g}_{H'-1}$, where $H = (G + Q_{CQI})$ and $H' = H / Q_m$,

and where $\underline{g}_i$, $i = 0, \ldots, H'-1$ are column vectors of length $Q_m$. $H$ is the total number of coded bits allocated for UL-SCH data and CQI/PMI information.

The control information and the data shall be multiplexed as follows:

Set *i*, *j*, *k* to 0

while $j < Q_{CQI}$ -- first place the control information

$\underline{g}_k = [q_j \ldots q_{j+Q_m-1}]^T$

$j = j + Q_m$

$k = k + 1$

end while

while $i < G$ -- then place the data

$$\underline{g}_k = [f_i \cdots f_{i+Q_m-1}]^T$$

$$i = i + Q_m$$

$$k = k + 1$$

end while

114. The Accused Products further practice a method comprising mapping the multiplexed signals to a 2-dimensional resource matrix comprising a plurality of columns and a plurality of rows, wherein the columns and the rows of the 2-dimensional resource matrix correspond to single carrier frequency divisional multiple access (SC-FDMA) symbols and subcarriers for each SC-FDMA symbol, respectively. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.212 section 5.2.2 and 3GPP TS 36.211 section 5.2.1.

# 5.2.2 Uplink shared channel

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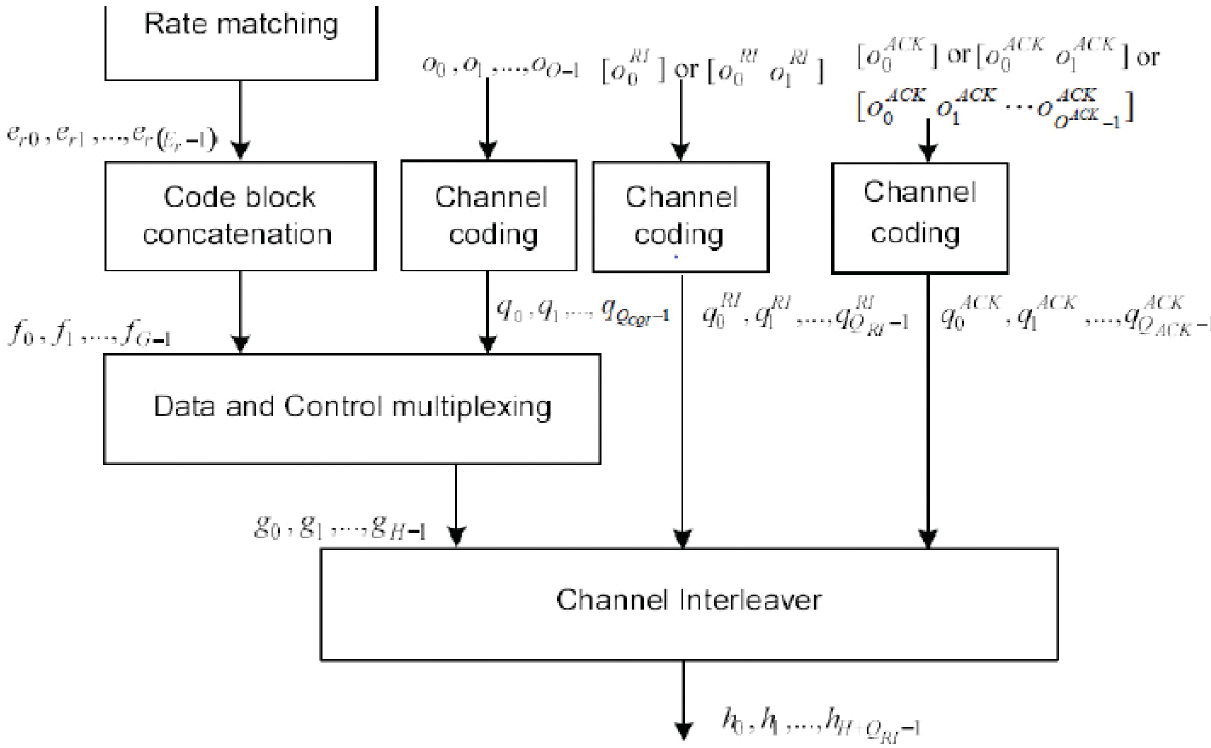


**Figure 5.2.2-1: Transport channel processing for UL-SCH**

## 5.2.2.8 Channel interleaver

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The channel interleaver described in this subclause in conjunction with the resource element mapping for PUSCH in [2] implements a time-first mapping of modulation symbols onto the transmit waveform while ensuring that the HARQ-ACK information is present on both slots in the subframe and is mapped to resources around the uplink demodulation reference signals.

The input to the channel interleaver are denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, ..., \underline{g}_{H'-1}$, $\underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, ..., \underline{q}_{Q'_{RI}-1}^{RI}$ and $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, ..., \underline{q}_{Q'_{ACK}-1}^{ACK}$. The number of modulation symbols in the subframe is given by $H'' = H' + Q'_{RI}$. The output bit sequence from the channel interleaver is derived as follows:

(1) Assign $C_{mux} = N_{\mathrm{symb}}^{\mathrm{PUSCH}}$ to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2,..., $C_{mux}-1$ from left to right. $N_{\mathrm{symb}}^{\mathrm{PUSCH}}$ is determined according to section 5.2.2.6.

(2) The number of rows of the matrix is $R_{mux} = (H'' \cdot Q_m)/C_{mux}$ and we define $R'_{mux} = R_{mux}/Q_m$.

The rows of the rectangular matrix are numbered 0, 1, 2,..., $R_{mux}-1$ from top to bottom.

(3) If rank information is transmitted in this subframe, the vector sequence $\underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, \ldots, \underline{q}_{Q'_{RI}-1}^{RI}$ is written onto the columns indicated by Table 5.2.2.8-1, and by sets of $Q_m$ rows starting from the last row and moving upwards according to the following pseudocode.

Set $i$, $j$ to 0.

Set $r$ to $R'_{mux}-1$

while $i < Q'_{RI}$

$c_{RI} = \text{Column Set}(j)$

$\underline{y}_{r \times C_{mux} + c_{RI}} = \underline{q}_i^{RI}$

$i = i+1$

$r = R'_{mux} - 1 - \lfloor i/4 \rfloor$

$j = (j+3) \bmod 4$

end while

Where ColumnSet is given in Table 5.2.2.8-1 and indexed left to right from 0 to 3.

(4) Write the input vector sequence, for $k$ = 0, 1,..., $H'-1$, into the $(R_{mux} \times C_{mux})$ matrix by sets of $Q_m$ rows starting with the vector $\underline{y}_0$ in column 0 and rows 0 to $(Q_m-1)$ and skipping the matrix entries that are already occupied:

$$\begin{bmatrix} \underline{y}_0 & \underline{y}_1 & \underline{y}_2 & \cdots & \underline{y}_{C_{mux}-1} \\ \underline{y}_{C_{mux}} & \underline{y}_{C_{mux}+1} & \underline{y}_{C_{mux}+2} & \cdots & \underline{y}_{2C_{mux}-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \underline{y}_{(R'_{mux}-1)\times C_{mux}} & \underline{y}_{(R'_{mux}-1)\times C_{mux}+1} & \underline{y}_{(R'_{mux}-1)\times C_{mux}+2} & \cdots & \underline{y}_{(R'_{mux}\times C_{mux}-1)} \end{bmatrix}$$

The pseudocode is as follows:

Set i, k to 0.

While k < $H'$,

if $\underline{y}_i$ is not assigned to RI symbols

$\underline{y}_i = \underline{g}_k$

k = k + 1

end if

i = i+1

end While

***

(6) The output of the block interleaver is the bit sequence read out column by column from the $(R_{mux} \times C_{mux})$ matrix. The bits after channel interleaving are denoted by $h_0, h_1, h_2, ..., h_{H+Q_{RI}-1}$.

**Table 5.2.2.8-1: Column set for Insertion of rank information**

| CP configuration | Column Set |
|---|---|
| Normal | {1, 4, 7, 10} |
| Extended | {0, 3, 5, 8} |

**Table 5.2.2.8-2: Column set for Insertion of HARQ-ACK information**

| CP configuration | Column Set |
|---|---|
| Normal | {2, 3, 8, 9} |
| Extended | {1, 2, 6, 7} |

## 5.2 Slot structure and physical resources

### 5.2.1 Resource grid

The transmitted signal in each slot is described by a resource grid of $N_{\mathrm{RB}}^{\mathrm{UL}} N_{\mathrm{sc}}^{\mathrm{RB}}$ subcarriers and $N_{\mathrm{symb}}^{\mathrm{UL}}$ SC-FDMA symbols. The resource grid is illustrated in Figure 5.2.1-1. The quantity $N_{\mathrm{RB}}^{\mathrm{UL}}$ depends on the uplink transmission bandwidth configured in the cell and shall fulfil

$$N_{\mathrm{RB}}^{\mathrm{min,UL}} \le N_{\mathrm{RB}}^{\mathrm{UL}} \le N_{\mathrm{RB}}^{\mathrm{max,UL}}$$

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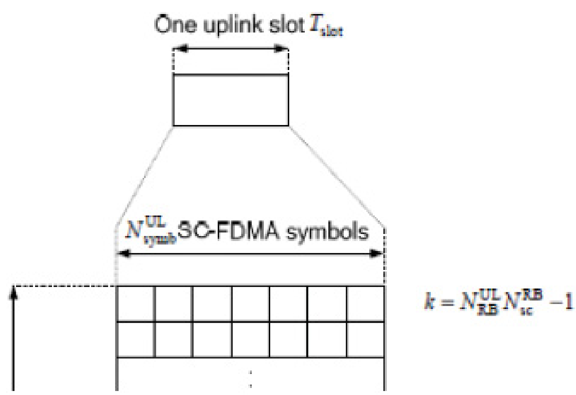


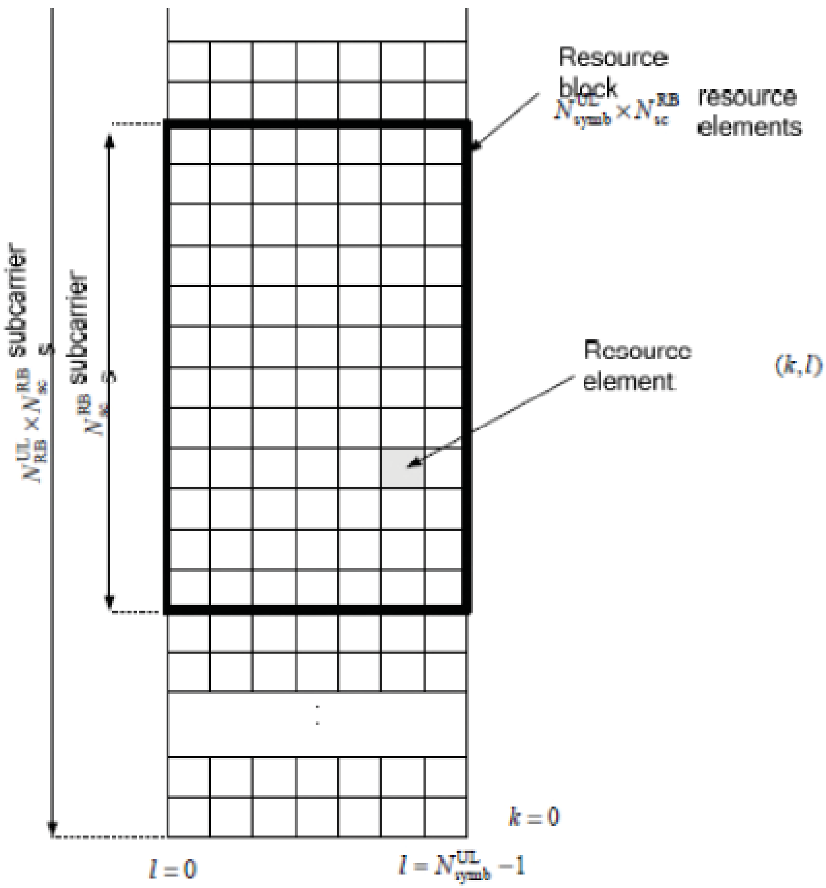



**Figure 5.2.1-1: Uplink resource grid.**

115. The Accused Products further practice a method wherein a number of columns of the 2-dimensional resource matrix corresponds to a number of SC-FDMA symbols within one subframe except specific SC-FDMA symbols used for a reference signal, and wherein the multiplexed signals are mapped from the first column of the first row to the last column of the first row, the first column of the second row to the last column of the second row, and so on, until all the multiplexed signals are mapped to the 2-dimensional resource matrix. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.211 section 4.1-4.2, 3GPP TS 36.211 section 5.2.1, and 3GPP TS 36.212 section 5.2.2.

## 4.1 Frame structure type 1

Frame structure type 1 is applicable to both full duplex and half duplex FDD. Each radio frame is $T_f = 307200 \cdot T_s = 10$ ms long and consists of 20 slots of length $T_{slot} = 15360 \cdot T_s = 0.5$ ms, numbered from 0 to 19. A subframe is defined as two consecutive slots where subframe $i$ consists of slots $2i$ and $2i+1$.

For FDD, 10 subframes are available for downlink transmission and 10 subframes are available for uplink transmissions in each 10 ms interval. Uplink and downlink transmissions are separated in the frequency domain. In half-duplex FDD operation, the UE cannot transmit and receive at the same time while there are no such restrictions in full-duplex FDD.

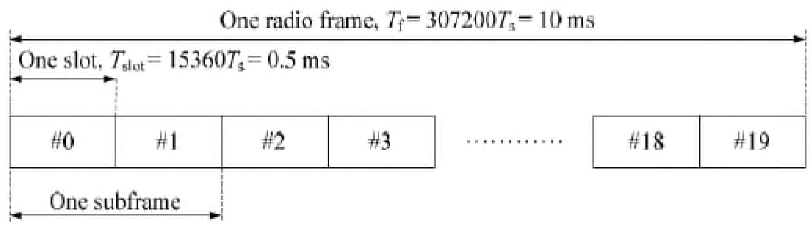



**Figure 4.1-1: Frame structure type 1.**

## 4.2 Frame structure type 2

Frame structure type 2 is applicable to TDD. Each radio frame of length $T_f = 307200 \cdot T_s = 10$ ms consists of two half-frames of length $153600 \cdot T_s = 5$ ms each. Each half-frame consists of five subframes of length $30720 \cdot T_s = 1$ ms. The supported uplink-downlink configurations are listed in Table 4.2-2 where, for each subframe in a radio frame, 'D' denotes the subframe is reserved for downlink transmissions, 'U' denotes the subframe is reserved for uplink transmissions and 'S' denotes a special subframe with the three fields DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is given by Table 4.2-1 subject to the total length of DwPTS, GP and UpPTS being equal to $30720 \cdot T_s = 1$ ms. Each subframe $i$ is defined as two slots, $2i$ and $2i+1$ of length $T_{slot} = 15360 \cdot T_s = 0.5$ ms in each subframe.

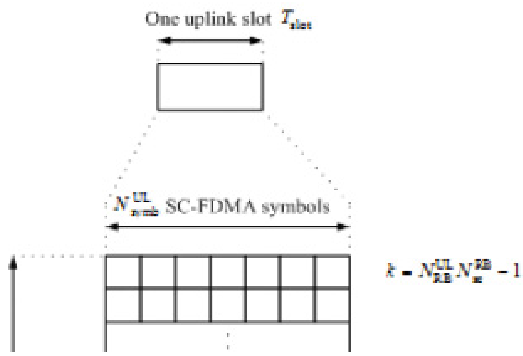
# 5.2 Slot structure and physical resources

## 5.2.1 Resource grid

The transmitted signal in each slot is described by a resource grid of $N_{RB}^{UL} N_{sc}^{RB}$ subcarriers and $N_{symb}^{UL}$ SC-FDMA symbols. The resource grid is illustrated in Figure 5.2.1-1. The quantity $N_{RB}^{UL}$ depends on the uplink transmission bandwidth configured in the cell and shall fulfil

$$N_{RB}^{\min,UL} \le N_{RB}^{UL} \le N_{RB}^{\max,UL}$$

***




## 5.2.2 Uplink shared channel

***

### 5.2.2.8 Channel interleaver

The channel interleaver described in this subclause in conjunction with the resource element mapping for PUSCH in [2] implements a time-first mapping of modulation symbols onto the transmit waveform while ensuring that the HARQ-ACK information is present on both slots in the subframe and is mapped to resources around the uplink demodulation reference signals.

The input to the channel interleaver are denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, ..., \underline{g}_{H'-1}$, $\underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, ..., \underline{q}_{Q'_{RI}-1}^{RI}$ and $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, ..., \underline{q}_{Q'_{ACK}-1}^{ACK}$. The number of modulation symbols in the subframe is given by $H'' = H' + Q'_{RI}$ .. The output bit sequence from the channel interleaver is derived as follows:

(1) Assign $C_{mux} = N_{symb}^{PUSCH}$ to be the number of columns of the matrix. The columns of the matrix are numbered 0, 1, 2,…, $C_{mux}-1$ from left to right. $N_{symb}^{PUSCH}$ is determined according to section 5.2.2.6.

(2) The number of rows of the matrix is $R_{mux} = (H''\cdot Q_m)/C_{mux}$ and we define $R'_{mux} = R_{mux}/Q_m$.

The rows of the rectangular matrix are numbered 0, 1, 2,…, $R_{mux}-1$ from top to bottom.

***

### 5.2.2.6 Channel coding of control information

***

When the UE transmits HARQ-ACK bits or rank indicator bits, it shall determine the number of coded symbols $Q'$ for HARQ-ACK or rank indicator as

$$Q' = \min\left(\left\lceil \frac{O\cdot M_{sc}^{PUSCH-initial}\cdot N_{symb}^{PUSCH-initial}\cdot \beta_{offset}^{PUSCH}}{\sum_{r=0}^{C-1} K_r}\right\rceil, 4\cdot M_{sc}^{PUSCH}\right)$$

where $O$ is the number of ACK/NACK bits or rank indicator bits, $M_{sc}^{PUSCH}$ is the scheduled bandwidth for PUSCH transmission in the current sub-frame for the transport block, expressed as a number of subcarriers in [2], and $N_{symb}^{PUSCH-initial}$ is the number of SC-FDMA symbols per subframe for initial PUSCH transmission for the same transport block given by $N_{symb}^{PUSCH-initial} = (2\cdot(N_{symb}^{UL}-1)-N_{SRS})$, where $N_{SRS}$ is equal to 1 if UE is configured to send PUSCH and SRS in the same subframe for initial transmission or if the PUSCH resource allocation for initial transmission even partially overlaps with the cell specific SRS subframe and bandwidth configuration defined in Section 5.5.3 of [2]. Otherwise $N_{SRS}$ is equal to 0. $M_{sc}^{PUSCH-initial}$, $C$, and $K_r$ are obtained from the initial PDCCH for the same transport

***

## 5.2.2 Uplink shared channel

***

### 5.2.2.8 Channel interleaver

***

(4) Write the input vector sequence, for $k = 0, 1,..., H'-1$, into the $(R_{mux} \times C_{mux})$ matrix by sets of $Q_m$ rows starting with the vector $\underline{y}_0$ in column 0 and rows 0 to $(Q_m - 1)$ and skipping the matrix entries that are already occupied:

$$\begin{bmatrix} \underline{y}_0 & \underline{y}_1 & \underline{y}_2 & \cdots & \underline{y}_{C_{mux}-1} \\ \underline{y}_{C_{mux}} & \underline{y}_{C_{mux}+1} & \underline{y}_{C_{mux}+2} & \cdots & \underline{y}_{2C_{mux}-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \underline{y}_{(R'_{mux}-1)\times C_{mux}} & \underline{y}_{(R'_{mux}-1)\times C_{mux}+1} & \underline{y}_{(R'_{mux}-1)\times C_{mux}+2} & \cdots & \underline{y}_{(R'_{mux}\times C_{mux}-1)} \end{bmatrix}$$

The pseudocode is as follows:

```
Set i, k to 0.
  While k < H',
    if y_i is not assigned to RI symbols
       y_i = g_k
       k = k + 1
    end if
    i = i+1
  end While
```

116. The Accused Products further practice a method comprising mapping ACK/NACK control signals to specific columns of the 2-dimensional resource matrix, wherein the specific columns correspond to SC-FDMA symbols right adjacent to the specific SC-FDMA symbols, wherein the ACK/NACK control signals overwrite some of the multiplexed signals mapped to the 2-dimensional resource matrix from the last row of the specific columns. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.211 section 4.1-4.2, 3GPP TS 36.212 sections 5.2.2.8 and 5.2.2, 3GPP TS 36.211 sections 5.2.1, 5.2.3, 5.5.2.1.2, 5.3.4, 5.5.2, and 3GPP TS 36.300 section 5.2.4.

# 4.1 Frame structure type 1

Frame structure type 1 is applicable to both full duplex and half duplex FDD. Each radio frame is $T_f = 307200 \cdot T_s = 10\ \text{ms}$ long and consists of 20 slots of length $T_{slot} = 15360 \cdot T_s = 0.5\ \text{ms}$, numbered from 0 to 19. A subframe is defined as two consecutive slots where subframe $i$ consists of slots $2i$ and $2i+1$.

For FDD, 10 subframes are available for downlink transmission and 10 subframes are available for uplink transmissions in each 10 ms interval. Uplink and downlink transmissions are separated in the frequency domain. In half-duplex FDD operation, the UE cannot transmit and receive at the same time while there are no such restrictions in full-duplex FDD.

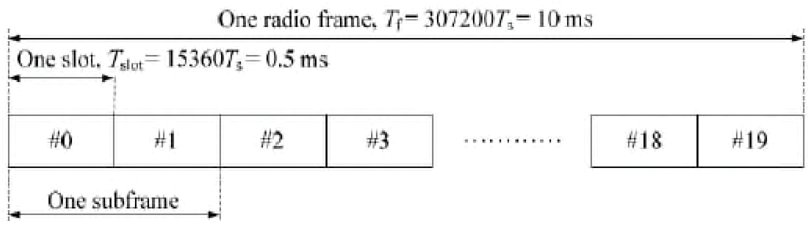



**Figure 4.1-1: Frame structure type 1.**

# 4.2 Frame structure type 2

Frame structure type 2 is applicable to TDD. Each radio frame of length $T_f = 307200 \cdot T_s = 10\ \text{ms}$ consists of two half-frames of length $153600 \cdot T_s = 5\ \text{ms}$ each. Each half-frame consists of five subframes of length $30720 \cdot T_s = 1\ \text{ms}$. The supported uplink-downlink configurations are listed in Table 4.2-2 where, for each subframe in a radio frame, 'D' denotes the subframe is reserved for downlink transmissions, 'U' denotes the subframe is reserved for uplink transmissions and 'S' denotes a special subframe with the three fields DwPTS, GP and UpPTS. The length of DwPTS and UpPTS is given by Table 4.2-1 subject to the total length of DwPTS, GP and UpPTS being equal to $30720 \cdot T_s = 1\ \text{ms}$. Each subframe $i$ is defined as two slots, $2i$ and $2i+1$ of length $T_{slot} = 15360 \cdot T_s = 0.5\ \text{ms}$ in each subframe.

### 5.2.2.8 Channel interleaver

The channel interleaver described in this subclause in conjunction with the resource element mapping for PUSCH in [2] implements a time-first mapping of modulation symbols onto the transmit waveform while ensuring that the HARQ-ACK information is present on both slots in the subframe and is mapped to resources around the uplink demodulation reference signals.

## 5.2 Slot structure and physical resources

### 5.2.1 Resource grid

The transmitted signal in each slot is described by a resource grid of $N_{RB}^{UL} N_{sc}^{RB}$ subcarriers and $N_{symb}^{UL}$ SC-FDMA symbols. The resource grid is illustrated in Figure 5.2.1-1. The quantity $N_{RB}^{UL}$ depends on the uplink transmission bandwidth configured in the cell and shall fulfil

$$N_{RB}^{\min,UL} \le N_{RB}^{UL} \le N_{RB}^{\max,UL}$$

***

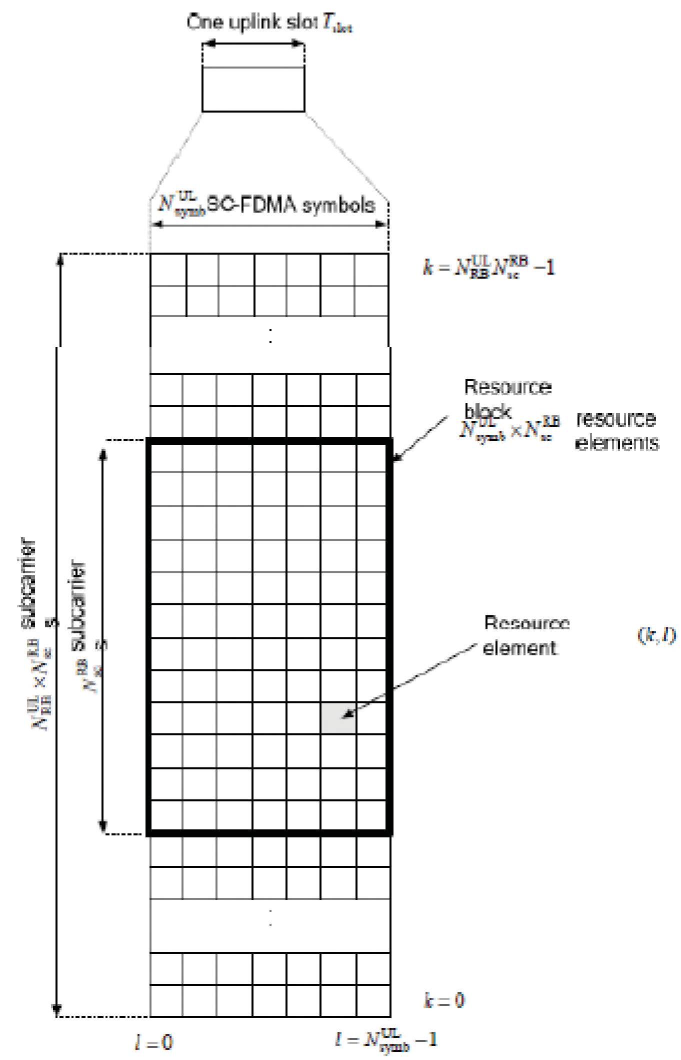



**Figure 5.2.1-1: Uplink resource grid.**

The number of SC-FDMA symbols in a slot depends on the cyclic prefix length configured by the higher layer parameter *UL-CyclicPrefixLength* and is given in Table 5.2.3-1.

## 5.2.3 Resource blocks

A physical resource block is defined as $N_{\text{symb}}^{\text{UL}}$ consecutive SC-FDMA symbols in the time domain and $N_{\text{sc}}^{\text{RB}}$ consecutive subcarriers in the frequency domain, where $N_{\text{symb}}^{\text{UL}}$ and $N_{\text{sc}}^{\text{RB}}$ are given by Table 5.2.3-1. A physical resource block in the uplink thus consists of $N_{\text{symb}}^{\text{UL}} \times N_{\text{sc}}^{\text{RB}}$ resource elements, corresponding to one slot in the time domain and 180 kHz in the frequency domain.

**Table 5.2.3-1: Resource block parameters**

| Configuration | $N_{\text{sc}}^{\text{RB}}$ | $N_{\text{symb}}^{\text{UL}}$ |
|---|---|---|
| Normal cyclic prefix | 12 | 7 |
| Extended cyclic prefix | 12 | 6 |

## 5.2.4 Uplink Reference signal

Uplink reference signals [for channel estimation for coherent demodulation] are transmitted in the 4-th block of the slot [*assumed normal CP*]. The uplink reference signals sequence length equals the size (number of sub-carriers) of the assigned resource.

### 5.5.2.1.2 Mapping to physical resources

The sequence $r^{\text{PUSCH}}(\cdot)$ shall be multiplied with the amplitude scaling factor $\beta_{\text{PUSCH}}$ and mapped in sequence starting with $r^{\text{PUSCH}}(0)$ to the same set of physical resource blocks used for the corresponding PUSCH transmission defined in Section 5.3.4. The mapping to resource elements $(k,l)$, with $l = 3$ for normal cyclic prefix and $l = 2$ for extended cyclic prefix, in the subframe shall be in increasing order of first $k$, then the slot number.

## 5.3.4 Mapping to physical resources

The block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$ shall be multiplied with the amplitude scaling factor $\beta_{\text{PUSCH}}$ in order to conform to the transmit power $P_{PUSCH}$ specified in Section 5.1.1.1 in [4], and mapped in sequence starting with $z(0)$ to physical resource blocks assigned for transmission of PUSCH. The mapping to resource elements $(k,l)$ corresponding to the physical resource blocks assigned for transmission and not used for transmission of reference signals and not reserved for possible SRS transmission shall be in increasing order of first the index $k$, then the index $l$, starting with the first slot in the subframe.

## 5.2.2 Uplink shared channel

***

### 5.2.2.8 Channel interleaver

***

(5) If HARQ-ACK information is transmitted in this subframe, the vector sequence $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, ..., \underline{q}_{Q'_{ACK}-1}^{ACK}$ is written onto the columns indicated by Table 5.2.2.8-2, and by sets of $Q_m$ rows starting from the last row and moving upwards according to the following pseudocode. Note that this operation overwrites some of the channel interleaver entries obtained in step (4).

Set $i, j$ to 0.

Set $r$ to $R'_{mux} - 1$

while $i < Q'_{ACK}$

$c_{ACK} = \text{ColumnSet}(j)$

$\underline{y}_{r \times C_{mux} + c_{ACK}} = \underline{q}_i^{ACK}$

$i = i + 1$

$r = R'_{mux} - 1 - \lfloor i/4 \rfloor$

$j = (j + 3) \bmod 4$

end while

Where ColumnSet is given in Table 5.2.2.8-2 and indexed left to right from 0 to 3.

***

**Table 5.2.2.8-2: Column set for Insertion of HARQ-ACK information**

| CP configuration | Column Set |
| --- | --- |
| Normal | {2, 3, 8, 9} |
| Extended | {1, 2, 6, 7} |

## 5.5.2 Demodulation reference signal

### 5.5.2.1 Demodulation reference signal for PUSCH

***

#### 5.5.2.1.2 Mapping to physical resources

The sequence $r^{\text{PUSCH}}(\cdot)$ shall be multiplied with the amplitude scaling factor $\beta_{\text{PUSCH}}$ and mapped in sequence starting with $r^{\text{PUSCH}}(0)$ to the same set of physical resource blocks used for the corresponding PUSCH transmission defined in Section 5.3.4. The mapping to resource elements $(k,l)$, with $l=3$ for normal cyclic prefix and $l=2$ for extended cyclic prefix, in the subframe shall be in increasing order of first $k$, then the slot number.

## 5.2.2 Uplink shared channel

***

### 5.2.2.8 Channel interleaver

***

(5) If HARQ-ACK information is transmitted in this subframe, the vector sequence $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, ..., \underline{q}_{Q'_{ACK}-1}^{ACK}$ is written onto the columns indicated by Table 5.2.2.8-2, and by sets of $Q_m$ rows starting from the last row and moving upwards according to the following pseudocode. Note that this operation overwrites some of the channel interleaver entries obtained in step (4).

117. The Accused Products further practice a method comprising transmitting the signals mapped to the 2-dimensional resource matrix by column by column to a base station. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.211 section 4.1 and 3GPP TS 36.211 section 5.2.1.

## 4.1 Frame structure type 1

Frame structure type 1 is applicable to both full duplex and half duplex FDD. Each radio frame is $T_f = 307200 \cdot T_s = 10\text{ ms}$ long and consists of 20 slots of length $T_{\text{slot}} = 15360 \cdot T_s = 0.5\text{ ms}$, numbered from 0 to 19. A subframe is defined as two consecutive slots where subframe $i$ consists of slots $2i$ and $2i+1$.

For FDD, 10 subframes are available for downlink transmission and 10 subframes are available for uplink transmissions in each 10 ms interval. Uplink and downlink transmissions are separated in the frequency domain. In half-duplex FDD operation, the UE cannot transmit and receive at the same time while there are no such restrictions in full-duplex FDD.

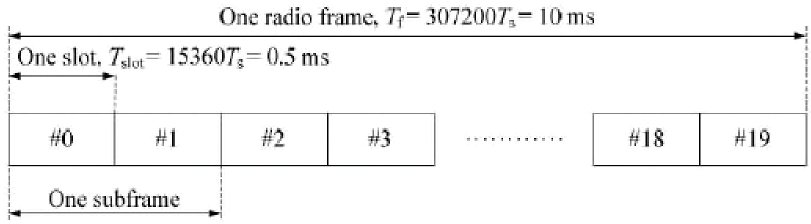



**Figure 4.1-1: Frame structure type 1.**

## 5.2 Slot structure and physical resources

### 5.2.1 Resource grid

The transmitted signal in each slot is described by a resource grid of $N_{RB}^{UL} N_{sc}^{RB}$ subcarriers and $N_{symb}^{UL}$ SC-FDMA symbols. The resource grid is illustrated in Figure 5.2.1-1. The quantity $N_{RB}^{UL}$ depends on the uplink transmission bandwidth configured in the cell and shall fulfil

$$N_{RB}^{min,UL} \le N_{RB}^{UL} \le N_{RB}^{max,UL}$$

***

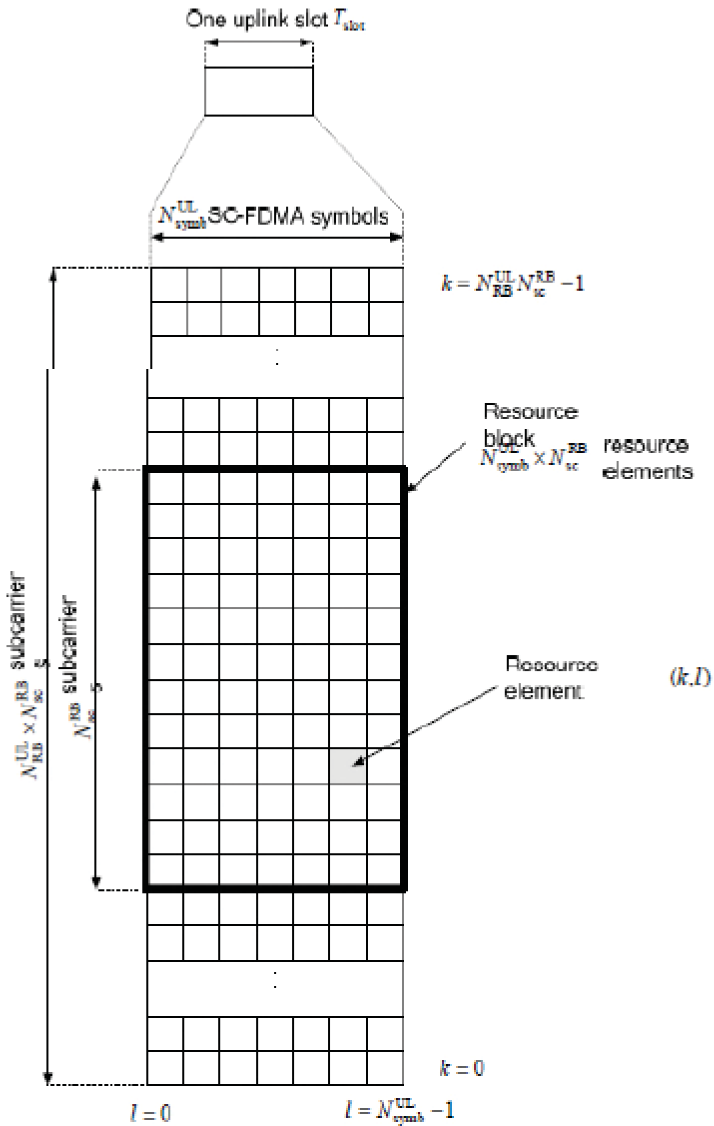



**Figure 5.2.1-1: Uplink resource grid.**

118. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’833 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’833 Patent.

119. Apple has had knowledge and notice of the ’833 Patent at least as of the filing of this Complaint.

120. Apple indirectly infringes the ’833 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’833 patent. Apple induces this direct infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple’s inducement, Apple’s customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the ’833 Patent. Apple performs these affirmative acts with knowledge of the ’833 Patent and with the intent, or willful blindness, that the induced acts directly infringe the ’833 Patent.

121. Apple also indirectly infringes the ’833 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple’s affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple’s customers and end-users use of the Apple Accused Products, such that the ’833 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the ’833 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the ’833 Patent. Apple performs these affirmative

acts with knowledge of the ’833 Patent and with intent, or willful blindness, that they cause the direct infringement of the ’833 Patent.

122. Apple’s infringement of the ’833 Patent has damaged and will continue to damage the Plaintiffs.

**COUNT VII: PATENT INFRINGEMENT OF THE ’290 PATENT**

123. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

124. Apple infringes, contributes to the infringement of, and/or induces infringement of the ’290 Patent by making, using, selling, offering for sale, exporting from, and/or importing into the United States products and/or methods covered by one or more claims of the ’290 Patent including, but not limited to, at least the Apple Accused Products.

125. For example and as shown below, the LTE Accused Products infringe claim 10 of the ’290 patent by virtue of their compatibility with and practice of the LTE standard. For example, each Accused Product is a mobile terminal configured to receive data in a Single-User MIMO (SU-MIMO) signaling mode and a Multi-User MIMO (MU-MIMO) signaling mode. As shown below, this functionality is described in the LTE Standard, including but not limited to 3GPP TS 36.300 § 5.1.5 and 3GPP TS 36.213 § 7.1.

> 5.1.5 Downlink multi-antenna transmission
>
> Multi-antenna transmission with 2 and 4 transmit antennas is supported. The maximum number of codeword is two irrespective to the number of antennas with fixed mapping between code words to layers.
>
> Spatial division multiplexing (SDM) of multiple modulation symbol streams to a single UE using the same time-frequency (-code) resource, also referred to as Single-User MIMO (SU-MIMO) is supported. When a MIMO channel is solely assigned to a single UE, it is known as SU-MIMO. Spatial division multiplexing of modulation symbol streams to different UEs using the same time-frequency resource, also referred to as MU-MIMO, is also supported. There is semi-static switching between SU-MIMO and MU-MIMO per UE.

## 7.1 UE procedure for receiving the physical downlink shared channel

A UE shall upon detection of a PDCCH with DCI format 1, 1A, 1B, 1C, 1D, 2, 2A or 2B intended for the UE in a subframe, decode the corresponding PDSCH in the same subframe with the restriction of the number of transport blocks defined in the higher layers...

The UE is semi-statically configured via higher layer signalling to receive PDSCH data transmissions signalled via PDCCH according to one of eight transmission modes, denoted mode 1 to mode 8....

If a UE is configured by higher layers to decode PDCCH with CRC scrambled by the C-RNTI, the UE shall decode the PDCCH and any corresponding PDSCH according to the respective combinations defined in table 7.1-5. The scrambling initialization of PDSCH corresponding to these PDCCHs is by C-RNTI.…

126. The Accused Products further comprise a controller configured to switch the mobile terminal between the SU-MIMO and MU-MIMO signaling modes. As shown below, this functionality is described in the LTE Standard, including but not limited to 3GPP TS 36.331 §§ 5.3.5, 5.3.10, and 6.3.2.

## 5.3.5 RRC connection reconfiguration

### 5.3.5.1 General

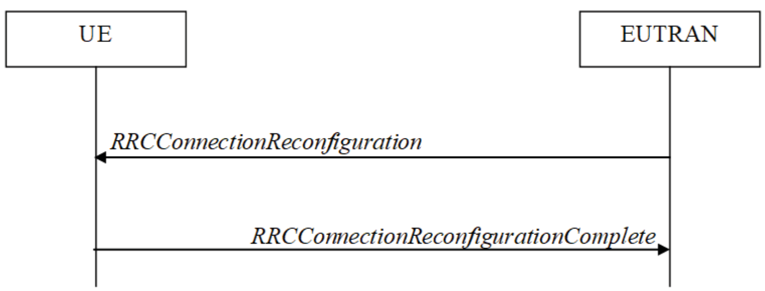



**Figure 5.3.5.1-1: RRC connection reconfiguration, successful**

[. . . ]

The purpose of this procedure is to modify an RRC connection, e.g. to establish/ modify/ release RBs, to perform handover, to setup/ modify/ release measurements.

[. . .]

5.3.5.3 Reception of an *RRCConnectionReconfiguration* not including the *mobilityControlInfo* by the UE

If the *RRCConnectionReconfiguration* message does not include the *mobilityControlInfo* and the UE is able to comply with the configuration included in this message, the UE shall:

1>if this is the first *RRCConnectionReconfiguration* message after successful completion of the RRC Connection Re-establishment procedure:

2>re-establish PDCP for SRB2 and for all DRBs that are established, if any;

2>re-establish RLC for SRB2 and for all DRBs that are established, if any;

2>if the *RRCConnectionReconfiguration* message includes the *fullConfig*:

3>perform the radio resource configuration procedure as specified in section 5.3.5.8;

2>if the *RRCConnectionReconfiguration* message includes the *radioResourceConfigDedicated*:

3>perform the radio resource configuration procedure as specified in 5.3.10;

[. . .]

5.3.10 Radio resource configuration

5.3.10.0 General

The UE shall:

1>if the received *radioResourceConfigDedicated* includes the *srb-ToAddModList*:

2>perform the SRB addition or reconfiguration as specified in 5.3.10.1;

1>if the received *radioResourceConfigDedicated* includes the *drb-ToReleaseList*:

2>perform DRB release as specified in 5.3.10.2;

1>if the received *radioResourceConfigDedicated* includes the *drb-ToAddModList*:

2>perform DRB addition or reconfiguration as specified in 5.3.10.3;

1>if the received *radioResourceConfigDedicated* includes the *mac-MainConfig*:

2>perform MAC main reconfiguration as specified in 5.3.10.4;

1>if the received *radioResourceConfigDedicated* includes *sps-Config*:

2>perform SPS reconfiguration according to 5.3.10.5;

1>if the received *radioResourceConfigDedicated* includes the *physicalConfigDedicated*:

2>reconfigure the physical channel configuration as specified in 5.3.10. 6.

[. . .]

5.3.10.6 Physical channel reconfiguration

The UE shall:

1>reconfigure the physical channel configuration in accordance with the received *physicalConfigDedicated*;

[. . .]

## 6.3.2 Radio resource control information elements

[. . .]

### – *PhysicalConfigDedicated*

The IE *PhysicalConfigDedicated* is used to specify the UE specific physical channel configuration.

***PhysicalConfigDedicated information element***

```
-- ASN1START

PhysicalConfigDedicated ::=     SEQUENCE {
    pdsch-ConfigDedicated               PDSCH-ConfigDedicated           OPTIONAL,       -- Need ON
    pucch-ConfigDedicated               PUCCH-ConfigDedicated           OPTIONAL,       -- Need ON
    pusch-ConfigDedicated               PUSCH-ConfigDedicated           OPTIONAL,       -- Need ON
    uplinkPowerControlDedicated     UplinkPowerControlDedicated     OPTIONAL,       -- Need ON
    tpc-PDCCH-ConfigPUCCH               TPC-PDCCH-Config                OPTIONAL,       -- Need ON
    tpc-PDCCH-ConfigPUSCH               TPC-PDCCH-Config                OPTIONAL,       -- Need ON
    cqi-ReportConfig                    CQI-ReportConfig                OPTIONAL,       -- Need ON
    soundingRS-UL-ConfigDedicated       SoundingRS-UL-ConfigDedicated   OPTIONAL,       -- Need ON
    antennaInfo                         CHOICE {
        explicitValue                       AntennaInfoDedicated,
        defaultValue                        NULL
    }       OPTIONAL,                                                                   -- Need ON
    schedulingRequestConfig         SchedulingRequestConfig     OPTIONAL,           -- Need ON
    ...,
    [[  cqi-ReportConfig-v920               CQI-ReportConfig-v920       OPTIONAL,       -- Need ON
        antennaInfo-v920                    AntennaInfoDedicated-v920   OPTIONAL        -- Need ON
    ]]
}

-- ASN1STOP
```

[. . .]

– *AntennaInfo*

The IE *AntennaInfoCommon* and the *AntennaInfoDedicated* are used to specify the common and the UE specific antenna configuration respectively.

***AntennaInfo* information elements**

```
-- ASN1START

AntennaInfoCommon ::=               SEQUENCE {
    antennaPortsCount                   ENUMERATED {an1, an2, an4, spare1}
}

AntennaInfoDedicated ::=            SEQUENCE {
    transmissionMode                    ENUMERATED {
                                            tm1, tm2, tm3, tm4, tm5, tm6,
                                            tm7, tm8-v920},
    codebookSubsetRestriction           CHOICE {
        n2TxAntenna-tm3                     BIT STRING (SIZE (2)),
        n4TxAntenna-tm3                     BIT STRING (SIZE (4)),
        n2TxAntenna-tm4                     BIT STRING (SIZE (6)),
        n4TxAntenna-tm4                     BIT STRING (SIZE (64)),
        n2TxAntenna-tm5                     BIT STRING (SIZE (4)),
        n4TxAntenna-tm5                     BIT STRING (SIZE (16)),
        n2TxAntenna-tm6                     BIT STRING (SIZE (4)),
        n4TxAntenna-tm6                     BIT STRING (SIZE (16))
    }       OPTIONAL,                                                   -- Cond TM
    ue-TransmitAntennaSelection         CHOICE{
            release                         NULL,
            setup                           ENUMERATED {closedLoop, openLoop}
    }
}

AntennaInfoDedicated-v920 ::=       SEQUENCE {
    codebookSubsetRestriction-v920      CHOICE {
        n2TxAntenna-tm8-r9                  BIT STRING (SIZE (6)),
        n4TxAntenna-tm8-r9                  BIT STRING (SIZE (32))
    }       OPTIONAL                                                    -- Cond TM8
}

-- ASN1STOP
```

[. . .]

| ***AntennaInfo* field descriptions** |
|---|
| ***antennaPortsCount***<br>Parameter represents the number of cell specific antenna ports where an1 corresponds to 1, an2 to 2 antenna ports etc. see TS 36.211 [21, 6.2.1]. |
| ***transmissionMode***<br>Points to one of Transmission modes defined in TS 36.213 [23, 7.1] where tm1 refers to transmission mode 1, tm2 to transmission mode 2 etc. |
| ***codebookSubsetRestriction***<br>Parameter: *codebookSubsetRestriction*, see TS 36.213 [23, 7.2] and TS 36.211 [21, 6.3.4.2.3]. The field *codebookSubsetRestriction-v920* is applicable only if PMI/RI reporting is configured. |
| ***ue-TransmitAntennaSelection***<br>For value *setup* the field indicates whether UE transmit antenna selection control is closed-loop or open-loop as described in TS 36.213 [23, 8.7]. |

| Conditional presence | Explanation |
|---|---|
| *TM* | The field is mandatory present if the *transmissionMode* is set to tm3, tm4, tm5 or tm6. Otherwise the field is not present and the UE shall delete any existing value for this field. |

127. The Accused Products further comprise a receiver configured to receive redefinition data from a base station, where the base station is configured to identify a data bit configured to be transmitted to the mobile terminal in a SU-MIMO bit stream, wherein the SU-

MIMO bit stream comprises a plurality of bits configured to be interpreted by the mobile terminal in the SU-MIMO signaling mode, and wherein the identified data bit is not required in the MU-MIMO signaling mode. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.300 § 11.1.1, 3GPP TS 36.213 § 7.1, and 3GPP TS 36.212 § 5.3.3.1.

### 11.1.1 Downlink Scheduling

In the downlink, E-UTRAN can dynamically allocate resources (PRBs and MCS) to UEs at each TTI via the C-RNTI on PDCCH(s). A UE always monitors the PDCCH(s) in order to find possible allocation when its downlink reception is enabled (activity governed by DRX when configured).

### 7.1 UE procedure for receiving the physical downlink shared channel

A UE shall upon detection of a PDCCH with DCI format 1, 1A, 1B, 1C, 1D, 2, 2A or 2B intended for the UE in a subframe, decode the corresponding PDSCH in the same subframe with the restriction of the number of transport blocks defined in the higher layers.

### 5.3.3.1.3A Format 1B

DCI format 1B is used for the compact scheduling of one PDSCH codeword with precoding information.

The following information is transmitted by means of the DCI format 1B:

- Localized/Distributed VRB assignment flag – 1 bit as defined in section 7.1.6.3 of 3GPP TS 36.331
- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits as defined in section 7.1.6.3 of 3GPP TS 36.331
  - For localized VRB:
    - $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits provide the resource allocation
  - For distributed VRB:
    - For $N_{RB}^{DL} < 50$
      - $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits provide the resource allocation
    - For $N_{RB}^{DL} \geq 50$
      - 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$
      - $(\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil - 1)$ bits provide the resource allocation
- Modulation and coding scheme – 5bits as defined in section 7.1.7 of 3GPP TS 36.331

[. . .]

- HARQ process number – 3 bits (FDD) , 4 bits (TDD)
- New data indicator – 1 bit
- Redundancy version – 2 bits
- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of 3GPP TS 36.331
- Downlink Assignment Index (this field is present in TDD for all the uplink –downlink configurations and only applies to TDD operation with uplink –downlink configuration 1-6. This field is not present in FDD) – 2 bits
- TPMI information for precoding – number of bits as specified in Table 5.3.3.1.3A-1

  TPMI information indicates which codebook index is used in Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 of 3GPP TS 36.213 corresponding to the single-layer transmission.
- PMI confirmation for precoding – 1 bit as specified in Table 5.3.3.1.3A-2

5.3.3.1.4A Format 1D

DCI format 1D is used for the compact scheduling of one PDSCH codeword with precoding and power offset information.

The following information is transmitted by means of the DCI format 1D:

- Localized/Distributed VRB assignment flag – 1 bit as defined in section 7.1.6.3 of 3GPP TS 36.331
- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits as defined in section 7.1.6.3 of 3GPP TS 36.331:
  - For localized VRB:

    $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits provide the resource allocation
  - For distributed VRB:
    - For $N_{RB}^{DL} < 50$

[. . .]

- $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits provide the resource allocation

- For $N_{RB}^{DL} \geq 50$

- 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$

- $(\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil - 1)$ bits provide the resource allocation

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of 3GPP TS 36.331
- HARQ process number – 3 bits (FDD), 4 bits (TDD)
- New data indicator – 1 bit
- Redundancy version – 2 bits
- TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of 3GPP TS 36.331
- Downlink Assignment Index (this field is present in TDD for all the uplink –downlink configurations and only applies to TDD operation with uplink –downlink configuration 1-6. This field is not present in FDD) – 2 bits
- TPMI information for precoding – number of bits as specified in Table 5.3.3.1.4A-1

  TPMI information indicates which codebook index is used in Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 of 3GPP TS 36.213 corresponding to the single-layer transmission.
- Downlink power offset – 1 bit as defined in section 7.1.5 of 3GPP TS 36.331

128. The Accused Products further comprise a receiver configured to receive redefinition data from a base station, where the base station is configured to redefine the identified data bit to comprise signaling data associated with the MU-MIMO signaling mode, wherein the redefinition data is configured to cause the mobile terminal to interpret the identified data bit as power offset signaling data associated with the MU-MIMO signaling mode. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 7.1.5, and 3GPP TS 36.212 § 5.3.3.1.4.

### 7.1.5 Multi-user MIMO scheme

For the multi-user MIMO transmission scheme of the PDSCH, the UE may assume that an eNB transmission on the PDSCH would be performed on one layer and according to Section 6.3.4.2.1 of [3]. The $\delta_{\text{power-offset}}$ dB value signalled on PDCCH with DCI format 1D using the downlink power offset field is given in Table 7.1.5-1.

**Table 7.1.5-1: Mapping of downlink power offset field in DCI format 1D to the $\delta_{\text{power-offset}}$ value.**

| Downlink power offset field | $\delta_{\text{power-offset}}$ [dB] |
|---|---|
| 0 | $-10\log_{10}(2)$ |
| 1 | 0 |

5.3.3.1.4A Format 1D

DCI format 1D is used for the compact scheduling of one PDSCH codeword with precoding and power offset information.

The following information is transmitted by means of the DCI format 1D:

[. . .]

- Downlink power offset – 1 bit as defined in section 7.1.5 of [3]

129. The Accused Products further comprise a receiver configured to receive a bit stream comprising the identified data bit at the mobile terminal using the MU-MIMO mode. As shown below, this functionality is described in the LTE Standard, including but not limited to in 3GPP TS 36.213 § 7.1, and 3GPP TS 36.212 § 5.3.3.1.4.

### 7.1 UE procedure for receiving the physical downlink shared channel

A UE shall upon detection of a PDCCH with DCI format 1, 1A, 1B, 1C, 1D, 2, 2A or 2B intended for the UE in a subframe, decode the corresponding PDSCH in the same subframe with the restriction of the number of transport blocks defined in the higher layers.

> 5.3.3.1.4A Format 1D
>
> DCI format 1D is used for the compact scheduling of one PDSCH codeword with precoding and power offset information.
>
> The following information is transmitted by means of the DCI format 1D:
>
> - Localized/Distributed VRB assignment flag – 1 bit as defined in section 7.1.6.3 of 3GPP TS 36.331
> - Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits as defined in section 7.1.6.3 of 3GPP TS 36.331:
>   - For localized VRB:
>
>     $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits provide the resource allocation
>   - For distributed VRB:
>     - For $N_{RB}^{DL} < 50$

[. . .]

> - $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits provide the resource allocation
>
> - For $N_{RB}^{DL} \geq 50$
>   - 1 bit, the MSB indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$
>   - $(\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil - 1)$ bits provide the resource allocation
>
> - Modulation and coding scheme – 5bits as defined in section 7.1.7 of 3GPP TS 36.331
> - HARQ process number – 3 bits (FDD), 4 bits (TDD)
> - New data indicator – 1 bit
> - Redundancy version – 2 bits
> - TPC command for PUCCH – 2 bits as defined in section 5.1.2.1 of 3GPP TS 36.331
> - Downlink Assignment Index (this field is present in TDD for all the uplink –downlink configurations and only applies to TDD operation with uplink –downlink configuration 1-6. This field is not present in FDD) – 2 bits
> - TPMI information for precoding – number of bits as specified in Table 5.3.3.1.4A-1
>
>   TPMI information indicates which codebook index is used in Table 6.3.4.2.3-1 or Table 6.3.4.2.3-2 of 3GPP TS 36.213 corresponding to the single-layer transmission.
> - Downlink power offset – 1 bit as defined in section 7.1.5 of 3GPP TS 36.331

130. The Accused Products further comprise a processor configured to interpret the identified data bit as the power offset signaling data associated with the MU-MIMO signaling mode based on the received redefinition data. As shown below, this functionality is described in

the LTE Standard, including but not limited to in 3GPP TS 36.213 § 7.1.5, and 3GPP TS 36.212 § 5.3.3.1.4.

7.1.5 Multi-user MIMO scheme

For the multi-user MIMO transmission scheme of the PDSCH, the UE may assume that an eNB transmission on the PDSCH would be performed on one layer and according to Section 6.3.4.2.1 of [3]. The $\delta_{\text{power-offset}}$ dB value signalled on PDCCH with DCI format 1D using the downlink power offset field is given in Table 7.1.5-1.

**Table 7.1.5-1: Mapping of downlink power offset field in DCI format 1D to the $\delta_{\text{power-offset}}$ value.**

| Downlink power offset field | $\delta_{\text{power-offset}}$ [dB] |
|---|---|
| 0 | $-10\log_{10}(2)$ |
| 1 | 0 |

5.3.3.1.4A Format 1D

DCI format 1D is used for the compact scheduling of one PDSCH codeword with precoding and power offset information.

The following information is transmitted by means of the DCI format 1D:

[. . .]

- Downlink power offset – 1 bit as defined in section 7.1.5 of [3]

131. Thus, as just illustrated above, the Apple Accused Products directly infringe one or more claims of the ’290 Patent. Apple makes, uses, sells, offers for sale, exports, and/or imports, in this District and/or elsewhere in the United States, these devices and thus directly infringes the ’290 Patent.

132. Apple has had knowledge and notice of the ’290 Patent at least as of the filing of this Complaint.

133. Apple indirectly infringes the ’290 patent, as provided in 35 U.S.C. § 271(b), by inducing infringement by others, such as Apple’s customers and end-users, in this District and elsewhere in the United States. For example, Apple’s customers and end-users directly infringe through their use of the inventions claimed in the ’290 patent. Apple induces this direct

infringement through its affirmative acts of manufacturing, selling, distributing, and/or otherwise making available the Apple Accused Products, and providing instructions, documentation, and other information to customers and end-users suggesting they use the Apple Accused Products in an infringing manner, including in-store technical support, online technical support, marketing, product manuals, advertisements, and online documentation. As a result of Apple's inducement, Apple's customers and end-users use the Apple Accused Products in the way Apple intends and directly infringe the '290 Patent. Apple performs these affirmative acts with knowledge of the '290 Patent and with the intent, or willful blindness, that the induced acts directly infringe the '290 Patent.

134. Apple also indirectly infringes the '290 Patent, as provided by 35 U.S.C. § 271(c), by contributing to direct infringement committed by others, such as customers and end-users, in this District and elsewhere in the United States. Apple's affirmative acts of selling and offering to sell, in this District and elsewhere in the United States, the Apple Accused Products and causing the Apple Accused Products to be manufactured, used, sold, and offered for sale contribute to Apple's customers and end-users use of the Apple Accused Products, such that the '290 Patent is directly infringed. The accused components within the Apple Accused Products are material to the invention of the '290 Patent, are not staple articles or commodities of commerce, have no substantial non-infringing uses, and are known by Apple to be especially made or adapted for use in the infringement of the '290 Patent. Apple performs these affirmative acts with knowledge of the '290 Patent and with intent, or willful blindness, that they cause the direct infringement of the '290 Patent.

135. Apple's infringement of the '290 Patent has damaged and will continue to damage the Plaintiffs.

**COUNT VIII: DECLARATORY JUDGMENT THAT THE PLAINTIFFS HAVE NOT VIOLATED FRAND OR COMPETITION LAW**

136. Plaintiffs incorporate by reference the preceding paragraphs as though fully set forth herein.

137. The Plaintiffs own patents essential to various standards, including for example, LTE. Apple infringes the Plaintiffs' essential patents and does not have a license to practice such patents.

138. The original assignee of the Plaintiffs' standard essential patents—for example, whether it be LG, Panasonic, Ericsson, or Samsung—voluntarily declared that they are prepared to grant licenses on terms that are fair, reasonable, and non-discriminatory ("FRAND"), in compliance with the ETSI IPR Policy. These declarations formed a contract ("FRAND contract") under French law.

139. There is a dispute between the Plaintiffs and Apple concerning whether the Plaintiffs' history of offers to Apple for a global license to the Plaintiffs' essential patents complies with the Plaintiffs' commitment to license their essential patents on FRAND terms and conditions pursuant to ETSI and ETSI's IPR Policy. The Plaintiffs have fully performed their obligations under the FRAND contract, but Apple disagrees and, as a result, has refused to license the Plaintiffs' standard essential patents on the FRAND terms the Plaintiffs have offered. There is a case or controversy of sufficient immediacy, reality, and ripeness to warrant the issuance of declaratory judgment.

140. In light of this dispute, the Plaintiffs are seeking relief in the United Kingdom ("UK") (more precisely, in the High Court of England and Wales, which has already determined FRAND terms including royalty rates for part of the Plaintiffs' patents with respect to another

company) in respect of Apple's infringement of certain UK patents. As part of those proceedings the Plaintiffs have requested the UK Court to make a determination as to the FRAND license terms in respect of the Plaintiffs' worldwide portfolio (the "UK FRAND Proceedings"). Accordingly, the UK FRAND Proceedings will determine FRAND terms for Plaintiffs' worldwide portfolios.

141. To the extent necessary beyond the UK FRAND Proceedings, the Plaintiffs request a declaratory judgment in this Court that negotiations toward a FRAND license with Apple were conducted in good faith, comply with the ETSI IPR Policy, and were consistent with competition law requirements. This request by the Plaintiffs is not duplicative or inconsistent with the UK FRAND Proceedings, and, to the extent necessary to avoid any duplication or inconsistency, should be subordinate to the UK FRAND Proceedings.

## DAMAGES

142. As a result of Apple's acts of infringement, Plaintiffs have suffered actual and consequential damages. To the fullest extent permitted by law, Plaintiffs seeks recovery of damages at least in the form of reasonable royalties.

## DEMAND FOR JURY TRIAL

143. Plaintiffs hereby demand a jury trial for all issues so triable.

## PRAYER FOR RELIEF

WHEREFORE, the Plaintiffs respectfully request that this Court enter judgment in their favor ordering, finding, declaring, and/or awarding Plaintiffs relief as follows:

A. that Apple infringes the Patents-in-Suit;

B. that Apple's infringement of the Patents-in-Suit is willful;

C. Plaintiffs' actual damages in an amount sufficient to compensate Plaintiffs for Apple's infringement of the Patents-in-Suit until such time as Apple ceases its infringing conduct, including supplemental damages post-verdict;

D. A declaration that Plaintiffs, in their history of negotiations with Apple in regard to a global license to the Plaintiffs' essential patents, have negotiated in good faith and otherwise complied with FRAND, as set forth in the relevant IPR licensing declarations to ETSI, as well as ETSI's IPR Policy and any applicable laws, and with competition law, such declaration being neither duplicative or inconsistent with the UK FRAND Proceedings, and, to the extent necessary to avoid any duplication or inconsistency, should be subordinate to the UK FRAND Proceedings;

E. damages against Apple for the amount the Plaintiffs prove at trial with respect to the breach of contract, count, as well as the Plaintiffs' expenses, costs and attorneys' fees incurred in conjunction with these counts;

F. enhanced damages pursuant to 35 U.S.C. § 284;

G. pre-judgment and post-judgment interest to the full extent allowed under the law, as well as their costs;

H. that this is an exceptional case and awarding the Plaintiffs their reasonable attorneys' fees pursuant to 35 U.S.C. § 285;

I. an accounting for acts of infringement; and

J. such other equitable relief which may be requested and to which the Plaintiffs are entitled.

DATED: February 25, 2019

Respectfully submitted,

*/s/ Kevin L. Burgess*
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