UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
WACO DIVISION

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| GENGHISCOMM HOLDINGS, LLC<br><br>Plaintiff,<br><br>v.<br><br>CONTINENTAL AUTOMOTIVE SYSTEMS, INC.<br><br>Defendant. | Case No. 6:24-cv-24<br><br>COMPLAINT FOR PATENT INFRINGEMENT AND JURY TRIAL DEMANDED |

**COMPLAINT**

This is an action for patent infringement arising under the patent laws of the United States, Title 35 of the United States Code, against Defendant Continental Automotive Systems, Inc. ("Continental" or "Defendant") that relates to eight U.S. patents owned by GenghisComm: U.S. Patent Nos. 9,768,842 (the "'842 Patent"), 10,200,227 (the "'227 Patent"), 10,389,568 (the "'568 Patent"), 11,075,786 (the "'786 Patent"), 11,223,508 (the "'508 Patent"), 11,252,005 (the "'005 Patent"), 11,381,285 (the "'285 Patent"), and 11,424,792 (the "'792 Patent") (collectively, the "Patents-in-Suit").

**THE PARTIES**

1. Plaintiff GenghisComm Holdings, LLC ("GenghisComm") is a Colorado limited liability company with an address at 942 Broadway Street, Suite 314c, Boulder, Colorado 80302.

2. Steve Shattil, Director of GenghisComm, is the named inventor on the patents and holds advanced degrees in physics and electrical engineering. He invented technologies which are essential parts of cellular and wireless standards.

3. GenghisComm has no FRAND obligations because it did not participate in standard setting.

4. A separate, third-party standard setting body—with no participation or other involvement by GenghisComm—chose to declare as essential to the standard setting body's standards the technology already invented, taught, and patented by GenghisComm through its prior patent filings.

5. GenghisComm is not, and was not, a member of any standard setting body that set any standard relevant to these patent claims, did not participate in setting its patents as standard, and has never bound itself to any contract or other declaration or other obligation whatsoever to license any of its patents on FRAND terms.

6. Defendant Continental is a Delaware corporation with a principal place of business at 1 Continental Drive, Auburn Hills, Michigan 48326. Upon information and belief, Continental can be served through its registered agent CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

7. Continental is a global leader in Advanced Driver Assistance Systems ("ADAS") development and is one of the world's largest automotive and technology suppliers.

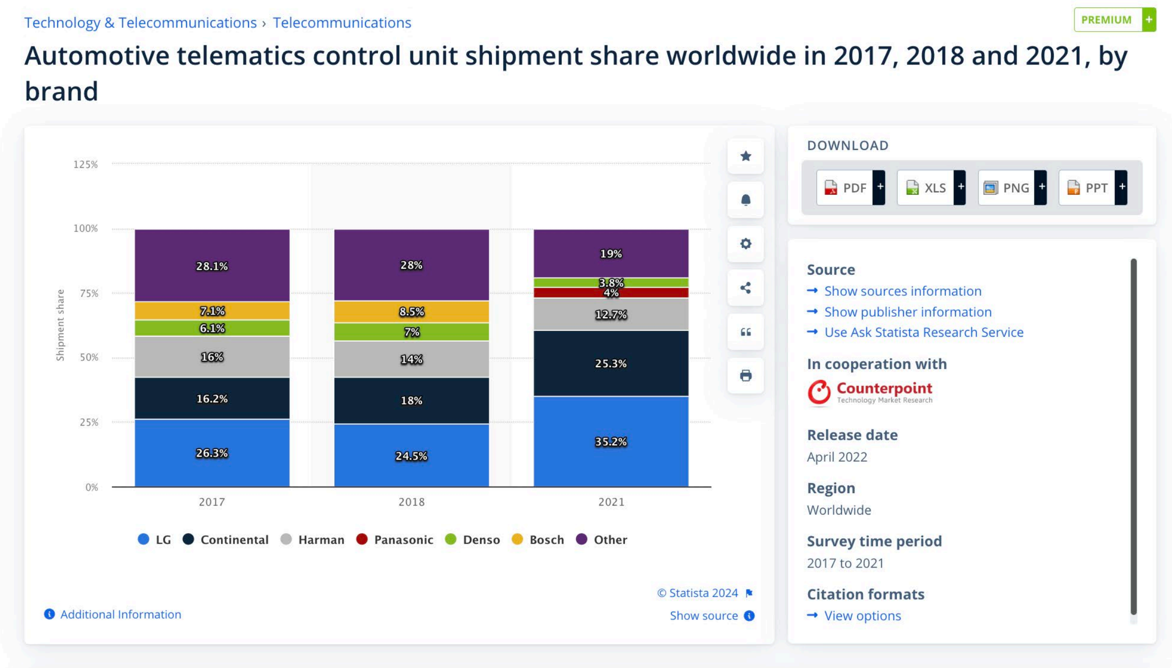
8. Continental is a supplier of telematics control units ("TCUs") that implement various cellular standards, including 4G and 5G.

9. Continental describes its TCUs at https://www.continental-automotive.com/en/components/connectivity/telematics-control-unit-telematics-box.html.

10. Continental describes its TCUs at https://conti-engineering.com/components/telematic-unit/.

11. Continental is a Tier 1 supplier of TCUs to various automotive original equipment manufacturers ("OEMs"), *i.e.*, vehicle manufacturers.

12. Continental has a 15-25% automotive telematics control unit shipment share worldwide.




13. In September 2022, Continental celebrated the opening of a new automotive manufacturing plant in New Braunfels, Texas.

14. Continental's New Braunfels, Texas facility has more than 215,000-square-feet and has 17 production lines running.

15. Continental's New Braunfels, Texas facility manufactures Advanced Driver Assistance Systems (ADAS), including mobility products and sensors, that enable the future of assisted and automated driving.

16. Continental invested more than $110 million (about €100 million) in in New Braunfels, Texas.

17. At New Braunfels, Texas, the first-ever automotive greenfield manufacturing location at for Continental's Autonomous Mobility Business Area produces ADAS technologies.

18. Since opening, Continental's New Braunfels, Texas plant has shipped more than 3.5 million units and hired approximately 400 employees.

19. The manufacturing facility is strategically located, putting Continental in the center of autonomous testing.

20. New Braunfels is in Comal County, Texas, part of the Western District of Texas.

21. Additionally in Uvalde, Texas, is Continental Tire's Uvalde Proving Grounds, and Continental Tire Research & Development North America.

22. Continental's Uvalde, Texas facility is about 4,927-acres.

23. Continental rents access to the Uvalde, Texas site to various OEMs, research companies, and others. Each year, testers and researchers log about 3.3 million miles at the site, or about 70,000 hours of testing time.

24. Continental's Uvalde Proving Grounds boasts about 26 paved and off-road courses, and 400 test vehicles including heavy equipment, tractors, passenger cars, light trucks, commercial vehicles, motorcycles, and trailers.

25. Continental's Uvalde site is also home to over 6,000 square feet of shop and private office space as well as secured bays that are available to non-tire automotive-related testing groups.

26. At the Uvalde, Texas site, Continental has showcased its digital tire monitoring offering, ContiConnect. The system uses proprietary sensors inside tires to track inflation pressure, casing temperature, and mileage among other metrics. Collected data is transmitted to the ContiConnect web portal. Over-the-road fleets can opt for the ContiConnect Live solution,

where the data is transmitted in real time from the truck to the web portal via the fleet's onboard telematics unit.

27. Uvalde County is in the Western District of Texas.

28. Continental makes, uses, imports, sells and offers for sale components used in vehicles for providing cellular connectivity for providing in-vehicle Wi-Fi as well as transmitting various diagnostic and other vehicle information to other devices and networks. A telematics module (or telematics control unit) provides either 4G LTE or 5G cellular network connectivity. The telematics module communicates with the 4G LTE or 5G network in accordance with the 3GPP LTE or 5G standards.

## JURISDICTION AND VENUE

29. This Complaint states causes of action for patent infringement arising under the patent laws of the United States, 35 U.S.C. § 1 *et seq.,* and, more particularly 35 U.S.C. § 271.

30. This Court has subject matter jurisdiction of this action under 28 U.S.C. §§ 1331 and 1338(a) in which the district courts have original and exclusive jurisdiction of any civil action for patent infringement.

31. GenghisComm incorporates the facts in paragraphs 7-27 by reference as if set forth in fully herein. These facts show that Continental has regular and established places of business in this District, including in at least New Braunfels, Texas and Uvalde, Texas.

32. Continental is subject to this Court's general personal jurisdiction pursuant to due process and/or the Texas Long Arm Statute, Tex. Civ. Prac. & Rem. Code § 17.042, due at least to its substantial business conducted in this District, including: (i) having conducted business in this District and the State of Texas through its multiple offices; (ii) having solicited business in the State of Texas, transacted business within the State of Texas and derived financial benefit

from residents of the State of Texas in this District, including benefits directly related to the instant patent infringement causes of action set forth herein by selling Continental parts in Texas and this District and/or selling Continental parts that are included in vehicles sold in Texas and in this District; (iii) having placed its products and services into the stream of commerce throughout the United States and having been actively engaged in transacting business in Texas and in this District, and (iv) having committed the complained of tortious acts in Texas and in this District.

33. Continental, directly and/or through subsidiaries and agents (including distributors, retailers, and others), makes, imports, ships, distributes, offers for sale, sells, uses, and advertises (including products and services through its website https://www.continental-automotive.com/en.html as well as other retailers) its products and/or services in the United States, the State of Texas, and the Western District of Texas.

34. Continental, directly and/or through its subsidiaries and agents (including distributors, retailers, and others), has purposefully and voluntarily placed one or more of its infringing products and/or services, as described below, into the stream of commerce with the expectation that they will be purchased and used by consumers in the Western District of Texas. These infringing products and/or services have been and continue to be purchased and used by consumers in the Western District of Texas. Continental has committed acts of patent infringement within the State of Texas and, more particularly, within the Western District of Texas. In addition, Continental is registered to do business in the State of Texas.

35. Venue is proper in this District under 28 U.S.C. §§ 1391(b) and (c) and 1400(b). Defendant is subject to personal jurisdiction in this District, has transacted business in this District, and has committed acts of patent infringement in this District.

36. This Court's exercise of personal jurisdiction over Continental is consistent with the Texas long-arm statute, Tex. Civ. Prac. & Rem. Code § 17.042, and traditional notions of fair play and substantial justice.

37. Continental is also subject to this Court's specific personal jurisdiction, because the present dispute arises from, and is related to, Continental's activities in Texas and in this District, as described above. These activities include Continental soliciting business from, and transacting business with customers in the State of Texas and deriving financial benefit from transactions with customers in the State of Texas in this District, including sales of Continental products. Continental, directly and/or through subsidiaries and agents (including distributors, retailers, and others), makes, imports, distributes, offers for sale, sells, uses, and advertises (including offering products and services through its website) its products and/or services in the United States, the State of Texas and the Western District of Texas.

38. Venue is proper in this District under §1400(b), which provides that "Any civil action for patent infringement may be brought in the judicial district where the defendant resides, or where the defendant has committed acts of infringement and has a regular and established place of business." Continental has committed acts of infringement in this District and has at least two regular and established places of business in this District at New Braunfels, Texas and Uvalde, Texas.

## **BACKGROUND FACTS REGARDING THE GENGHISCOMM PATENTS**

39. GenghisComm is the owner of record an assignee of each of the Patents-in-Suit.

40. GenghisComm has the exclusive right to sue and the exclusive right to recover damages for infringement of the Patents-in-Suit during all relevant time periods.

41. On September 19, 2017, the ’842 Patent entitled “Pre-coding in multi-user MIMO” was duly and legally issued by the USPTO. The ’842 Patent (at 1:5-22) notes that:

> This application is a Continuation of U.S. patent application Ser. No. 14/967,633, filed Dec. 14, 2015, which is a Continuation-in-Part of U.S. patent application Ser. No. 14/168,466 filed Jan. 30, 2014, which is a Continuation-in-Part of U.S. patent application Ser. No. 11/187,107 filed Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to Provisional Appl. No. 60/598,187, filed Aug. 2, 2004, and which is a Continuation-in-Part of U.S. patent application Ser. No. 10/145,854, filed May 14, 2002. The patent applications, U.S. patent application Ser. No. 13/116,984, filed May 26, 2011, U.S. patent application Ser. No. 12/328,917, filed Dec. 5, 2008, now U.S. Pat. No. 7,965,761, U.S. patent application Ser. No. 11/621,014 filed Jan. 8, 2007, now U.S. Pat. No. 7,593,449, U.S. patent application Ser. No. 10/131,163 filed Apr. 24, 2002, now U.S. Pat. No. 7,430,257, and U.S. Provisional Application 60/286,850, filed Apr. 26, 2001 are expressly incorporated by reference in their entireties.

42. The ’842 Patent, at 30:53-55, further notes that the 10/145,854 application is incorporated by reference as well.

43. On February 5, 2019, the ’227 Patent entitled “Pre-coding in multi-user MIMO” was duly and legally issued by the USPTO. The ’227 Patent (at 1:5-22) notes that:

> This application is a Continuation-in-Part of U.S. patent application Ser. No. 14/168,466 filed Jan. 30, 2014, which is a Continuation-in-Part of U.S. patent application Ser. No. 11/187,107 filed Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to Provisional Appl. No. 60/598,187, filed Aug. 2, 2004, and which is a Continuation-in-Part of U.S. patent application Ser. No. 10/145,854, filed May 14, 2002, each of which is expressly incorporated by reference in its entirety. The patent applications, U.S. patent application Ser. No. 15/149,382, filed May 9, 2016; U.S. patent application Ser. No. 13/116,984, filed May 26, 2011; U.S. patent application Ser. No. 12/328,917, filed Dec. 5, 2008, now U.S. Pat. No. 7,965,761; U.S. patent application Ser. No. 11/621,014, filed Jan. 8, 2007, now U.S. Pat. No. 7,593,449; U.S. patent application Ser. No. 10/131,163, filed Apr. 24, 2002, now U.S. Pat. No. 7,430,257; and U.S. Provisional Application 60/286,850, filed Apr. 26, 2001 are expressly incorporated by reference in their entireties.

44. On August 20, 2019, the ’568 Patent entitled “Single carrier frequency division multiple access baseband signal generation” was duly and legally issued by the USPTO. The ’568 Patent (at 1:5-23) notes that:

> This application is a continuation of U.S. patent application Ser. No. 15/489,664 filed on Apr. 17, 2017, which is a continuation of U.S. patent application Ser. No. 15/149,382, filed on May 9, 2016, now U.S. Pat. No. 9,628,231, which is a continuation in part of U.S. patent application Ser. No. 14/727,769 filed Jun. 1, 2015, which is a continuation of U.S. patent application Ser. No. 14/276,309 filed May 13, 2014, now U.S. Pat. No. 9,048,897, which is a continuation U.S. patent application Ser. No. 12/545,572, filed Aug. 21, 2009, now U.S. Pat. No. 9,042,333, which is a division of U.S. patent application Ser. No. 11/187,107 filed on Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to U.S. Provisional Patent Application No. 60/598,187 filed Aug. 2, 2004 and is a continuation in part of U.S. patent application Ser. No. 10/145,854 filed on May 14, 2002, all of which are hereby incorporated by reference in their entireties and all of which this application claims priority under at least 60 U.S.C. 120 and/or any other applicable provision in Title 60 of the United States Code.

45. On July 27, 2021, the '786 Patent entitled "Multicarrier sub-layer for direct sequence channel and multiple-access coding" was duly and legally issued by the USPTO. The '786 Patent (at 1:8-29) notes that:

> This application is a Continuation of U.S. patent application Ser. No. 16/199,221, filed Nov. 26, 2018, now U.S. Pat. No. 10,644,916, which is a Continuation of U.S. patent application Ser. No. 16/027,191, filed Jul. 3, 2018, now U.S. patent Ser. No. 10/574,497, which is a Continuation of U.S. patent application Ser. No. 15/489,664, filed Apr. 17, 2017, now U.S. Pat. No. 9,800,448, which is a Continuation of U.S. patent application Ser. No. 15/149,382, filed May 9, 2016, now U.S. Pat. No. 9,628,231, which is a Continuation-in-Part of U.S. patent application Ser. No. 14/727,769, filed Jun. 1, 2015, which is a Continuation of U.S. patent application Ser. No. 14/276,309, filed May 13, 2014, now U.S. Pat. No. 9,048,897, which is a Continuation of U.S. patent application Ser. No. 12/545,572, filed Aug. 21, 2009, now U.S. Pat. No. 9,042,333, which is a Divisional of U.S. patent application Ser. No. 11/187,107, filed on Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to Provisional Appl. No. 60/598,187, filed Aug. 2, 2004, all of which are hereby incorporated by reference in their entireties and all of which this application claims priority under at least 35 U.S.C. 120 and/or any other applicable provision in Title 35 of the United States Code.

46. On September 19, 2017, the '508 Patent entitled "Wireless communications using flexible channel bandwidth" was duly and legally issued by the USPTO. The '508 Patent (at 1:6-28) notes that:

> This application is a continuation of U.S. patent application Ser. No. 16/426,240, filed on May 30, 2019, which is a continuation of U.S. patent application Ser. No.

> 15/786,270, filed on Oct. 17, 2017, now U.S. Pat. No. 10,389,568, which is a continuation of U.S. patent application Ser. No. 15/489,664, filed on Apr. 17, 2017, now U.S. Pat. No. 9,800,448, which is a continuation of U.S. patent application Ser. No. 15/149,382, filed on May 9, 2016, now U.S. Pat. No. 9,628,231, which is a continuation-in-part of U.S. patent application Ser. No. 14/727,769, filed Jun. 1, 2015, which is a continuation of U.S. patent application Ser. No. 14/276,309, filed May 13, 2014, now U.S. Pat. No. 9,048,897, which is a continuation U.S. patent application Ser. No. 12/545,572, filed Aug. 21, 2009, now U.S. Pat. No. 8,670,390, which is a division of U.S. patent application Ser. No. 11/187,107, filed on Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to U.S. Provisional Patent Application No. 60/598,187, filed Aug. 2, 2004, all of which are hereby incorporated by reference in their entireties and all of which this application claims priority under at least 35 U.S.C. 120 and/or any other applicable provision in Title 35 of the United States Code.

47. On February 15, 2022, the ’005 Patent entitled “Spreading and precoding in OFDM” was duly and legally issued by the USPTO. The ’005 Patent (at 1:5-19) notes that:

> This application is a Continuation-in-Part of U.S. patent application Ser. No. 14/727,769, entitled “Cooperative Wireless Networks,” filed Jun. 1, 2015, which is a Continuation of U.S. patent application Ser. No. 14/276,309, entitled “Cooperative Wireless Networks,” filed May 13, 2014, now U.S. Pat. No. 9,048,897, which is a Continuation of U.S. patent application Ser. No. 12/545,572, entitled “Cooperative Wireless Networks,” filed Aug. 21, 2009, now U.S. Pat. No. 8,750,264, which is a Divisional of U.S. patent application Ser. No. 11/187,107, entitled “Cooperative Beam-Forming in Wireless Networks,” filed on Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to Provisional Appl. No. 60/598,187, filed Aug. 2, 2004, all of which are incorporated by reference in their entireties.

48. On July 5, 2022, the ’285 Patent entitled “Transmit pre-coding” was duly and legally issued by the USPTO. The ’285 Patent (at 1:5-15) notes that:

> This application is a Continuation of U.S. patent application Ser. No. 14/727,769, filed Jun. 1, 2015, which is a Continuation of U.S. patent application Ser. No. 14/276,309, filed May 13, 2014, now U.S. Pat. No. 9,048,897, which is a Continuation of U.S. patent application Ser. No. 12/545,572, filed Aug. 21, 2009, now U.S. Pat. No. 8,750,264, which is a Divisional of U.S. patent application Ser. No. 11/187,107, filed on Jul. 22, 2005, now U.S. Pat. No. 8,670,390, which claims priority to Provisional Appl. No. 60/598,187, filed Aug. 2, 2004, all of which are incorporated by reference in their entireties.

49. On August 23, 2022, the ’792 Patent entitled “Coordinated multipoint systems” was duly and legally issued by the USPTO. The ’792 Patent (at 1:5-16) notes that:

> This application is a Continuation of U.S. patent application Ser. No. 16/575,713, filed on Sep. 19, 2019, now U.S. Pat. No. 10,931,338, which is a Continuation of U.S. patent application Ser. No. 14/733,013, filed Jun. 8, 2015, now U.S. Pat. No. 10,425,135, which is a Continuation-in-Part of U.S. patent application Ser. No. 13/116,984, filed May 26, 2011, now U.S. Pat. No. 10,014,882, which is a Continuation-in-Part of U.S. patent application Ser. No. 12/328,917, filed Dec. 5, 2008, now U.S. Pat. No. 7,965,761, which is a Divisional of U.S. patent application Ser. No. 11/621,014 filed Jan. 8, 2007, now U.S. Pat. No. 7,593,449, all of which are expressly incorporated by reference in their entireties.

## CONTINENTAL'S INFRINGING PRODUCTS

50. Defendant has been, and now is, directly infringing claims of the Patents-in-Suit under 35 U.S.C. § 271(a) by making, using, offering for sale, selling, and/or importing telematics control units ("TCU's") and Network Access Devices ("NAD's") that provide LTE and 5G cellular connectivity (e.g., in-car Wi-Fi hotspots) in this District and elsewhere in the United States that include the apparatuses claimed in the Patents-in-Suit.

51. Continental's infringing products include its TCU's and NAD's that offer LTE and 5G network connectivity and that adhere to the LTE and 5G standards. Defendant's infringing products with LTE connectivity are collectively referred to as the "Accused Continental LTE Devices." Defendant's infringing products with 5G connectivity are collectively referred to as the "Accused Continental 5G Devices."

## CONTINENTAL'S KNOWLEDGE OF THE PATENTS-IN-SUIT AND CONTINUED INFRINGEMENT DESPITE THAT KNOWLEDGE

52. GenghisComm sent letters to several carmakers making them aware of infringement of its patents in September 2021.

53. On October 15, 2021, counsel for GenghisComm received correspondence from lawyer Dave Djavaherian on behalf of Continental indicating that it was the supplier of relevant components to car companies, and requesting that GenghisComm engage in discussions with Continental directly. The letter stated: "Continental understands that you recently sent letters to

certain of its customers – including at least GM, Subaru, and Toyota – claiming that certain devices supplied to those customers by Continental utilize patented technologies owned by GenghisComm Holdings LLC. To the extent your client believes its patents are relevant to Continental devices, we believe it would be most appropriate for GenghisComm to engage in licensing discussions relating to Continental devices directly with Continental, rather than with its customers."

54. On October 20, 2021, counsel for GenghisComm replied to Continental's counsel Mr. Djavaherian. Continental responded the same day by requesting materials "as may be relevant to our discussions."

55. On November 8, 2021, GenghisComm sent Continental an email message explaining its infringement position against Continental and attaching detailed claim charts demonstrating how Continental products infringed GenghisComm's 9,768,842, 9,800,448, 10,009,208, 10,200,227 and 10,389,568 patents.

56. The parties exchanged a number of other letters and emails, including letters from Continental on November 23, 2021, February 9, 2022, April 13, 2022. GenghisComm sent emails and letters on or around October 10, November 8, December 13 and in March 2022.

57. Additional emails were exchanged and counsel for GenghisComm and Continental also spoke by phone in May 2022.

58. On September 15, 2023, GenghisComm again reached out to Continental by email, stating:

> …we are offering rates consistent with the left-hand column on enclosed rate card for telematics communications units (TCUs) that are sold into the US market. To the extent a company is selling other devices covered by the patents (such as mobile handsets), those would have to be accounted for as well. As we await litigation developments that may increase the rates, we are willing to offer a discount of 25% off the lowest portfolio wide-rate on the rate card to the next

TCU supplier to reach an agreement with GenghisComm. In addition, GenghisComm plans to increase all the rates by 20% effective January 1, 2024. Please give us a call if you would like to discuss a license agreement.

59. The September 15, 2023 email included GenghisComm's 2022 rate card.

60. Continental never provided its relevant sales unit volumes.

61. Continental never made any offer to resolve the issues with GenghisComm.

62. Continental never took a license to GenghisComm's patents.

63. Despite knowledge of the Patents-in-Suit and knowledge of the manner in which the Patents-in-Suit are infringed as demonstrated in the provided claim charts, Continental has continued to infringe, and/or induce the infringement of, the Patents-in-Suit.

64. This Complaint serves as notice to Continental to at least the '786, '508, '005, '285, and '792 Patents, and serves as additional notice for the '842, '227 and '568 Patents and the manner in which the Patents-in-Suit are infringed.

**COUNT I: INFRINGEMENT OF U.S. PATENT '842 CLAIM 1**

65. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

66. Claim 1 of the '842 Patent provides:

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| Claim 1 Preamble | An OFDM transmitter, comprising: |
| Element A | an OFDM spreader configured to spread a plurality of data symbols with Fourier coefficients to generate a discrete Fourier Transform (DFT)-spread data signal; |
| Element B | a mapper configured to map the DFT-spread data signal to a plurality of OFDM subcarriers; and |
| Element C | an OFDM modulator configured to modulate the DFT-spread data signal onto the plurality of OFDM subcarriers to produce an OFDM transmission signal comprising a superposition of the OFDM subcarriers, wherein the OFDM spreader is configured to provide the superposition with a reduced peak-to-average power ratio. |

67. Continental makes, uses, sells, offers for sale, and imports vehicles that include wireless devices that utilize 4G LTE networks and that comply with the 4G LTE wireless standards (e.g., 3GPP TS 36.211 version 8.7.0 Release 8; the "LTE Specification") and its requirements for uplink physical channel communications. These communications are sent from Accused Continental LTE Devices to eNodeB receivers located at cell sites.

68. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 1 of the '842 Patent.

69. The Accused Continental LTE Devices include a transmitter (e.g., cellular modem with transceiver) used for LTE network connectivity and communications.

70. LTE network uplink physical channel transmissions rely on single-carrier frequency-division multiple access (SC-FDMA), and downlink physical channel transmission rely on orthogonal frequency-division multiplexing (OFDM). An SC-FDMA signal is a modulated OFDM signal, and is derived from the OFDM signal sent to the Accused Continental LTE Devices.

71. The transmitter in Accused Continental LTE Devices includes an OFDM spreader that is used to spread data symbols onto subcarriers using the LTE Specification's Transform Precoding method according to the equation below:

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\text{sc}}^{\text{PUSCH}} + k) = \frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}} \sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l \cdot M_{\text{sc}}^{\text{PUSCH}} + i) e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$

$$k = 0,...,M_{\text{sc}}^{\text{PUSCH}} - 1$$

$$l = 0,...,M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}} - 1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}} = M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \le N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

The LTE Transform Precoding method uses a discrete Fourier transform (highlighted in the above equation) to generate a spread data signal. The transform precoding step is a complex-matrix multiply that spreads each data symbol across multiple subcarriers. One feature resulting from transform precoding is that the superposition of subcarriers has a lower peak-to-average power ratio (PAPR) compared to downlink OFDM signals.

72. The transmitter in Accused Continental LTE Devices includes a mapper that is used to map the spread data signals onto subcarriers consistent with the LTE Specification section 5.4.3 (Mapping to Physical Resources). The LTE specification requires a resource element mapper for mapping the spread data signals to physical resource elements (subcarriers).

73. The transmitter in Accused Continental LTE Devices include an OFDM modulator that is used to modulate the mapped and spread data symbols onto the physical resource elements (subcarriers) consistent with the LTE Specification section 5.6 (SC-FDMA baseband signal generation):

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor}^{\lceil N_{RB}^{UL} N_{sc}^{RB}/2 \rceil - 1} a_{k^{(-)},l} \cdot e^{j2\pi (k+1/2)\Delta f (t - N_{CP,l} T_s)}$$

for $0 \le t < (N_{CP,l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB} / 2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1} (N_{CP,l'} + N) T_s$ within the slot.

Table 5.6-1lists the values of $N_{CP,l}$ that shall be used. Note that different SC-FDMA symbols within a slot may have different cyclic prefix lengths.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

This process entails modulating the mapped and spread data signals onto OFDM subcarriers for each uplink slot to generate a time-domain OFDM signal. The process of SC-FMDA baseband signal generation results in a signal that consists of a superposition of subcarrier signals that mimic a single carrier signal.

74. Continental directly infringes claim 1 of the ’842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

75. Continental has had knowledge of the ’842 Patent since November 8, 2021.

76. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 1 of the ’842 Patent under 35 U.S.C. § 271(a) directly.

77. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT II: INFRINGEMENT OF U.S. PATENT '842 CLAIM 2**

78. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

79. Claim 2 of the '842 Patent provides:

| | |
|---|---|
| Element A | The OFDM transmitter recited in claim 1, wherein the OFDM spreader comprises an N-point DFT and the OFDM modulator comprises an M-point inverse discrete Fourier Transform, wherein M>N. |

80. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 2 of the '842 Patent.

81. The transmitter in Accused Continental LTE Devices performs SC-FDMA baseband signal generation consistent with the LTE Specification sections 5.5.3 (transform precoding) and 5.6 (SC-FDMA signal generation).

82. The transform precoding step spreads data symbols to cause the superposition of modulated subcarriers to mimic a single carrier, while the signal generation step modulates the spread signals onto scheduled subcarrier signals for uplink transmission. There are fewer data symbols (N) than the total number of subcarriers in the uplink bandwidth (M) because the number of scheduled subcarriers is less than the total number of subcarriers in the uplink bandwidth.

83. The transform precoding step utilizes an N-point discrete Fourier transform (DFT), as shown in the highlighted portion of the equation below:

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\text{sc}}^{\text{PUSCH}}+k)=\frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}}\sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l \cdot M_{\text{sc}}^{\text{PUSCH}}+i)e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$

$$k=0,...,M_{\text{sc}}^{\text{PUSCH}}-1$$

$$l=0,...,M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}}=M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}}=2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \le N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

The N-point DFT transforms data symbols from the time domain into the frequency domain.

84. The SC-FDMA signal generation step utilizes an M-point inverse DFT, as shown in the highlighted portion of the equation below:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t)=\sum_{k=-\lfloor N_{\text{RB}}^{\text{UL}}N_{\text{sc}}^{\text{RB}}/2\rfloor}^{\lceil N_{\text{RB}}^{\text{UL}}N_{\text{sc}}^{\text{RB}}/2\rceil-1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f(t-N_{\text{CP},l}T_s)}$$

for $0 \le t < (N_{\text{CP},l}+N)\times T_s$ where $k^{(-)}=k+\lfloor N_{RB}^{UL}N_{sc}^{RB}/2\rfloor$, $N=2048$, $\Delta f=15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l=0$, where SC-FDMA symbol $l>0$ starts at time $\sum_{l'=0}^{l-1}(N_{\text{CP},l'}+N)T_s$ within the slot.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

The M-point inverse DFT is used to generate time-domain symbols from the frequency-domain transform symbols generated during transform precoding.

85. Continental directly infringes claim 2 of the ’842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

86. Continental has had knowledge of the ’842 Patent since November 8, 2021.

87. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 2 of the ’842 Patent under 35 U.S.C. § 271(a) directly.

88. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT III: INFRINGEMENT OF U.S. PATENT ’842 CLAIM 3**

89. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

90. Claim 3 of the ’842 Patent provides:

| | |
|---|---|
| Element A | The OFDM transmitter recited in claim 1, wherein the OFDM modulator comprises an inverse fast Fourier transform. |

91. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 3 of the ’842 Patent.

92. The transmitter in Accused Continental LTE Devices performs SC-FDMA baseband signal generation consistent with the LTE Specification section 5.6. LTE Specification section 5.6 utilizes an inverse fast Fourier transform to produce the time-continuous signal:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor}^{\lceil N_{RB}^{UL} N_{sc}^{RB}/2 \rceil - 1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f (t - N_{CP,l} T_s)}$$

for $0 \le t < (N_{CP,l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

93. Continental directly infringes claim 3 of the ’842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

94. Continental has had knowledge of the ’842 Patent since November 8, 2021.

95. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 3 of the ’842 Patent under 35 U.S.C. § 271(a) directly.

96. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT IV: INFRINGEMENT OF U.S. PATENT ’842 CLAIM 4**

97. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

98. Claim 4 of the ’842 Patent provides:

| | |
|---|---|
| Element A | The OFDM transmitter recited in claim 1, wherein the data symbols comprise reference-signal symbols, which comprise at least one of known training symbols and synchronization symbols. |

99. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 4 of the ’842 Patent.

100. A later release of the LTE Specification, release 15, introduced requirements (Section 5.5.2.1 and 5.5.3 in release 15) for reference signals used in the physical channel uplink. These reference signal requirements specify that at least one of the data symbols be a reference signal used for demodulation and synchronization. The Accused Continental LTE Devices comply with this release 15 of the LTE Specification.

101. Demodulation reference signals are used for channel estimation, while synchronization reference signals are used for signal-quality estimation. Both channel estimation and signal-quality estimation are types of training symbols.

102. Continental directly infringes claim 4 of the ’842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

103. Continental has had knowledge of the ’842 Patent since November 8, 2021.

104. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 4 of the ’842 Patent under 35 U.S.C. § 271(a) directly.

105. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT V: INFRINGEMENT OF U.S. PATENT ’842 CLAIM 7**

106. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

107. Claim 7 of the '842 Patent provides:

| | |
|---|---|
| Element A | The OFDM transmitter recited in claim 1, further comprising a cyclic prefix appender configured to append at least one of a cyclic prefix, a postfix, and a guard interval to the OFDM transmission signal. |

108. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 7 of the '842 Patent.

109. During SC-FDMA baseband signal generation, the inverse DFT used to modulate data symbols onto subcarriers also appends the cyclic prefix, as shown in the highlighted portion of the equation below:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{\mathrm{RB}}^{\mathrm{UL}} N_{\mathrm{sc}}^{\mathrm{RB}}/2 \rfloor}^{\lceil N_{\mathrm{RB}}^{\mathrm{UL}} N_{\mathrm{sc}}^{\mathrm{RB}}/2 \rceil -1} a_{k^{(-)},l} \cdot e^{j2\pi (k+1/2)\Delta f \underline{(t-N_{\mathrm{CP},l}T_s)}}$$

for $0 \le t < (N_{\mathrm{CP},l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB} / 2 \rfloor$, $N = 2048$, $\Delta f = 15\,\mathrm{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1} (N_{\mathrm{CP},l'} + N)T_s$ within the slot.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

110. Continental directly infringes claim 7 of the '842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

111. Continental has had knowledge of the '842 Patent since November 8, 2021.

112. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 7 of the ’842 Patent under 35 U.S.C. § 271(a) directly.

113. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT VI: INFRINGEMENT OF U.S. PATENT ’842 CLAIM 8**

114. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

115. Claim 8 of the ’842 Patent provides:

| | |
|---|---|
| Element A | The OFDM transmitter recited in claim 1, wherein the OFDM spreader is configured to provide channel precoding. |

116. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 8 of the ’842 Patent.

117. During uplink processing, Accused Continental LTE Devices employ transform precoding in accordance with the LTE Specification:

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\text{sc}}^{\text{PUSCH}} + k) = \frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}} \sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l \cdot M_{\text{sc}}^{\text{PUSCH}} + i) e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$

$$k = 0,..., M_{\text{sc}}^{\text{PUSCH}} - 1$$

$$l = 0,..., M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}} - 1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}} = M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \leq N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

The highlighted portion of the above equation corresponds to a DFT used to spread data symbols using spreading codes. The transform precoding DFT precodes data symbols to be used in transmission.

118. Continental directly infringes claim 8 of the ’842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

119. Continental has had knowledge of the ’842 Patent since November 8, 2021.

120. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 8 of the ’842 Patent under 35 U.S.C. § 271(a) directly.

121. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT VII: INFRINGEMENT OF U.S. PATENT ’842 CLAIM 9**

122. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

123. Claim 9 of the '842 Patent provides:

| | |
|---|---|
| Element A | The OFDM transmitter recited in claim 1, wherein the plurality of data symbols are at least one of time-multiplexed with reference-signal symbols, frequency-multiplexed with reference-signal symbols, and code-multiplexed with reference-signal symbols. |

124. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 9 of the '842 Patent.

125. A later release of the LTE Specification, release 15, introduced requirements (Section 5.5.2.1 and 5.5.3 in release 15) for reference signals used in the physical channel uplink. These reference signal requirements specify that at least one of the data symbols be a reference signal used for demodulation and synchronization. The Accused Continental LTE Devices comply with this release 15 of the LTE Specification.

126. The reference signals are time multiplexed with other uplink transmissions from the same device, and frequency multiplexed with uplink transmissions from multiple devices.

127. Continental directly infringes claim 9 of the '842 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

128. Continental has had knowledge of the '842 Patent since November 8, 2021.

129. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 9 of the '842 Patent under 35 U.S.C. § 271(a) directly.

130. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT VIII: INFRINGEMENT OF U.S. PATENT '227 CLAIM 22**

131. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

132. Claim 22 of the '227 Patent provides:

| | |
|---|---|
| Claim 22 Preamble | An apparatus comprising: |
| Element A | a processor; and |
| Element B | a non-transitory memory coupled to the processor, the non-transitory memory including a set of instructions stored therein and executable by the processor to: |
| Element C | perform an invertible transform on a set of data symbols to generate a plurality N of spread data symbols, the invertible transform comprising complex-valued spreading codes; |
| Element D | map the N spread data symbols to at least N subcarriers of a plurality M of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers to generate a set of complex subcarrier amplitudes; and |
| Element E | perform an M-point inverse discrete Fourier transform (IDFT) on the set of complex subcarrier amplitudes to generate a time-domain sequence to be transmitted into a wireless channel, the time-domain sequence comprising a superposition of the OFDM subcarriers, wherein the invertible transform is configured to provide the superposition with a reduced peak-to-average power ratio. |

133. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 4G LTE networks and that comply with the 4G LTE wireless standards (e.g., 3GPP TS 36.211 version 8.7.0 Release 8; the "LTE Specification") and its requirements for uplink physical channel communications. These communications are sent from Accused Continental LTE Devices to eNodeB receivers located at cell sites.

134. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 22 of the '227 Patent.

135. The Accused Continental LTE Devices must have processors and non-transitory memory coupled to the processor in order to apply LTE physical channel signal processing consistent with the LTE Specification. For example, the Continental Hermes 3.0 LFT2 Telematics Control Unit includes, upon information and belief, a Qualcomm MDMxxxx modem with Arm Cortex A-7 processor that must include memory for storing at least programming instructions. For example, Continental's CES 4G/5G Telematics Control Unit includes a Qualcomm SA515M modem chipset and ARM Cortex-A7 Application Processor running Linux based Continental Telematics Platform stored in memory.[1]

136. The memory of Accused Continental LTE Devices includes instructions for performing transform precoding on data symbols according to the LTE Specification. The transform precoding process utilizes a discrete Fourier transform (DFT) to transform OFDM data symbols (N) into spread OFDM complex-valued data symbols used during physical channel uplink communications, as shown in the highlighted portion below (Section 5.3.3 of the LTE Specification):

[1] The CES TCU product description can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

## 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l\cdot M_{\text{sc}}^{\text{PUSCH}}+k)=\frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}}\sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l\cdot M_{\text{sc}}^{\text{PUSCH}}+i)e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$

$$k=0,...,M_{\text{sc}}^{\text{PUSCH}}-1$$

$$l=0,...,M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}}=M_{\text{RB}}^{\text{PUSCH}}\cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}}=2^{\alpha_2}\cdot 3^{\alpha_3}\cdot 5^{\alpha_5}\le N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2,\alpha_3,\alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

The DFT is invertible.

137. One feature resulting from transform precoding using the invertible DFT of Section 5.3.3 of the LTE Specification is that it generates complex-valued data symbols that, when mapped and modulated onto physical resource subcarriers, results in a superposition of subcarriers having a lower peak-to-average power ratio (PAPR) compared to downlink OFDM signals.

138. The memory of Accused Continental LTE Devices includes instructions for mapping the N spread data signals onto N subcarriers consistent with the LTE Specification section 5.4.3 (Mapping to Physical Resources):

## 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.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

The N spread data symbols correspond to the "$z(0)$…" complex-valued symbols described in Section 5.3.4 of the LTE Specification, and are mapped onto the same number (N) of subcarriers assigned to the UE out of the total number of subcarriers in the uplink bandwidth (M).

139. The complex valued data symbols (N spread data symbols) are multiplied by an amplitude scaling factor, and then mapped to M physical resource blocks (OFDM subcarriers) to generate complex subcarrier amplitudes used during the SC-FDMA baseband signal generation step.

140. The memory of Accused Continental LTE Devices includes instructions for modulating the mapped and spread data symbols onto N physical resource elements (subcarriers) consistent with the LTE Specification section 5.6 (SC-FDMA baseband signal generation). This process entails modulating the mapped and spread data signals onto OFDM subcarriers for each uplink slot to generate a time-domain OFDM signal. The process of SC-FMDA baseband signal generation results in a signal that consists of a superposition of subcarrier signals that mimic a single carrier signal.

141. The SC-FDMA baseband signal generation step uses an M-point inverse DFT:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor}^{\lceil N_{RB}^{UL} N_{sc}^{RB}/2 \rceil -1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f (t - N_{CP,l} T_s)}$$

for $0 \le t < (N_{CP,l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB} / 2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1} (N_{CP,l'} + N) T_s$ within the slot.

Table 5.6-1lists the values of $N_{CP,l}$ that shall be used. Note that different SC-FDMA symbols within a slot may have different cyclic prefix lengths.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

142. N (number of subcarriers) < M (total number of subcarriers) allows for the pulse-shaping seen in SC-FDMA. That is, the subcarriers in the SC-FDMA signal combine in phase at uniformly spaced intervals in each SC-FDMA symbol duration to produce a pulse waveform in each interval, which allows multiple subcarriers to mimic a single carrier signal. OFDM baseband signal generation typically upsamples the data being transmitted, which means that the size of the inverse DFT is larger than the number of assigned subcarriers onto which the data is modulated. This is also the case for SC-FDMA baseband signal generation (Section 5.6). DFT spreading (i.e., transform precoding, Section 5.3.3) is applied to the data before mapping to the inverse DFT, so the DFT size is smaller than the inverse DFT size. This causes the DFT to shape the output of the inverse DFT into uniformly spaced pulses in each SC-FDMA symbol duration, which causes the SC-FDMA signal to resemble a single-carrier signal.

143. Continental directly infringes claim 22 of the ’227 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

144. Continental has had knowledge of the ’227 Patent since November 8, 2021.

145. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 22 of the ’227 Patent under 35 U.S.C. § 271(a) directly.

146. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT IX: INFRINGEMENT OF U.S. PATENT ’227 CLAIM 24**

147. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

148. Claim 24 of the ’227 Patent provides:

| | |
|---|---|
| Element A | The apparatus recited in claim 22, configured to reside on a User Equipment. |

149. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 24 of the ’227 Patent.

150. Accused Continental LTE Devices are User Equipment that include the processor and memory described above.

151. Continental directly infringes claim 24 of the ’227 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

152. Continental has had knowledge of the ’227 Patent since November 8, 2021.

153. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 24 of the '227 Patent under 35 U.S.C. § 271(a) directly.

154. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT X: INFRINGEMENT OF U.S. PATENT '227 CLAIM 25**

155. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

156. Claim 25 of the '227 Patent provides:

| | |
|---|---|
| Element A | The apparatus recited in claim 22, wherein M>N. |

157. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 25 of the '227 Patent.

158. During processing for the physical channel uplink, the number of subcarriers available for use, M, exceeds the number of data symbols and subcarriers, N, that are ultimately modulated onto those subcarriers. The number of subcarriers and data symbols actually used (N) by user equipment in the uplink is less than the overall number of subcarriers in the uplink bandwidth (M) to allow for the pulse-shaping seen in SC-FDMA.

159. N (number of subcarriers) < M (total number of subcarriers) allows for the pulse-shaping seen in SC-FDMA. That is, the subcarriers in the SC-FDMA signal combine in phase at uniformly spaced intervals in each SC-FDMA symbol duration to produce a pulse waveform in each interval, which allows multiple subcarriers to mimic a single carrier signal. OFDM

baseband signal generation typically upsamples the data being transmitted, which means that the size of the inverse DFT is larger than the number of assigned subcarriers onto which the data is modulated. This is also the case for SC-FDMA baseband signal generation (Section 5.6). DFT spreading (i.e., transform precoding, Section 5.3.3) is applied to the data before mapping to the inverse DFT, so the DFT size is smaller than the inverse DFT size. This causes the DFT to shape the output of the inverse DFT into uniformly spaced pulses in each SC-FDMA symbol duration, which causes the SC-FDMA signal to resemble a single-carrier signal.

160. Continental directly infringes claim 25 of the ’227 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

161. Continental has had knowledge of the ’227 Patent since November 8, 2021.

162. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 25 of the ’227 Patent under 35 U.S.C. § 271(a) directly.

163. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XI: INFRINGEMENT OF U.S. PATENT ’227 CLAIM 26**

164. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

165. Claim 26 of the ’227 Patent provides:

| | |
|---|---|
| Element A | The apparatus recited in claim 22, wherein the IDFT comprises an inverse fast Fourier transform. |

166. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 26 of the ’227 Patent.

167. Accused Continental LTE Devices perform SC-FDMA baseband signal generation consistent with the LTE Specification section 5.6. LTE Specification section 5.6 utilizes an inverse fast Fourier transform to produce the SC-FDMA time-continuous signal.

168. Continental directly infringes claim 26 of the ’227 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

169. Continental has had knowledge of the ’227 Patent since November 8, 2021.

170. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 26 of the ’227 Patent under 35 U.S.C. § 271(a) directly.

171. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

## COUNT XII: INFRINGEMENT OF U.S. PATENT ’227 CLAIM 28

172. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

173. Claim 28 of the ’227 Patent provides:

| | |
|---|---|
| Element A | The apparatus recited in claim 22, wherein the non-transitory memory further comprises instructions to append at least one of a cyclic prefix, a postfix, and a guard interval to the time-domain sequence. |

174. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 28 of the ’227 Patent.

175. During SC-FDMA baseband signal generation, the inverse DFT used to modulate data symbols onto subcarriers also appends the cyclic prefix, as shown in the highlighted portion of the equation below:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor}^{\lceil N_{RB}^{UL} N_{sc}^{RB}/2 \rceil - 1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f(t - N_{CP,l} T_s)}$$

for $0 \le t < (N_{CP,l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1}(N_{CP,l'} + N)T_s$ within the slot.

Table 5.6-1lists the values of $N_{CP,l}$ that shall be used. Note that different SC-FDMA symbols within a slot may have different cyclic prefix lengths.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

176. Continental directly infringes claim 28 of the ’227 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

177. Continental has had knowledge of the ’227 Patent since November 8, 2021.

178. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 28 of the ’227 Patent under 35 U.S.C. § 271(a) directly.

179. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

## COUNT XIII: INFRINGEMENT OF U.S. PATENT '568 CLAIM 24

180. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

181. Claim 24 of the '568 Patent provides:

| | |
|---|---|
| Claim 24 Preamble | An apparatus comprising: |
| Element A | a processor; and |
| Element B | a non-transitory computer-readable memory communicatively coupled to the processor, the memory including a set of instructions stored thereon and executable by the processor for: |
| Element C | dividing a block of complex-valued symbols into a plurality of sets of complex-valued symbols; |
| Element D | transform precoding each of the plurality of sets of complex-valued symbols into a block of transform-precoded complex-valued symbols; and |
| Element E | generating an Orthogonal Frequency Division Multiplex (OFDM) signal comprising a plurality of OFDM subcarriers modulated by the transform-precoded complex-valued symbols, wherein the transform precoding generates a plurality of orthogonal spreading codes to provide a superposition of the plurality of OFDM subcarriers with a reduced peak-to-average-power ratio. |

182. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 4G LTE networks and that comply with the 4G LTE wireless standards (e.g., 3GPP TS 36.211 version 8.7.0 Release 8; the "LTE Specification") and its requirements for uplink physical channel communications. These communications are sent from Accused Continental LTE Devices to eNodeB receivers located at cell sites.

183. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 24 of the '568 Patent.

184. The Accused Continental LTE Devices must have processors and non-transitory memory coupled to the processor in order to apply LTE physical channel signal processing consistent with the LTE Specification. For example, the Continental Hermes 3.0 LFT2 Telematics Control Unit includes, upon information and belief, a Qualcomm MDMxxxx modem with Arm Cortex A-7 processor that must include memory for storing at least programming instructions. For example, Continental's CES 4G/5G Telematics Control Unit includes a Qualcomm SA515M modem chipset and ARM Cortex-A7 Application Processor running Linux based Continental Telematics Platform stored in memory.[2]

185. The memory in Accused Continental LTE Devices stores instructions for processing physical channel uplink (from user equipment to eNode B) and downlink (from eNode B to user equipment) consistent with the LTE Specification.

186. For the uplink, the LTE Specification employs a Transform Precoding step (section 5.3.3):

[2] The CES TCU product description can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\text{sc}}^{\text{PUSCH}}+k)=\frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}}\sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l \cdot M_{\text{sc}}^{\text{PUSCH}}+i)e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$
$$k=0,...,M_{\text{sc}}^{\text{PUSCH}}-1$$
$$l=0,...,M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}}=M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}}=2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \le N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

where OFDM data symbols are divided into $M_{symb}/M_{sc}^{PUSCH}$ sets, with each set corresponding to one SC-FDMA symbol. The division process results in multiple sets of complex-valued symbols. These complex-valued symbols are transform precoded using a discrete Fourier transform to generate blocks of transform precoded complex-valued symbols. The transform precoding step is a complex-matrix multiply that spreads the complex-valued symbols across multiple subcarriers. One feature resulting from transform precoding is that the superposition of subcarriers has a lower peak-to-average power ratio (PAPR) compared to downlink OFDM signals.

187. The block of transform precoded complex-valued symbols are then mapped to physical resources (subcarriers) consistent with LTE Specification section 5.4.3 (Mapping to Physical Resources):

### 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.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

188. Once mapped, the pre-coded complex-valued symbols are then modulated on physical resources (subcarriers) in accordance with LTE Specification 5.6 (SC-FDMA Baseband Signal Generation). The SC-FDMA Baseband Signal Generation step utilizes an inverse DFT to generate a time-domain signal, as shown in the highlighted portion below

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{\text{RB}}^{\text{UL}} N_{\text{sc}}^{\text{RB}}/2 \rfloor}^{\lceil N_{\text{RB}}^{\text{UL}} N_{\text{sc}}^{\text{RB}}/2 \rceil -1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f (t - N_{\text{CP},l} T_s)}$$

for $0 \le t < (N_{\text{CP},l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1} (N_{\text{CP},l'} + N) T_s$ within the slot.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

189. SC-FDMA itself stands for single-carrier frequency division multiple division access, and is a modulated version of an OFDM signal that uses the same subcarriers as regular OFDM. The process of transform precoding and SC-FMDA baseband signal generation results in a transmitted signal that consists of a superposition of OFDM subcarrier signals that mimic a single carrier signal.

190. Continental directly infringes claim 24 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

191. Continental has had knowledge of the ’568 Patent since November 8, 2021.

192. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 24 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

193. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XIV: INFRINGEMENT OF U.S. PATENT ’568 CLAIM 25**

194. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

195. Claim 25 of the ’568 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 24, wherein the transform precoding spreads the block of complex-valued symbols with a plurality of orthogonal spreading codes comprising complex-valued coefficients of a discrete Fourier transform (DFT) to produce the block of transform-precoded complex-valued symbols. |

196. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 25 of the ’568 Patent.

197. During transform precoding in accordance with the LTE Specification, complex-valued symbols are spread onto orthogonal spreading codes consistent with the below equation that employs a discrete Fourier transform:

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\mathrm{symb}}-1)$ is divided into $M_{\mathrm{symb}}/M_{\mathrm{sc}}^{\mathrm{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\mathrm{sc}}^{\mathrm{PUSCH}}+k) = \frac{1}{\sqrt{M_{\mathrm{sc}}^{\mathrm{PUSCH}}}} \sum_{i=0}^{M_{\mathrm{sc}}^{\mathrm{PUSCH}}-1} d(l \cdot M_{\mathrm{sc}}^{\mathrm{PUSCH}}+i) e^{-j\frac{2\pi ik}{M_{\mathrm{sc}}^{\mathrm{PUSCH}}}}$$

$$k = 0,...,M_{\mathrm{sc}}^{\mathrm{PUSCH}}-1$$

$$l = 0,...,M_{\mathrm{symb}}/M_{\mathrm{sc}}^{\mathrm{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\mathrm{symb}}-1)$. The variable $M_{\mathrm{sc}}^{\mathrm{PUSCH}} = M_{\mathrm{RB}}^{\mathrm{PUSCH}} \cdot N_{\mathrm{sc}}^{\mathrm{RB}}$, where $M_{\mathrm{RB}}^{\mathrm{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\mathrm{RB}}^{\mathrm{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \leq N_{\mathrm{RB}}^{\mathrm{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

In the above equation, the complex-valued coefficients correspond to the variable $e^{-j\frac{2\pi ik}{M_{sc}^{PUSCH}}}$.

198. One property of the DFT used in transform precoding is that it is an orthogonal matrix, such that symbols will be spread orthogonally.

199. The transform precoding step generates a block of transform precoded complex-valued symbols, $z(0),\ldots z(M_{\mathrm{symb}}-1)$.

200. Continental directly infringes claim 25 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

201. Continental has had knowledge of the ’568 Patent since November 8, 2021.

202. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 25 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

203. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XV: INFRINGEMENT OF U.S. PATENT '568 CLAIM 26**

204. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

205. Claim 26 of the '568 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 25, wherein the DFT is a fast Fourier transform (FFT). |

206. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim26 of the '568 Patent.

207. Transform precoding in accordance with the LTE Specification employs a DFT which is a fast Fourier transform, as shown in the equation below:

## 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\text{sc}}^{\text{PUSCH}}+k)=\frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}}\sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l \cdot M_{\text{sc}}^{\text{PUSCH}}+i)e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$

$$k=0,...,M_{\text{sc}}^{\text{PUSCH}}-1$$

$$l=0,...,M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}}=M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}}=2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \le N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

208. Continental directly infringes claim 26 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

209. Continental has had knowledge of the ’568 Patent since November 8, 2021.

210. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 26 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

211. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

## COUNT XVI: INFRINGEMENT OF U.S. PATENT ’568 CLAIM 29

212. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

213. Claim 29 of the ’568 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 24, comprising instructions for:<br>mapping the block of transform-precoded complex-valued symbols to physical resource blocks assigned for transmission of a physical uplink shared channel. |

214. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 29 of the ’568 Patent.

215. During signal processing for the physical channel uplink, transform-precoded complex-valued symbols $z(0),\ldots z(M_{\text{symb}}\text{-}1)$ are mapped onto physical resource blocks in accordance with section 5.3.4 of the LTE Specification:

### 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.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

216. The physical resource blocks are assigned to user equipment for the purpose of physical channel uplink transmissions.

217. Continental directly infringes claim 29 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

218. Continental has had knowledge of the ’568 Patent since November 8, 2021.

219. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 29 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

220. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XVII: INFRINGEMENT OF U.S. PATENT ’568 CLAIM 32**

221. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

222. Claim 32 of the ’568 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 29, wherein the mapping is configured to select the plurality of OFDM subcarriers according to at least one of a frequency division multiple access scheme, a time division multiple access scheme, a space division multiple access scheme, a code division multiple access scheme, and a frequency-hoping scheme. |

223. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 32 of the '568 Patent.

224. During signal processing for the physical channel uplink, transform-precoded complex-valued symbols $z(0),\ldots z(M_{\text{symb}}\text{-}1)$ are mapped onto physical resource blocks in accordance with section 5.3.4 of the LTE Specification.

### 5.3.4 Mapping to physical resources

The block of complex-valued symbols $z(0),\ldots,z(M_{\text{symb}}-1)$ 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.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

This mapping process further entails selecting from physical resource elements within the physical resource blocks.

225. The physical resource elements within a block correspond to OFDM subcarriers.

226. Once mapped, the complex-valued symbols are modulated onto the physical resources (OFDM subcarriers) during SC-FDMA baseband signal generation, in accordance with Section 5.6 of the LTE Specification.

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor}^{\lceil N_{RB}^{UL} N_{sc}^{RB}/2 \rceil - 1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f(t - N_{CP,l}T_s)}$$

for $0 \leq t < (N_{CP,l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1}(N_{CP,l'} + N)T_s$ within the slot.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

SC-FDMA stands for single carrier frequency division multiple access. The subcarriers are selected and mapped according to at least a frequency division multiple access scheme.

227. Continental directly infringes claim 32 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

228. Continental has had knowledge of the ’568 Patent since November 8, 2021.

229. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 32 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

230. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XVIII: INFRINGEMENT OF U.S. PATENT ’568 CLAIM 33**

231. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

232. Claim 33 of the ’568 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 24, comprising instructions for: scrambling a block of bits of one subframe of a physical uplink shared channel resulting in a block of scrambled bits; and |
| Element B | modulating the block of scrambled bits resulting in the block of complex-valued symbols. |

233. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 33 of the '568 Patent.

234. During physical channel uplink signal processing, a block of bits on the physical uplink shared channel are scrambled using a scrambling sequence to generate a block of scrambled bits in accordance with Section 5.3.1 of the LTE Specification:

### 5.3.1 Scrambling

The block of bits $b(0),...,b(M_{bit}-1)$, where $M_{bit}$ is the number of bits transmitted on the physical uplink shared channel in one subframe, shall be scrambled with a UE-specific scrambling sequence prior to modulation, resulting in a block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{bit}-1)$ according to the following pseudo code

Source: 3GPP TS 36.211 version 8.7.0 Release 8

235. After scrambling, the block of scrambled bits are modulated to generate a block of complex-valued symbols in accordance with Section 5.3.2 of the LTE Specification:

### 5.3.2 Modulation

The block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{bit}-1)$ shall be modulated as described in Section 7.1, resulting in a block of complex-valued symbols $d(0),...,d(M_{symb}-1)$. Table 5.3.2-1 specifies the modulation mappings applicable for the physical uplink shared channel.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

236. Continental directly infringes claim 33 of the '568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

237. Continental has had knowledge of the '568 Patent since November 8, 2021.

238. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 33 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

239. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XIX: INFRINGEMENT OF U.S. PATENT ’568 CLAIM 34**

240. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

241. Claim 34 of the ’568 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 33, wherein the scrambling is configured to scramble the block of bits into a block of scrambled bits with at least one pseudo-noise code. |

242. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 34 of the ’568 Patent.

243. The LTE Specification section 5.3.1 requires that the scrambling of the block of bits use pseudo noise code:

### 5.3.1 Scrambling

The block of bits $b(0),...,b(M_{\text{bit}}-1)$, where $M_{\text{bit}}$ is the number of bits transmitted on the physical uplink shared channel in one subframe, shall be scrambled with a UE-specific scrambling sequence prior to modulation, resulting in a block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{\text{bit}}-1)$ according to the following pseudo code

Source: 3GPP TS 36.211 version 8.7.0 Release 8

244. Continental directly infringes claim 34 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

245. Continental has had knowledge of the ’568 Patent since November 8, 2021.

246. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 34 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

247. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XX: INFRINGEMENT OF U.S. PATENT ’568 CLAIM 44**

248. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

249. Claim 44 of the ’568 Patent provides:

| | |
|---|---|
| Element A | The method of claim 24, wherein each of the plurality of sets of complex-valued symbols is a single carrier frequency division multiple access (SC-FDMA) symbol. |

250. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 44 of the ’568 Patent.

251. The LTE Specification section 5.6 (SC-FDMA baseband signal generation) defines how to generate SC-FDMA symbols of a time-continuous signal.

252. Continental directly infringes claim 44 of the ’568 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

253. Continental has had knowledge of the ’568 Patent since November 8, 2021.

254. Continental makes, uses, and/or imports the Accused Continental LTE Devices knowing that Continental infringed and continues to infringe at least claim 44 of the ’568 Patent under 35 U.S.C. § 271(a) directly.

255. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXI: INFRINGEMENT OF U.S. PATENT ’786 CLAIM 10**

256. GenghisComm incorporates by reference the allegations set forth in paragraphs 1 the preceding paragraphs of this Complaint as though set forth in full herein.

257. Claim 10 of the ’786 Patent provides:

| | |
|---|---|
| Claim 10 Preamble | An apparatus for communication in a wireless communication network that employs a first set of complex-valued codes to encode data symbols to be transmitted, and employs a second set of complex-valued codes to recover transmitted data symbols from a received signal, the apparatus comprising: |
| Element A | at least one processor; and |
| Element B | a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor for: |
| Element C | selecting a plurality of subcarriers to be transmitted; |
| Element D | encoding the data symbols with the first set of complex-valued codes to produce encoded data symbols; |
| Element E | applying the encoded data symbols to the plurality of subcarriers to produce a spread-Orthogonal Frequency Division Multiplexing (OFDM) signal; and |
| Element F | wherein the first set of complex-valued codes are complex conjugates of the second set of complex-valued codes. |

258. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 4G LTE networks and that comply with the 4G LTE wireless standards (e.g., 3GPP TS 36.211 version 8.7.0 Release 8; the “LTE Specification”) and its requirements for uplink

physical channel communications. These communications are sent from Accused Continental LTE Devices to eNodeB receivers located at cell sites.

259. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 10 of the ’786 Patent.

260. The Accused Continental LTE Devices are devices that are used in LTE wireless communication networks. The LTE radio network uses both physical channel uplink communications from the device to eNode B, and physical channel downlink communications from the eNode B to the device. The uplink relies on a single-carrier frequency division multiple access (SC-FDMA) scheme, which entails the use of transform precoding data using complex-valued codes to encode data symbols to be sent from the device. The eNode B receives the SC-FDMA signals from the device, and decodes the signals using a second set of complex-valued codes that are the inverse of the first set of complex-valued codes.

261. The Accused Continental LTE Devices must have processors and non-transitory memory coupled to the processor in order to apply LTE physical channel signal processing consistent with the LTE Specification. For example, the Continental Hermes 3.0 LFT2 Telematics Control Unit includes, upon information and belief, a Qualcomm MDMxxxx modem with Arm Cortex A-7 processor that must include memory for storing at least programming instructions. For example, Continental’s CES 4G/5G Telematics Control Unit includes a Qualcomm SA515M modem chipset and ARM Cortex-A7 Application Processor running Linux based Continental Telematics Platform stored in memory.[3]

[3] The CES TCU product description can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

262. The memory in Accused Continental LTE Devices stores instructions for processing physical channel uplink (from user equipment to eNode B) and downlink (from eNode B to user equipment) consistent with the LTE Specification.

263. For the uplink, the LTE Specification employs a Transform Precoding step (section 5.3.3), where OFDM data symbols are divided into $M_{symb} / M_{sc}^{PUSCH}$ sets, with each set corresponding to one SC-FDMA symbol. The division process results in the first set of complex-valued symbols. These complex-valued symbols are transform precoded using a discrete Fourier transform (DFT) to generate blocks of transform precoded complex-valued symbols. The DFT includes complex-valued codes used to encode the complex-valued data symbols that are to be transmitted, as shown in the highlighted portion of the equation below:

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}} / M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l \cdot M_{\text{sc}}^{\text{PUSCH}} + k) = \frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}} \sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} d(l \cdot M_{\text{sc}}^{\text{PUSCH}} + i) e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$

$$k = 0,...,M_{\text{sc}}^{\text{PUSCH}} - 1$$

$$l = 0,...,M_{\text{symb}} / M_{\text{sc}}^{\text{PUSCH}} - 1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}} = M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5} \leq N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

264. The DFT used in transform precoding for the uplink is the inverse of the DFT used by the eNodeB to decode the transform-precoded uplink signals. Because the DFT used for transform-precoding in the uplink is a unitary matrix, its complex conjugate is also its inverse.

265. In accordance with the LTE Specification, Accused Continental LTE Devices are assigned physical resource blocks to be used for uplink transmissions to base stations. Each physical resource block includes twelve subcarriers, and determine the number of inputs for SC-FDMA signal generation. Accused Continental LTE Devices select subcarriers based on the number of resource blocks assigned to the device.

266. During uplink signal processing, Accused Continental LTE Devices transform precode complex valued symbols in accordance with Section 5.3.3 of the LTE Specification. The transform precoding step generates complex-valued data symbols by using the complex-valued codes of the discrete Fourier transform used in transform precoding, as shown in the highlighted portion of the equation below:

### 5.3.3 Transform precoding

The block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$ is divided into $M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one SC-FDMA symbol. Transform precoding shall be applied according to

$$z(l\cdot M_{\text{sc}}^{\text{PUSCH}}+k)=\frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}}\sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1}d(l\cdot M_{\text{sc}}^{\text{PUSCH}}+i)e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$
$$k=0,...,M_{\text{sc}}^{\text{PUSCH}}-1$$
$$l=0,...,M_{\text{symb}}/M_{\text{sc}}^{\text{PUSCH}}-1$$

resulting in a block of complex-valued symbols $z(0),...,z(M_{\text{symb}}-1)$. The variable $M_{\text{sc}}^{\text{PUSCH}}=M_{\text{RB}}^{\text{PUSCH}}\cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}}=2^{\alpha_2}\cdot 3^{\alpha_3}\cdot 5^{\alpha_5}\le N_{\text{RB}}^{\text{UL}}$$

where $\alpha_2,\alpha_3,\alpha_5$ is a set of non-negative integers.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

267. During transform precoding, complex-valued symbols $d(0),\ldots d(M_{\text{symb}}-1)$ are encoded with the complex-valued codes to produce encoded complex-valued data symbols, $z(0),\ldots z((M_{\text{symb}}-1)$.

268. The encoded complex-valued data symbols are then mapped to, and modulated onto, physical resources (subcarriers) during SC-FDMA baseband signal generation in accordance with the LTE Specification Section 5.6:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t) = \sum_{k=-\lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor}^{\lceil N_{RB}^{UL} N_{sc}^{RB}/2 \rceil -1} a_{k^{(-)},l} \cdot e^{j2\pi(k+1/2)\Delta f (t - N_{CP,l} T_s)}$$

for $0 \le t < (N_{CP,l} + N) \times T_s$ where $k^{(-)} = k + \lfloor N_{RB}^{UL} N_{sc}^{RB}/2 \rfloor$, $N = 2048$, $\Delta f = 15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l = 0$, where SC-FDMA symbol $l > 0$ starts at time $\sum_{l'=0}^{l-1} (N_{CP,l'} + N) T_s$ within the slot.

Table 5.6-1lists the values of $N_{CP,l}$ that shall be used. Note that different SC-FDMA symbols within a slot may have different cyclic prefix lengths.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

269. The SC-FDMA baseband signal generation step employs another DFT that spreads OFDM data into a form that resembles a single carrier. The SC-FDMA signal (spread OFDM signal) is then transmitted from Accused Continental LTE Devices to base stations.

270. Continental directly infringes claim 10 of the ’786 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

271. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXII: INFRINGEMENT OF U.S. PATENT '786 CLAIM 11**

272. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

273. Claim 11 of the '786 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 10, wherein selecting is responsive to spectrum allocation or is configured to provide for orthogonal frequency division multiple access. |

274. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 11 of the '786 Patent.

275. In accordance with the LTE Specification, Accused Continental LTE Devices are assigned physical resources (subcarriers) to be used for the uplink. This assignment of subcarriers is spectrum allocation. Subcarriers are then selected for use from those assigned.

276. Continental directly infringes claim 11 of the '786 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

277. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXIII: INFRINGEMENT OF U.S. PATENT '786 CLAIM 15**

278. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

279. Claim 15 of the '786 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 10, wherein the plurality of subcarriers are contiguous subcarriers or interleaved subcarriers. |

280. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 15 of the '786 Patent.

281. The use of SC-FDMA (or spread OFDM) allows for subcarriers to be distributed in two manners: contiguously, where subcarriers for a given device are contiguous in the frequency spectrum; or interleaved, where subcarriers for a given device are interspersed with other device subcarriers in the same frequency spectrum.

282. Continental directly infringes claim 15 of the '786 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

283. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

## COUNT XXIV: INFRINGEMENT OF U.S. PATENT '786 CLAIM 16

284. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

285. Claim 16 of the '786 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 10, wherein encoding comprises multiplying a vector or matrix of data symbols with a vector or matrix comprising the first set of complex-valued codes. |

286. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 16 of the '786 Patent.

287. Accused Continental LTE Devices perform transform precoding in accordance with the LTE Specification. The transform precoding step employs a DFT, which itself

represents a vector multiplication. The DFT can be represented as a complex matrix multiplication, where data symbols are multiplied by the matrix of complex-valued codes.

288. Continental directly infringes claim 16 of the ’786 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

289. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXV: INFRINGEMENT OF U.S. PATENT ’786 CLAIM 17**

290. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

291. Claim 17 of the ’786 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 10, wherein applying comprises modulating the encoded data symbols onto the plurality of subcarriers. |

292. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 17 of the ’786 Patent.

293. Accused Continental LTE Devices process signals for uplink transmission in accordance with the LTE Specification. As part of the signal processing, complex-valued (encoded) data symbols are mapped to, and then modulated onto subcarriers. The modulation of encoded data symbols onto subcarriers is given by Section 5.6 of the LTE Specification.:

## 5.6 SC-FDMA baseband signal generation

This section applies to all uplink physical signals and physical channels except the physical random access channel.

The time-continuous signal $s_l(t)$ in SC-FDMA symbol $l$ in an uplink slot is defined by

$$s_l(t)=\sum_{k=-\lfloor N_{RB}^{UL}N_{sc}^{RB}/2\rfloor}^{\lceil N_{RB}^{UL}N_{sc}^{RB}/2\rceil-1} a_{k^{(-)},l}\cdot e^{j2\pi(k+1/2)\Delta f\left(t-N_{CP,l}T_s\right)}$$

for $0\leq t<\left(N_{CP,l}+N\right)\times T_s$ where $k^{(-)}=k+\lfloor N_{RB}^{UL}N_{sc}^{RB}/2\rfloor$, $N=2048$, $\Delta f=15\,\text{kHz}$ and $a_{k,l}$ is the content of resource element $(k,l)$.

The SC-FDMA symbols in a slot shall be transmitted in increasing order of $l$, starting with $l=0$, where SC-FDMA symbol $l>0$ starts at time $\sum_{l'=0}^{l-1}(N_{CP,l'}+N)T_s$ within the slot.

Table 5.6-1lists the values of $N_{CP,l}$ that shall be used. Note that different SC-FDMA symbols within a slot may have different cyclic prefix lengths.

Source: 3GPP TS 36.211 version 8.7.0 Release 8

294. Continental directly infringes claim 17 of the '786 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

295. As a direct and proximate result of Continental's acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXVI: INFRINGEMENT OF U.S. PATENT '786 CLAIM 18**

296. GenghisComm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

297. Claim 18 of the '786 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 10, wherein the non-transitory computer-readable memory further includes instructions stored thereon and executable by the processor for adding a cyclic prefix to the spread-OFDM signal before transmitting the spread-OFDM signal. |

298. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 18 of the ’786 Patent.

299. Accused Continental LTE Devices process signals for uplink transmission in accordance with the LTE Specification. As part of the signal processing, the LTE Specification section 5.2.3 (and Table 5.2.3-1) requires adding a cyclic prefix to the spread OFDM signal.

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

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

Source: 3GPP TS 36.211 version 8.7.0 Release 8

300. Continental directly infringes claim 18 of the ’786 Patent by selling, offering to sell, and using the Accused Continental LTE Devices.

301. As a direct and proximate result of Continental’s acts of patent infringement, GenghisComm has been and continues to be injured, and has sustained and will continue to sustain damages.

## COUNT XXVII: INFRINGEMENT OF U.S. PATENT ’508 CLAIM 17

302. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

303. Claim 17 of the ’508 Patent provides:

| | |
|---|---|
| Claim 17 Preamble | An apparatus for communicating in a mobile radio communications network, comprising: |
| Element A | a transceiver-control circuitry configured for: |
| Element B | provisioning a consecutive series of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers for uplink or downlink communications; |

| | |
|---|---|
| Element C | provisioning a plurality of different selectable subcarrier spacings for the consecutive series of OFDM subcarriers; and |
| Element D | performing discrete Fourier transform (DFT) coding on a plurality of data symbols to produce DFT coded symbols; and |
| Element E | an OFDM transceiver communicatively coupled to the transceiver-control circuitry and configured for: |
| Element F | performing an inverse-DFT on the coded symbols to produce a single-carrier frequency division multiple access signal that comprises a sum of the consecutive series of OFDM subcarriers; and |
| Element G | transmitting the single-carrier frequency division multiple access signal in the mobile radio communications network; |
| Element H | wherein provisioning the plurality of different selectable subcarrier spacings comprises providing the single-carrier frequency division multiple access signal with a particular one of a set of different symbol periods by selecting one of the plurality of different selectable subcarrier spacings. |

304. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 5G networks and 5G wireless standards (e.g., 3GPP TS 38.211 version 15.2.0 release 15; the "5G Specification") and the requirements for uplink and downlink physical channel communications. These communications are sent from Accused Continental 5G Devices, as previously defined, to eNodeB receivers located at cell sites.

305. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 17 of the '508 Patent.

306. The Accused Continental 5G Devices must have transceiver-control circuitry configured for 5G physical channel uplink and downlink communications in accordance with the 5G Specification (e.g., through a cellular modem transceiver). For example, Continental's website describes its CES 4G/5G Telematic Control Unit as including a Qualcomm SA515M Modem chipset with ARM Cortex-A7 processor. Upon information and belief, this TCU's modem includes a transceiver and transceiver control circuitry. For example, Continental's

website describes its 5G Telematic Control Unit as used for 5G cellular communications and including a network access device, necessitating a transceiver and transceiver control circuitry, upon information and belief.[4]

307. The 5G Specification requires defining OFDM symbols for use with subcarriers (resource elements) in either the uplink or downlink. The subcarriers used in uplink or downlink communications are allowed to have different subcarriers spacings for selection and use: 15, 30, 60, 120, or 240 kHz. These different spacings are defined in Section 4.3.2 of the 5G Specification:

## 4.3.2 Slots

For subcarrier spacing configuration $\mu$, slots are numbered $n_s^\mu \in \{0,..., N_{slot}^{subframe,\mu} - 1\}$ in increasing order within a subframe and $n_{s,f}^\mu \in \{0,..., N_{slot}^{frame,\mu} - 1\}$ in increasing order within a frame. There are $N_{symb}^{slot}$ consecutive OFDM symbols in a slot where $N_{symb}^{slot}$ depends on the cyclic prefix as given by Tables 4.3.2-1 and 4.3.2-2. The start of slot $n_s^\mu$ in a subframe is aligned in time with the start of OFDM symbol $n_s^\mu N_{symb}^{slot}$ in the same subframe.

OFDM symbols in a slot can be classified as 'downlink', 'flexible', or 'uplink'. Signaling of slot formats is described in subclause 11.1 of [5, TS 38.213].

In a slot in a downlink frame, the UE shall assume that downlink transmissions only occur in 'downlink' or 'flexible' symbols.

In a slot in an uplink frame, the UE shall only transmit in 'uplink' or 'flexible' symbols.

A UE not capable of full-duplex communication is not expected to transmit in the uplink earlier than $N_{Rx\text{-}Tx}T_c$ after the end of the last received downlink symbol in the same cell where $N_{Rx\text{-}Tx}$ is given by [TS 38.101].

**Table 4.3.2-1: Number of OFDM symbols per slot, slots per frame, and slots per subframe for normal cyclic prefix.**

| $\mu$ | $N_{symb}^{slot}$ | $N_{slot}^{frame,\mu}$ | $N_{slot}^{subframe,\mu}$ |
|---|---|---|---|
| 0 | 14 | 10 | 1 |
| 1 | 14 | 20 | 2 |
| 2 | 14 | 40 | 4 |
| 3 | 14 | 80 | 8 |
| 4 | 14 | 160 | 16 |

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

[4] Both the CES and 5G TCU product descriptions can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

308. These selectable subcarrier spacings allow for different numbers of slots (or subframes) to be used for a given radio frame. For example, if a 15Khz spacing is selected, then there will be 1 slot in the frame (OFDM symbol period of ~ 66.6 ms); 30kHz allows for 2 slots (~33.3 ms OFDM symbol period); 60kHz allows for 4 slots (~16.66 ms symbol period); 120kHz allows for 8 slots (8.3ms symbol period). Thus, for each subcarrier spacing, there are different possible symbol periods.

309. The Accused Continental 5G Devices perform transform precoding in accordance with the 5G Specification (section 6.3.1.4):

### 6.3.1.4 Transform precoding

If transform precoding is not enabled according to 6.1.3 of [6, TS38.214], $y^{(\lambda)}(i) = x^{(\lambda)}(i)$ for each layer $\lambda = 0,1,...,\upsilon - 1$.

If transform precoding is enabled according to 6.1.3 of [6, TS38.214], $\upsilon = 1$ and $\tilde{x}^{(0)}(i)$ depends on the configuration of phase-tracking reference signals.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are not being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ for the single layer $\lambda = 0$ shall be divided into $M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one OFDM symbol and $\tilde{x}^{(0)}(i) = x^{(0)}(i)$.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ shall be divided into sets, each set corresponding to one OFDM symbol, and where set $l$ contains $M_{\text{sc}}^{\text{PUSCH}} - \varepsilon_l N_{\text{samp}}^{\text{group}} N_{\text{group}}^{\text{PTRS}}$ symbols and is mapped to the complex-valued symbols $\tilde{x}^{(0)}(lM_{\text{sc}}^{\text{PUSCH}} + i')$ corresponding to OFDM symbol $l$ prior to transform precoding, with $i' \in \{0,1,...,M_{\text{sc}}^{\text{PUSCH}} - 1\}$ and $i' \neq m$. The index $m$ of PT-RS samples in set $l$, the number of samples per PT-RS group $N_{\text{samp}}^{\text{group}}$, and the number of PT-RS groups $N_{\text{group}}^{\text{PTRS}}$ are defined in clause 6.4.1.2.2.2. The quantity $\varepsilon_l = 1$ when OFDM symbol $l$ contains one or more PT-RS samples, otherwise $\varepsilon_l = 0$.

Transform precoding shall be applied according to

$$y^{(0)}(l \cdot M_{\text{sc}}^{\text{PUSCH}} + k) = \frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}} \sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} \tilde{x}^{(0)}(l \cdot M_{\text{sc}}^{\text{PUSCH}} + i) e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$
$$k = 0,...,M_{\text{sc}}^{\text{PUSCH}} - 1$$
$$l = 0,...,M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}} - 1$$

resulting in a block of complex-valued symbols $y^{(0)}(0),...,y^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$. The variable $M_{\text{sc}}^{\text{PUSCH}} = M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

The transform precoding entails applying a discrete Fourier transform to blocks of complex-valued data symbols $x^{(0)}(0),\ldots x^{(0)}(M_{symb}^{layer}$ - 1) to generate transform pre-coded complex-valued data symbols $y^{(0)}(0),\ldots y^{(0)}(M_{symb}^{layer}$ - 1).

310. Accused Continental 5G Devices include an OFDM transceiver for sending and receiving physical communications. The OFDM transceiver is in communication with the transceiver-control circuitry. The OFDM transceiver is configured to perform OFDM baseband

signal processing in accordance with the 5G Specification (section 5.3.1 OFDM baseband signal generation):

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,\ldots,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^\mu T_c - t_{\text{start},l}^\mu\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^\mu \le t < t_{\text{start},l}^\mu + \left(N_u^\mu + N_{\text{CP},l}^\mu\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

$\Delta f$ is given by clause 4.2, $\mu$ is the subcarrier spacing configuration, and $\mu_0$ is the largest $\mu$ value among the subcarrier spacing configurations provided to the UE for this carrer. The starting position of OFDM symbol $l$ for subcarrier spacing configuration $\mu$ in a subframe is given by

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

OFDM baseband signal generation entails the use of an inverse discrete Fourier transform (highlighted in the equation above) on the pre-coded complex-valued data symbols to generate a single carrier frequency division multiple access (SC-FDMA) signal. Application of the inverse DFT results in modulating the pre-coded complex-valued data symbols onto the OFDM signals. These SC-FDMA signals are then transmitted by Accused Continental 5G Devices to base stations/eNode Bs.

311. Continental directly infringes claim 17 of the ’508 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

312. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXVIII: INFRINGEMENT OF U.S. PATENT '508 CLAIM 18**

313. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

314. Claim 18 of the '508 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 17, wherein at least one of the plurality of different selectable subcarrier spacings equals at least one other of the plurality of different selectable subcarrier spacings multiplied by a scaling factor that is a power of two. |

315. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 18 of the '508 Patent.

316. Accused Continental 5G Devices perform physical channel uplink and downlink processing in accordance with the 5G Specification. The 5G Specification (section 4.2 numerologies) includes selectable subcarrier spacings, ranging from 15kHz to 240kHz:

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15\,[\text{kHz}]$ | Cyclic prefix |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

The subcarrier spacings are defined as D$f$ = $2^m$ * 15[kHz], where $m$ is a subcarrier spacing configuration that represents a scaling factor that is a power of 2.

317. Continental directly infringes claim 18 of the '508 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

318. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXIX: INFRINGEMENT OF U.S. PATENT '508 CLAIM 19**

319. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

320. Claim 19 of the '508 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 17, wherein the OFDM transceiver is further configured to add a cyclic prefix to the single-carrier frequency division multiple access signal. |

321. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 19 of the '508 Patent.

322. The transceiver in Accused Continental 5G Devices is configured to perform physical channel uplink and downlink processing in accordance with the 5G Specification. The 5G Specification includes OFDM baseband signal generation (Section 5.3.1). This step includes

adding a cyclic prefix to the SC-FDMA signal:

## 5.3 OFDM baseband signal generation

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,...,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^\mu T_c - t_{\text{start},l}^\mu\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^\mu \le t < t_{\text{start},l}^\mu + \left(N_u^\mu + N_{\text{CP},l}^\mu\right)T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

In the above equation, $N_{CP,l}^\mu$ is defined as the cyclix prefix length.

323. Continental directly infringes claim 19 of the '508 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

324. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXX: INFRINGEMENT OF U.S. PATENT '508 CLAIM 20**

325. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

326. Claim 20 of the '508 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 17, wherein the plurality of different selectable subcarrier spacings comprise integer multiples of a first subcarrier spacing. |

327. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 20 of the ’508 Patent.

328. Accused Continental 5G Devices perform physical channel uplink and downlink processing in accordance with the 5G Specification. The 5G Specification (section 4.2 numerologies) includes selectable subcarrier spacings: 15kHz, 30kHz, 60kHz, 120kHz, and 240kHz. The subcarrier spacings are integers of a first subcarrier spacing, with the integers being 2, 4, 8 and 16.

329. Continental directly infringes claim 20 of the ’508 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

330. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXI: INFRINGEMENT OF U.S. PATENT ’508 CLAIM 21**

331. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

332. Claim 21 of the ’508 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 17, wherein each of the plurality of different selectable subcarrier spacings is configured for one of a plurality of different deployment scenarios, the plurality of different deployment scenarios comprising different system requirements or different channel characteristics. |

333. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 21 of the ’508 Patent.

334. Accused Continental 5G Devices perform physical channel uplink and downlink processing in accordance with the 5G Specification. The 5G Specification (section 4.2 numerologies) includes selectable subcarrier spacings: 15kHz, 30kHz, 60kHz, 120kHz, and 240kHz. The different subcarrier spacings are provided because of the wide range of frequency channels allowed for in 5G communication, with each channel having different characteristics. For example, the 5G Specification section 5.5.4.1 explains that two frequency ranges are allowed: FR1 and FR2. FR1 encompasses 410MHz-7125Mhz, and FR2 encompasses 24250MHz-52600Mhz frequencies. The subcarrier spacings allow for different numbers of slots within radio subframes, with the number of subframes utilized for different frequency ranges: subcarrier spacings of 15 and 30kHz are suitable for use with FR1; subcarrier spacing of 60Khz is suitable for both FR1 and FR2; subcarrier spacings of 120 and 240kHz are suitable for use with FR2.

335. The lower frequency ranges have limited spectrum such that smaller subcarrier spacings are used to maximize the data communicated. Conversely, in higher frequency ranges, such as mmWave, frequency drift increases (Doppler spread). To compensate for the drift, larger subcarrier spacings are used.

336. Continental directly infringes claim 21 of the ’508 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

337. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXII: INFRINGEMENT OF U.S. PATENT '508 CLAIM 22**

338. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

339. Claim 22 of the '508 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 17, wherein each of the plurality of different selectable subcarrier spacings produces a different number of symbols per frame. |

340. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental LTE Devices that meet each and every element of claim 22 of the '508 Patent.

341. Accused Continental 5G Devices perform physical channel uplink and downlink processing in accordance with the 5G Specification. The 5G Specification (section 4.2 numerologies) includes selectable subcarrier spacings: 15kHz, 30kHz, 60kHz, 120kHz, and 240kHz. Each spacing allows for a different number of subframes and a different number of symbols per frame.

342. Section 4.3.1 of the 5G Specification defines transmissions as organized into frames, with each frame consisting of 10 subframes, with the number of consecutive OFDM symbols per subframe defined as $N_{\text{symb}}^{\text{slot}} \times N_{\text{slot}}^{\text{frame},\mu}$:

### 4.3.1 Frames and subframes

Downlink and uplink transmissions are organized into frames with $T_f = (\Delta f_{max} N_f / 100) \cdot T_c = 10\,\text{ms}$ duration, each consisting of ten subframes of $T_{sf} = (\Delta f_{max} N_f / 1000) \cdot T_c = 1\,\text{ms}$ duration. The number of consecutive OFDM symbols per subframe is $N_{symb}^{subframe,\mu} = N_{symb}^{slot} N_{slot}^{subframe,\mu}$. Each frame is divided into two equally-sized half-frames of five subframes each with half-frame 0 consisting of subframes 0 – 4 and half-frame 1 consisting of subframes 5 – 9.

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

343. Section 4.3.2 of the 5G Specification further defines subcarrier spacings and the number of OFDM symbols per slot, slots per frame, and slots per subframe:

### 4.3.2 Slots

For subcarrier spacing configuration $\mu$, slots are numbered $n_s^\mu \in \{0,..., N_{slot}^{subframe,\mu} - 1\}$ in increasing order within a subframe and $n_{s,f}^\mu \in \{0,..., N_{slot}^{frame,\mu} - 1\}$ in increasing order within a frame. There are $N_{symb}^{slot}$ consecutive OFDM symbols in a slot where $N_{symb}^{slot}$ depends on the cyclic prefix as given by Tables 4.3.2-1 and 4.3.2-2. The start of slot $n_s^\mu$ in a subframe is aligned in time with the start of OFDM symbol $n_s^\mu N_{symb}^{slot}$ in the same subframe.

OFDM symbols in a slot can be classified as 'downlink', 'flexible', or 'uplink'. Signaling of slot formats is described in subclause 11.1 of [5, TS 38.213].

In a slot in a downlink frame, the UE shall assume that downlink transmissions only occur in 'downlink' or 'flexible' symbols.

In a slot in an uplink frame, the UE shall only transmit in 'uplink' or 'flexible' symbols.

A UE not capable of full-duplex communication is not expected to transmit in the uplink earlier than $N_{Rx\text{-}Tx} T_c$ after the end of the last received downlink symbol in the same cell where $N_{Rx\text{-}Tx}$ is given by [TS 38.101].

**Table 4.3.2-1: Number of OFDM symbols per slot, slots per frame, and slots per subframe for normal cyclic prefix.**

| $\mu$ | $N_{symb}^{slot}$ | $N_{slot}^{frame,\mu}$ | $N_{slot}^{subframe,\mu}$ |
|---|---|---|---|
| 0 | 14 | 10 | 1 |
| 1 | 14 | 20 | 2 |
| 2 | 14 | 40 | 4 |
| 3 | 14 | 80 | 8 |
| 4 | 14 | 160 | 16 |

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

344. Thus, for $\mu = [0, 1, 2, 3, 4]$ the number of OFDM symbols per frame are equal to $N_{symb}^{slot} \times N_{slot}^{frame,\mu} = [140, 280, 560, 1120, 2240]$, where $\mu$ is a subcarrier spacing configuration.

345. Continental directly infringes claim 22 of the '508 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

346. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXIII: INFRINGEMENT OF U.S. PATENT '005 CLAIM 13**

347. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

348. Claim 13 of the '005 Patent provides:

| | |
|---|---|
| Claim 13 Preamble | An apparatus for communication in a wireless network, comprising: |
| Element A | at least one processor; and |
| Element B | at least one non-transitory computer-readable memory in electronic communication with the at least one processor, wherein instructions stored in the at least one non-transitory computer-readable memory are executable by the at least one processor for: |
| Element C | producing a set of subcarrier values that equals a product of a complex-valued code matrix with a matrix of data symbols; |
| Element D | selecting a set of subcarriers assigned for use by a user device; and |
| Element E | modulating the subcarrier values onto the set of subcarriers to produce a plurality of modulated subcarriers; and |
| Element F | producing a time-domain waveform from a superposition of the plurality of modulated subcarriers, the time-domain waveform to be transmitted in the wireless network by the user device; |
| Element G | wherein producing the set of subcarrier values employs a plurality of complex-valued codes that shapes interference patterns of the superposition to produce a plurality of cyclic-shifted waveforms that each have one of the data symbols modulated thereon. |

349. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 5G networks and 5G wireless standards (e.g., 3GPP TS 38.211 version 15.2.0 release 15; the "5G Specification") and the requirements for uplink and downlink physical channel

communications. These communications are sent from Accused Continental 5G Devices, as previously defined, to eNodeB receivers located at cell sites.

350. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 13 of the ’005 Patent.

351. Accused Continental 5G Devices must have processors and non-transitory memory coupled to the processor for electronically communicating programming instructions necessary for compliance with 5G requirements. The memory of Accused Continental 5G Devices store instructions that are executed by the processor of the Accused Continental 5G Devices. For example, Continental’s website describes its CES 4G/5G Telematic Control Unit as including a Qualcomm SA515M Modem chipset with ARM Cortex-A7 processor. Upon information and belief, this TCU includes memory for storing programming instructions. For example, Continental’s website describes its 5G Telematic Control Unit as including an i.MX8 multi-core processor, up to 64GB eMMC memory, and up to 8GB of LPDDR4 memory.[5]

352. The 5G Specification requires the production and use of subcarriers and subcarrier values that are generated during the 5G Specification’s Transform Precoding step defined in Section 6.3.1.4:

[5] Both the CES and 5G TCU product descriptions can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

### 6.3.1.4 Transform precoding

If transform precoding is not enabled according to 6.1.3 of [6, TS38.214], $y^{(\lambda)}(i) = x^{(\lambda)}(i)$ for each layer $\lambda = 0,1,...,\upsilon - 1$.

If transform precoding is enabled according to 6.1.3 of [6, TS38.214], $\upsilon = 1$ and $\tilde{x}^{(0)}(i)$ depends on the configuration of phase-tracking reference signals.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are not being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ for the single layer $\lambda = 0$ shall be divided into $M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one OFDM symbol and $\tilde{x}^{(0)}(i) = x^{(0)}(i)$.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ shall be divided into sets, each set corresponding to one OFDM symbol, and where set $l$ contains $M_{\text{sc}}^{\text{PUSCH}} - \varepsilon_l N_{\text{samp}}^{\text{group}} N_{\text{group}}^{\text{PTRS}}$ symbols and is mapped to the complex-valued symbols $\tilde{x}^{(0)}(lM_{\text{sc}}^{\text{PUSCH}} + i')$ corresponding to OFDM symbol $l$ prior to transform precoding, with $i' \in \{0,1,...,M_{\text{sc}}^{\text{PUSCH}} - 1\}$ and $i' \neq m$. The index $m$ of PT-RS samples in set $l$, the number of samples per PT-RS group $N_{\text{samp}}^{\text{group}}$, and the number of PT-RS groups $N_{\text{group}}^{\text{PTRS}}$ are defined in clause 6.4.1.2.2.2. The quantity $\varepsilon_l = 1$ when OFDM symbol $l$ contains one or more PT-RS samples, otherwise $\varepsilon_l = 0$.

Transform precoding shall be applied according to

$$y^{(0)}(l \cdot M_{\text{sc}}^{\text{PUSCH}} + k) = \frac{1}{\sqrt{M_{\text{sc}}^{\text{PUSCH}}}} \sum_{i=0}^{M_{\text{sc}}^{\text{PUSCH}}-1} \tilde{x}^{(0)}(l \cdot M_{\text{sc}}^{\text{PUSCH}} + i) e^{-j\frac{2\pi ik}{M_{\text{sc}}^{\text{PUSCH}}}}$$
$$k = 0,...,M_{\text{sc}}^{\text{PUSCH}} - 1$$
$$l = 0,...,M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}} - 1$$

resulting in a block of complex-valued symbols $y^{(0)}(0),...,y^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$. The variable $M_{\text{sc}}^{\text{PUSCH}} = M_{\text{RB}}^{\text{PUSCH}} \cdot N_{\text{sc}}^{\text{RB}}$, where $M_{\text{RB}}^{\text{PUSCH}}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{\text{RB}}^{\text{PUSCH}} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

353. The 5G Specification's transform precoding step uses a Discrete Fourier transform (DFT), as shown in the outlined box above. The DFT itself is a complex matrix transform where values are calculated by multiplying a matrix of complex-valued codes with a matrix of data symbols. The complex-valued codes are included in the DFT's exponential term $e^{-j\frac{2\pi ik}{M_{sc}^{PUSCH}}}$. This term is a linear phase that defines a circular (cyclic) shift in the time-domain transform when frequency-domain values (inputs) are multiplied by the linear phase.

354. The 5G Specification requires assigning resource blocks to each device, with each resource block consisting of up to 12 consecutive subcarriers. The actual number of subcarriers selected and used depends on the usage scenario. The 5G Specification introduced variable subcarrier spacing (numerology) to accommodate different usage scenarios, with spacings of 15, 30, 60, 120 and 240kHz allowed in the 5G Specification. The number of subcarriers used depends on the subcarrier spacing utilized by the Accused Continental 5G Devices.

355. The Accused Continental 5G Devices modulate subcarrier values onto subcarriers to produce modulated subcarriers when implementing the 5G Specification's OFDM baseband signal generation step (Section 5.3.1):

## 5.3 OFDM baseband signal generation

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,...,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^\mu T_c - t_{\text{start},l}^\mu\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^\mu \le t < t_{\text{start},l}^\mu + \left(N_u^\mu + N_{\text{CP},l}^\mu\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

356. The baseband signal generation step converts frequency-domain values from the transform precoding step into time-domain values (waveforms) using an inverse Fast Fourier transform (IFFT). Each input symbol (complex-valued symbols in the frequency domain arising from transform precoding) into the IFFT is modulated onto a particular subcarrier frequency and

output as a discrete time signal. If multiple symbols are input into the IFFT at the same time, the output discrete time signal is a sum—or superposition—of the subcarrier frequencies modulated with their corresponding symbols. The resulting signal resembles a single carrier signal.

357. The sum (superposition) of the modulated subcarriers itself is based on the amplitudes of each of the subcarriers, with each subcarrier's amplitude varying in time according to its frequency. When summed, the varying amplitudes of the subcarriers results in a combination of constructive and destructive interference, such that the transform precoding step ultimately shapes interference patterns. Generally speaking, constructive interference is when the crest of a wave meets the crest of another wave at the same point, with the overall amplitude at that point being the sum of the two individual amplitudes. Destructive interference occurs when the crest of one wave meets the trough of another wave at the same point, with the overall amplitude at that point being the difference between the two individual waves.

358. Continental directly infringes claim 13 of the '005 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

359. Continental makes, uses, and/or imports the Accused Continental 5Gs Devices knowing that Continental infringed and continues to infringe claims of the '005 Patent under 35 U.S.C. § 271(a) directly.

360. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXIV: INFRINGEMENT OF U.S. PATENT '005 CLAIM 18**

361. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

362. Claim 18 of the ’005 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 13, wherein modulating and producing the time-domain waveform is performed using an inverse discrete Fourier transform. |

363. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 18 of the ’005 Patent.

364. Accused Continental 5G Devices comply with the 5G Specification, and apply the 5G Specification’s OFDM baseband signal generation step (Section 5.3.1):

## 5.3 OFDM baseband signal generation

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,...,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^\mu T_c - t_{\text{start},l}^\mu\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^\mu \le t < t_{\text{start},l}^\mu + \left(N_u^\mu + N_{\text{CP},l}^\mu\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

365. The baseband generation step employs an inverse discrete Fourier transform to modulate data symbols on subcarriers and generate the time-domain waveform.

366. Continental directly infringes claim 18 of the ’005 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

367. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’005 Patent under 35 U.S.C. § 271(a) directly.

368. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXV: INFRINGEMENT OF U.S. PATENT ’005 CLAIM 19**

369. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

370. Claim 19 of the ’005 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 13, wherein selecting the set of subcarriers comprises selecting one of a plurality of selectable subcarrier spacings. |

371. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 19 of the ’005 Patent.

372. Accused Continental 5G Devices comply with the 5G Specification. The 5G Specification supports multiple OFDM numerologies (subcarrier spacings), shown below, that can be selected depending on the usage scenario. Different subcarrier spacings utilize different numbers of subcarriers.

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15$ [kHz] | **Cyclic prefix** |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

373. Continental directly infringes claim 19 of the ’005 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

374. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’005 Patent under 35 U.S.C. § 271(a) directly.

375. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXVI: INFRINGEMENT OF U.S. PATENT ’285 CLAIM 11**

376. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

377. Claim 11 of the ’285 Patent provides:

| | |
|---|---|
| Claim 11 Preamble | An apparatus for communication in a wireless communication network, the apparatus comprising: |
| Element A | at least one processor; and |
| Element B | a non-transitory computer-readable memory communicatively coupled to the at least one processor, the non-transitory computer-readable memory including a set of instructions stored thereon and executable by the at least one processor for: |

| | |
|---|---|
| Element C | encoding a set of data symbols with a set of complex-valued codes, to produce a set of subcarrier values; |
| Element D | modulating the set of subcarrier values onto a set of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers assigned for use by the user device, to produce a plurality of modulated subcarriers; and |
| Element E | producing a time-domain waveform that comprises a superposition of the plurality of modulated subcarriers, the time-domain waveform to be transmitted in the wireless network by the user device; |
| Element F | wherein the set of subcarrier values comprises a first polyphase code that encodes a first of the set of data symbols and at least a second polyphase code that encodes at least a second of the set of data symbols; |
| Element G | wherein the first polyphase code causes constructive and destructive interference between the plurality of modulated subcarriers to produce a first periodic pulse waveform having a peak value that is centered at a first time in an OFDM symbol interval, and the second polyphase code causes constructive and destructive interference between the plurality of modulated subcarriers to produce a second periodic pulse waveform having a peak value that is centered at a second time in the OFDM symbol interval, the second time different from the first time. |

378. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 5G networks and 5G wireless standards (e.g., 3GPP TS 38.211 version 15.2.0 release 15; the "5G Specification") and the requirements for uplink and downlink physical channel communications. These communications are sent from Accused Continental 5G Devices, as previously defined, to eNodeB receivers located at cell sites.

379. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 13 of the '005 Patent.

380. Accused Continental 5G Devices must have processors and non-transitory memory coupled to the processor for electronically communicating programming instructions necessary for compliance with 5G requirements. The memory of Accused Continental 5G Devices store instructions that are executed by the processor of the Accused Continental 5G Devices. For example, Continental's website describes its CES 4G/5G Telematic Control Unit as

including a Qualcomm SA515M Modem chipset with ARM Cortex-A7 processor. Upon information and belief, this TCU includes memory for storing programming instructions. For example, Continental's website describes its 5G Telematic Control Unit as including an i.MX8 multi-core processor, up to 64GB eMMC memory, and up to 8GB of LPDDR4 memory.[6]

381. The 5G Specification requires the production and use of subcarriers and subcarrier values that are generated during the 5G Specification's Transform Precoding step defined in Section 6.3.1.4:

### 6.3.1.4 Transform precoding

If transform precoding is not enabled according to 6.1.3 of [6, TS38.214], $y^{(\lambda)}(i) = x^{(\lambda)}(i)$ for each layer $\lambda = 0,1,...,\upsilon - 1$.

If transform precoding is enabled according to 6.1.3 of [6, TS38.214], $\upsilon = 1$ and $\tilde{x}^{(0)}(i)$ depends on the configuration of phase-tracking reference signals.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are not being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ for the single layer $\lambda = 0$ shall be divided into $M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one OFDM symbol and $\tilde{x}^{(0)}(i) = x^{(0)}(i)$.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ shall be divided into sets, each set corresponding to one OFDM symbol, and where set $l$ contains $M_{\text{sc}}^{\text{PUSCH}} - \varepsilon_l N_{\text{samp}}^{\text{group}} N_{\text{group}}^{\text{PTRS}}$ symbols and is mapped to the complex-valued symbols $\tilde{x}^{(0)}(lM_{\text{sc}}^{\text{PUSCH}} + i')$ corresponding to OFDM symbol $l$ prior to transform precoding, with $i' \in \{0,1,...,M_{\text{sc}}^{\text{PUSCH}} - 1\}$ and $i' \neq m$. The index $m$ of PT-RS samples in set $l$, the number of samples per PT-RS group $N_{\text{samp}}^{\text{group}}$, and the number of PT-RS groups $N_{\text{group}}^{\text{PTRS}}$ are defined in clause 6.4.1.2.2.2. The quantity $\varepsilon_l = 1$ when OFDM symbol $l$ contains one or more PT-RS samples, otherwise $\varepsilon_l = 0$.

[6] Both the CES and 5G TCU product descriptions can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

* * * *

Transform precoding shall be applied according to

$$y^{(0)}(l \cdot M_{sc}^{PUSCH} + k) = \frac{1}{\sqrt{M_{sc}^{PUSCH}}} \sum_{i=0}^{M_{sc}^{PUSCH}-1} \tilde{x}^{(0)}(l \cdot M_{sc}^{PUSCH} + i) e^{-j\frac{2\pi ik}{M_{sc}^{PUSCH}}}$$

$$k = 0,..., M_{sc}^{PUSCH} - 1$$

$$l = 0,..., M_{symb}^{layer} / M_{sc}^{PUSCH} - 1$$

resulting in a block of complex-valued symbols $y^{(0)}(0),..., y^{(0)}(M_{symb}^{layer} - 1)$. The variable $M_{sc}^{PUSCH} = M_{RB}^{PUSCH} \cdot N_{sc}^{RB}$, where $M_{RB}^{PUSCH}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{RB}^{PUSCH} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

382. The transform precoding step of the 5G Specification employs a Discrete Fourier transform to encode input data symbols with complex-valued codes to generate subcarriers encoded with the input data. The DFT itself includes an exponential term that corresponds to complex-valued codes (the boxed portion of the equation above). These complex-valued codes are multiplied by the data symbols. The DFT's exponential term is used to phase shift inputs to the DFT by defining codes that are polyphasic. Each polyphase code is applied to the input data symbol.

383. The Accused Continental 5G Devices modulate subcarrier values from the transform precoding step onto subcarriers to produce modulated OFDM subcarriers when implementing the 5G Specification's OFDM baseband signal generation step (Section 5.3.1), shown below. Each Accused Continental 5G Device is assigned resource blocks for use, with each resource block consisting of up to twelve subcarriers.

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,...,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^{\mu} T_c - t_{\text{start},l}^{\mu}\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^{\mu} \le t < t_{\text{start},l}^{\mu} + \left(N_u^\mu + N_{\text{CP},l}^{\mu}\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^{\mu} = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

$\Delta f$ is given by clause 4.2, $\mu$ is the subcarrier spacing configuration, and $\mu_0$ is the largest $\mu$ value among the subcarrier spacing configurations provided to the UE for this carrer. The starting position of OFDM symbol $l$ for subcarrier spacing configuration $\mu$ in a subframe is given by

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

384. The baseband signal generation step converts frequency-domain values from the transform precoding step into time-domain values (waveforms) using an inverse Fast Fourier transform (IFFT). Each input symbol (complex-valued symbols in the frequency domain arising from transform precoding) into the IFFT is modulated onto a particular subcarrier frequency and output as a discrete time signal. If multiple symbols are input into the IFFT at the same time, the output discrete time signal is a sum—or superposition—of the subcarrier frequencies modulated with their corresponding symbols. The resulting signal resembles a single carrier signal that is then used during transmission from Accused Continental 5G Devices to the 5G network.

385. The sum (superposition) of the modulated subcarriers itself is based on the amplitudes of each of the subcarriers, with each subcarrier's amplitude varying in time according to its frequency. When summed, the varying amplitudes of the subcarriers results in a combination of constructive and destructive interference, such that the transform precoding step ultimately shapes interference patterns. Generally speaking, constructive interference is when the

crest of a wave meets the crest of another wave at the same point, with the overall amplitude at that point being the sum of the two individual amplitudes. Destructive interference occurs when the crest of one wave meets the trough of another wave at the same point, with the overall amplitude at that point being the difference between the two individual waves.

386. In OFDM systems, such as the 5G network, subcarriers are uniformly spaced based on a selected subcarrier spacing D*f* such that the time-domain OFDM symbol is periodic with a symbol period of 1/*f*. As discussed above, the baseband signal generation step employs an inverse DFT which produces a discrete-time OFDM signal having *N* samples and a period of *N*. When values of a first polyphase code are chosen, the codes provide phase offsets to the subcarriers that cause all of the subcarriers' phases to align at a particular time inside the symbol period, which causes constructive interference and results in a pulse waveform being centered at that time. If a second polyphase code also produces a pulse waveform, that pulse waveform is preferably centered at a different time in order for it to be distinguished from the first pulse waveform. This happens when the codes are chosen from the rows or columns of a DFT matrix.

387. Continental directly infringes claim 11 of the '285 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

388. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the '285 Patent under 35 U.S.C. § 271(a) directly.

389. As a direct and proximate result of Continental's acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXVII: INFRINGEMENT OF U.S. PATENT '285 CLAIM 17**

390. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

391. Claim 17 of the '285 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 11, further comprising adding a cyclic prefix to the time-domain waveform. |

392. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 17 of the '285 Patent.

393. The transceiver in Accused Continental 5G Devices is configured to perform physical channel uplink and downlink processing in accordance with the 5G Specification. The 5G Specification includes OFDM baseband signal generation (Section 5.3.1). This step includes adding a cyclic prefix to the signal:

## 5.3 OFDM baseband signal generation

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,...,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^\mu T_c - \underline{t_{\text{start},l}^\mu}\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^\mu \le t < t_{\text{start},l}^\mu + \left(N_u^\mu + N_{\text{CP},l}^\mu\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

In the above equation, $N_{CP,l}^{\mu}$ is defined as the cyclic prefix length.

394. Continental directly infringes claim 17 of the ’285 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

395. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’285 Patent under 35 U.S.C. § 271(a) directly.

396. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXVIII: INFRINGEMENT OF U.S. PATENT ’285 CLAIM 19**

397. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

398. Claim 19 of the ’285 Patent provides:

| | |
|---|---|
| Element A | The apparatus of claim 11, wherein modulating comprises selecting one of a set of subcarrier frequency spacings. |

399. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 19 of the ’285 Patent.

400. Accused Continental 5G Devices comply with the 5G Specification. The 5G Specification supports multiple OFDM numerologies (subcarrier spacings) that can be selected depending on the usage scenario, as shown below. Different subcarrier spacings utilize different numbers of subcarriers.

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15\,[\text{kHz}]$ | **Cyclic prefix** |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

401. Continental directly infringes claim 19 of the ’285 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

402. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’285 Patent under 35 U.S.C. § 271(a) directly.

403. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XXXIX: INFRINGEMENT OF U.S. PATENT ’792 CLAIM 8**

404. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

405. Claim 8 of the ’792 Patent provides:

| | |
|---|---|
| Claim 8 Preamble | An apparatus for providing flexible channel bandwidth in mobile radio communications, comprising: |
| Element A | at least one processor; and |
| Element B | at least one non-transitory computer-readable memory in electronic communication with the at least one processor, and instructions stored in the at least one memory, the instructions executable by the at least one processor for: |

| | |
|---|---|
| Element C | provisioning a set of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers for mobile radio communications; |
| Element D | encoding data symbols with polyphase codes derived from a discrete Fourier transform to produce encoded data symbols; and |
| Element E | modulating the encoded data symbols onto the OFDM subcarriers to produce a superposition signal that resembles a single-carrier signal and has one of a plurality of different symbol durations; |
| Element F | wherein provisioning comprises selecting one of a plurality of different selectable subcarrier spacings, to provide for the one of the plurality of different symbol durations. |

406. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 5G networks and 5G wireless standards (e.g., 3GPP TS 38.211 version 15.2.0 release 15; the "5G Specification") and the requirements for uplink and downlink physical channel communications. These communications are sent from Accused Continental 5G Devices, as previously defined, to eNodeB receivers located at cell sites.

407. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 13 of the '005 Patent.

408. Accused Continental 5G Devices must have processors Accused Continental 5G Devices must have processors and non-transitory memory coupled to the processor for electronically communicating programming instructions necessary for compliance with 5G requirements. The memory of Accused Continental 5G Devices store instructions that are executed by the processor of the Accused Continental 5G Devices. For example, Continental's website describes its CES 4G/5G Telematic Control Unit as including a Qualcomm SA515M Modem chipset with ARM Cortex-A7 processor. Upon information and belief, this TCU includes memory for storing programming instructions. For example, Continental's website

describes its 5G Telematic Control Unit as including an i.MX8 multi-core processor, up to 64GB eMMC memory, and up to 8GB of LPDDR4 memory.[7]

409. 5G cellular communications use orthogonal frequency division multiplexing (OFDM) for radio transmissions. As implemented in the 5G Specification, each Accused Continental 5G Device is assigned resource blocks, with each resource block consisting of up to twelve subcarriers. The 5G Specification includes various numerologies to accommodate different usage scenarios. These numerologies define various subcarrier spacings, ranging from 15kHz to 240kHz, as shown below:

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15$ [kHz] | **Cyclic prefix** |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

410. Depending on the subcarrier spacing selected, the subcarriers will have different symbol durations. For example, an OFDM symbol duration is 66.6 microseconds when using a subcarrier spacing of 15kHz, while the OFDM symbol duration is halved (33.3 microseconds) when the subcarrier spacing is doubled to 30kHz:

[7] Both the CES and 5G TCU product descriptions can be found at https://conti-engineering.com/components/telematic-unit/, last accessed January 16, 2024.

**Table 5.5.4.1-2: Multiple numerologies in NR**

| Cyclic Prefix | subcarrier spacing (SCS) [kHz] | Number of subframes per radio frame | Number of slots per subframe | Number of OFDM symbols per slot | Applicable frequency range |
|---|---|---|---|---|---|
| normal | 15 | 10 | 1 | 14 | FR1 |
| normal | 30 | 10 | 2 | 14 | FR1 |
| normal | 60 | 10 | 4 | 14 | FR1 and FR2 |
| extended | 60 | 10 | 4 | 12 | FR1 and FR2 |
| normal | 120 | 10 | 8 | 14 | FR2 |
| normal | 240 | 10 | 16 | 14 | FR2 |

Note: Additional specific numerologies are defined for PRACH, as described in Section 5.5.4.3.

Note that, for the 60 kHz SCS, an extended CP is possible. The extended CP is approximately four times longer than the normal CP and is used for cells having large delay spread. In this case, one slot consists of only 12 OFDM symbols.

The OFDM symbol duration and CP length are inversely proportional of the SCS. E.g. for 15 kHz SCS, the OFDM symbol duration is approximately 66.6 $\mu$s and the CP length is approximately 4.7 $\mu$s. When the SCS is doubled, i.e. 30 kHz, the OFDM and CP lengths are approximately devided by two compared to the 15kHz SCS.

Source: 5G Specification, 3GPP TR 21.915 version 15.0.0 release 15

411. The 5G Specification requires a transform precoding step (Section 6.3.1.4) which utilizes a discrete Fourier transform (DFT) to encode input data symbols with polyphase codes to generate transform precoded data symbols:

### 6.3.1.4 Transform precoding

If transform precoding is not enabled according to 6.1.3 of [6, TS38.214], $y^{(\lambda)}(i) = x^{(\lambda)}(i)$ for each layer $\lambda = 0,1,...,\upsilon - 1$.

If transform precoding is enabled according to 6.1.3 of [6, TS38.214], $\upsilon = 1$ and $\tilde{x}^{(0)}(i)$ depends on the configuration of phase-tracking reference signals.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are not being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ for the single layer $\lambda = 0$ shall be divided into $M_{\text{symb}}^{\text{layer}} / M_{\text{sc}}^{\text{PUSCH}}$ sets, each corresponding to one OFDM symbol and $\tilde{x}^{(0)}(i) = x^{(0)}(i)$.

If the procedure in [6, TS 38.214] indicates that phase-tracking reference signals are being used, the block of complex-valued symbols $x^{(0)}(0),...,x^{(0)}(M_{\text{symb}}^{\text{layer}} - 1)$ shall be divided into sets, each set corresponding to one OFDM symbol, and where set $l$ contains $M_{\text{sc}}^{\text{PUSCH}} - \varepsilon_l N_{\text{samp}}^{\text{group}} N_{\text{group}}^{\text{PTRS}}$ symbols and is mapped to the complex-valued symbols $\tilde{x}^{(0)}(lM_{\text{sc}}^{\text{PUSCH}} + i')$ corresponding to OFDM symbol $l$ prior to transform precoding, with $i' \in \{0,1,...,M_{\text{sc}}^{\text{PUSCH}} - 1\}$ and $i' \neq m$. The index $m$ of PT-RS samples in set $l$, the number of samples per PT-RS group $N_{\text{samp}}^{\text{group}}$, and the number of PT-RS groups $N_{\text{group}}^{\text{PTRS}}$ are defined in clause 6.4.1.2.2.2. The quantity $\varepsilon_l = 1$ when OFDM symbol $l$ contains one or more PT-RS samples, otherwise $\varepsilon_l = 0$.

* * * *

Transform precoding shall be applied according to

$$y^{(0)}(l \cdot M_{sc}^{PUSCH} + k) = \frac{1}{\sqrt{M_{sc}^{PUSCH}}} \sum_{i=0}^{M_{sc}^{PUSCH}-1} \tilde{x}^{(0)}(l \cdot M_{sc}^{PUSCH} + i) e^{-j\frac{2\pi ik}{M_{sc}^{PUSCH}}}$$

$$k = 0, \ldots, M_{sc}^{PUSCH} - 1$$

$$l = 0, \ldots, M_{symb}^{layer} / M_{sc}^{PUSCH} - 1$$

resulting in a block of complex-valued symbols $y^{(0)}(0), \ldots, y^{(0)}(M_{symb}^{layer} - 1)$. The variable $M_{sc}^{PUSCH} = M_{RB}^{PUSCH} \cdot N_{sc}^{RB}$, where $M_{RB}^{PUSCH}$ represents the bandwidth of the PUSCH in terms of resource blocks, and shall fulfil

$$M_{RB}^{PUSCH} = 2^{\alpha_2} \cdot 3^{\alpha_3} \cdot 5^{\alpha_5}$$

where $\alpha_2, \alpha_3, \alpha_5$ is a set of non-negative integers.

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

412. As shown in the above, the DFT includes an exponential term that generates polyphase codes that are applied to input data symbols.

413. The 5G Specification requires an OFDM baseband signal generation step (Section 5.3.1), as shown below:

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0, 1, \ldots, N_{slot}^{subframe,\mu} N_{symb}^{slot} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{grid}^{size,\mu} N_{sc}^{RB} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{grid,x}^{size,\mu} N_{sc}^{RB}/2\right)\Delta f\left(t - N_{CP,l}^\mu T_c - t_{start,l}^\mu\right)}$$

$$k_0^\mu = \left(N_{grid,x}^{start,\mu} + N_{grid,x}^{size,\mu}/2\right) N_{sc}^{RB} - \left(N_{grid,x}^{start,\mu_0} + N_{grid,x}^{size,\mu_0}/2\right) N_{sc}^{RB} 2^{\mu_0 - \mu}$$

where $t_{start,l}^\mu \le t < t_{start,l}^\mu + \left(N_u^\mu + N_{CP,l}^\mu\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{CP,l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

$\Delta f$ is given by clause 4.2, $\mu$ is the subcarrier spacing configuration, and $\mu_0$ is the largest $\mu$ value among the subcarrier spacing configurations provided to the UE for this carrer. The starting position of OFDM symbol $l$ for subcarrier spacing configuration $\mu$ in a subframe is given by

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

414. The baseband signal generation step involves modulating the encoded data symbols generated during the transform precoding step onto OFDM subcarriers. This baseband signal generation step uses an inverse DFT to transform the encoded data symbols from the frequency-domain into the time-domain, with the output being a discrete-time signal. When multiple symbols are input into the inverse DFT at the same time, the output discrete-time signal is a sum (or superposition) of the subcarrier frequencies modulated with their corresponding symbols. This summing of outputs resembles a single carrier.

415. Continental directly infringes claim 8 of the ’792 Patent by selling, offering to sell, and using the Accused Continental 5G Devices.

416. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’792 Patent under 35 U.S.C. § 271(a) directly.

417. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XL: INFRINGEMENT OF U.S. PATENT ’792 CLAIM 9**

418. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

419. Claim 9 of the ’792 Patent provides:

| | |
|---|---|
| Claim 9 | The apparatus of claim 8, wherein at least one of the plurality of different selectable subcarrier spacings equals at least one other of the plurality of different selectable subcarrier spacings multiplied by a scaling factor that is a power of two. |

420. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 5G networks and 5G wireless standards (e.g., 3GPP TS 38.211 version 15.2.0 release 15; the "5G Specification") and the requirements for uplink and downlink physical channel communications. These communications are sent from Accused Continental 5G Devices, as previously defined, to eNodeB receivers located at cell sites.

421. The 5G Specification's numerologies allow for different subcarrier spacings to be used. The different subcarrier spacings are based on a scaling factor that is a power of two, as shown in the highlighted section below.

## 4.2 Numerologies

Multiple OFDM numerologies are supported as given by Table 4.2-1 where $\mu$ and the cyclic prefix for a bandwidth part are obtained from the higher-layer parameter *subcarrierSpacing* and *cyclicPrefix*, respectively.

**Table 4.2-1: Supported transmission numerologies.**

| $\mu$ | $\Delta f = 2^{\mu} \cdot 15\,[\text{kHz}]$ | **Cyclic prefix** |
|---|---|---|
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

* * * *

$\Delta f$ Subcarrier spacing

* * * *

$\mu$ Subcarrier spacing configuration, $\Delta f = 2^{\mu} \cdot 15\,[\text{kHz}]$

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

422. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 9 of the '792 Patent.

423. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’792 Patent under 35 U.S.C. § 271(a) directly.

424. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**COUNT XLI: INFRINGEMENT OF U.S. PATENT ’792 CLAIM 10**

425. Genghiscomm incorporates by reference the allegations set forth in the preceding paragraphs of this Complaint as though set forth in full herein.

426. Claim 10 of the ’792 Patent provides:

| | |
|---|---|
| Claim 10 | The apparatus of claim 8, further comprising instructions stored in the at least one non-transitory computer-readable memory, the instructions executable by the at least one processor for adding a cyclic prefix to the superposition signal. |

427. Continental makes, uses, sells, offers for sale, and imports wireless devices that utilize 5G networks and 5G wireless standards (e.g., 3GPP TS 38.211 version 15.2.0 release 15; the “5G Specification”) and the requirements for uplink and downlink physical channel communications. These communications are sent from Accused Continental 5G Devices, as previously defined, to eNodeB receivers located at cell sites.

428. The Accused Continental 5G Devices have memory (e.g., RAM, LPDDR) that stores programming instructions to implement the requirements of the 5G Specification, including the 5G Specification’s use of cyclic prefixes to the OFDM baseband signal:

## 5.3 OFDM baseband signal generation

### 5.3.1 OFDM baseband signal generation for all channels except PRACH

The time-continuous signal $s_l^{(p,\mu)}(t)$ on antenna port $p$ and subcarrier spacing configuration $\mu$ for OFDM symbol $l \in \{0,1,...,N_{\text{slot}}^{\text{subframe},\mu} N_{\text{symb}}^{\text{slot}} - 1\}$ in a subframe for any physical channel or signal except PRACH is defined by

$$s_l^{(p,\mu)}(t) = \sum_{k=0}^{N_{\text{grid}}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}} - 1} a_{k,l}^{(p,\mu)} \cdot e^{j2\pi\left(k + k_0^\mu - N_{\text{grid},x}^{\text{size},\mu} N_{\text{sc}}^{\text{RB}}/2\right)\Delta f\left(t - N_{\text{CP},l}^\mu T_c - t_{\text{start},l}^\mu\right)}$$

$$k_0^\mu = \left(N_{\text{grid},x}^{\text{start},\mu} + N_{\text{grid},x}^{\text{size},\mu}/2\right) N_{\text{sc}}^{\text{RB}} - \left(N_{\text{grid},x}^{\text{start},\mu_0} + N_{\text{grid},x}^{\text{size},\mu_0}/2\right) N_{\text{sc}}^{\text{RB}} 2^{\mu_0 - \mu}$$

where $t_{\text{start},l}^\mu \le t < t_{\text{start},l}^\mu + \left(N_u^\mu + N_{\text{CP},l}^\mu\right) T_c$ is the time within the subframe,

$$N_u^\mu = 2048\kappa \cdot 2^{-\mu}$$

$$N_{\text{CP},l}^\mu = \begin{cases} 512\kappa \cdot 2^{-\mu} & \text{extended cyclic prefix} \\ 144\kappa \cdot 2^{-\mu} + 16\kappa & \text{normal cyclic prefix, } l = 0 \text{ or } l = 7 \cdot 2^\mu \\ 144\kappa \cdot 2^{-\mu} & \text{normal cyclic prefix, } l \ne 0 \text{ and } l \ne 7 \cdot 2^\mu \end{cases}$$

Source: 5G Specification, 3GPP TS 38.211 version 15.2.0 release 15

429. Continental has and continues to make, use, sell, import, and/or offer for sale the Accused Continental 5G Devices that meet each and every element of claim 10 of the ’792 Patent.

430. Continental makes, uses, and/or imports the Accused Continental 5G Devices knowing that Continental infringed and continues to infringe claims of the ’792 Patent under 35 U.S.C. § 271(a) directly.

431. As a direct and proximate result of Continental’s acts of patent infringement, Genghiscomm has been and continues to be injured, and has sustained and will continue to sustain damages.

**WILLFUL INFRINGEMENT**

432. Continental has infringed and continues to infringe the above identified claims of each of the Patents-in-Suit despite its knowledge of the ’842, ’227 and ’568 Patents and its knowledge that at least Accused Continental LTE Devices, were and are using the technology

claimed by the since November 8, 2021, and the objectively high likelihood that its acts constitute patent infringement.

433. Continental's infringement of the Patents-in-Suit is willful and deliberate, entitling GenghisComm to enhanced damages under 35 U.S.C. § 284.

434. Continental's willful infringement and unwillingness to enter into license negotiations with GenghisComm make this an exceptional case such that GenghisComm should be entitled to recover its attorneys' fees and costs incurred in relation to this matter pursuant to 35 U.S.C. §285.

**JURY DEMAND**

GenghisComm demands a trial by jury on all issues so triable.

**PRAYER FOR RELIEF**

WHEREFORE, Plaintiff GenghisComm requests that this Court enter judContinentalent in its favor and against Continental as follows:

A. Adjudging, finding, and declaring that Continental has infringed of the above-identified claims of each of the Patents-in-Suit under 35 U.S.C. § 271;

B. Awarding the past and future damages arising out of Continental's infringement of the Patents-in-Suit to GenghisComm in an amount no less than a reasonable royalty, together with prejudContinentalent and post-judContinentalent interest, in an amount according to proof;

C. Adjudging, finding, and declaring that Continental's infringement is willful and enhanced damages and fees as a result of that willfulness under 35 U.S.C. § 284;

D. Adjudging, finding, and declaring that this is an "exceptional" case pursuant to 35 U.S.C. § 285;

E. Awarding attorney's fees, costs, or other damages pursuant to 35 U.S.C. §§ 284 or 285 or as otherwise permitted by law; and

F. Granting GenghisComm such other further relief as is just and proper, or as the Court deems appropriate.

Dated: January 16, 2024

Respectfully submitted,

By: */s/ Alison Aubry Richards*

Alison Aubry Richards (arichards@giplg.com)
(IL Bar # 6285669)
Global IP Law Group, LLC
55 W. Monroe St.
Ste. 3400
Chicago, Illinois 60603
Phone: 312.241.1500

*Attorneys for Plaintiff, GenghisComm Holdings, LLC*

## CERTIFICATE OF SERVICE

I hereby certify that on January 16, 2024, the foregoing was electronically filed with the CM/ECF system, which will send a notification of such filing to all counsel of record.

/s/*Alison A. Richards*
***Attorney for Plaintiff***