IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

BELL NORTHERN RESEARCH, LLC,	
Plaintiff,	Civil Action No. 6:21-cv-833-ADA
v.	
APPLE INC.,	JURY TRIAL
Defendant.	

FIRST AMENDED COMPLAINT

Plaintiff Bell Northern Research, LLC ("BNR" or "Plaintiff") files this First Amended Complaint against Apple, Inc. ("Apple") for infringement of U.S. Patent Nos. 8,204,554 (the "'554 Patent"), 7,319,889 (the "'889 Patent"), RE 48,629 (the "'629 Patent"), 8,416,862 (the "'862 Patent"), 7,957,450 (the "'450 Patent"), 7,564,914 (the "'914 Patent"), 6,963,129 (the "'129 Patent"), 6,858,930 (the "'930 Patent"), 7,039,435 (the "'435 Patent"), and 8,396,072 (the "'072 Patent") (collectively, the "BNR Patents"). Plaintiff, on personal knowledge as to its own acts, and on information and belief as to all others based on investigation, alleges as follows:

SUMMARY OF THE ACTION

1.   This is a patent infringement suit relating to Apple's unauthorized and unlicensed use of the BNR Patents in its wireless products. The technologies claimed in the BNR Patents support many of Apple's core functionalities, including cellular, wi-fi, and battery preservation, not to mention the health of Apple's customers.

2.   The BNR Patents come from a rich pedigree dating back to the late 19th century. This is when a collection of companies, referred to as the Bell System, sprang to life from the ideas and patented technologies created by Alexander Graham Bell. Two technical development streams

arose from this collective: Western Electric (the R&D stream) and Northern Electric (the manufacturing stream).

3.   The R&D portion of the Bell System (Western Electric) operated as a laboratory, creating designs for telephones, switches, and other electrical equipment. In 1925, AT&T and Western Electric combined their engineering departments to form Bell Labs. Bell Labs is one of America's greatest technology incubators, and paved the way for many technological advances we know and use today, including the transistor, several kinds of lasers, the UNIX operating system, and computer languages such as C++. In total, Bell Labs received nine Nobel Prizes for its work over the years.

4.   The manufacturing portion of the Bell System (Northern Electric) came out of National Bell Telephone of Boston's commission to Charles Fleetford Sise to create Bell Telephone Company of Canada. Bell Canada originally made telephones and other equipment based on Western Electric's designs, and spun out its manufacturing business into Northern Electric in 1895. After cutting ties with Western Electric, Northern Electric began inventing its own designs, and eventually started its own research and development labs in Canada. Bell Canada and Northern Electric combined their R&D organizations to form BNR.

5.   Collectively, these companies spurred a digital revolution in telecom, starting with the first digital telephone switch in 1975. They continued to push the industry to new heights in the late 1980s, when BNR announced the desire to create a global fiber optic network (called "FiberWorld"). Its goal was to give users easy, reliable, and fast access to a variety of multimedia services. To realize this vision, Bell Labs and subsequent innovators made numerous breakthroughs in laser, semiconductor, photodetector, amplifier, and waveguide designs. These advancements lead to the modern fiber optic systems currently used all over the world.

6.   This work naturally led to cellular telecommunications as well. On May 6, 1992, BNR VP George Brody—along with executives from Bell Cellular and Northern Electric—made the first Canada-US digital cellular call. It stretched from Toronto, Ontario to Fort Worth, Texas.

7.   Eventually, the Bell System broke up and spawned several new companies. They included telecommunications powerhouses Lucent and Agere Systems. Lucent was absorbed by Nokia, while Agere Systems was acquired by LSI, and then Avago/Broadcom. BNR was folded into Nortel.

8.   Although Nortel was ultimately unsuccessful in its bid to supply digital telecommunications and networking solutions to the market, several Bell Labs, Northern Electric, and Nortel alumni decided to reenergize BNR in 2017. Today it is the successor in interest to many of the key telecommunications technologies developed and spun out of Bell System's early work, some of which form the basis of the BNR Patents.

9.   BNR brings this action to put a stop to Apple's unauthorized and unlicensed use of the BNR Patents.

THE PARTIES

10.   BNR is a Delaware limited liability company with its principal place of business at 401 North Michigan Avenue, Chicago, Illinois 60611.

11.   Apple is a corporation organized under the laws of the State of California with its principal place of business at 1 Apple Park Way, Cupertino, California 95014.

12.   Apple directly and/or indirectly develops, designs, manufactures, uses, distributes, markets, offers to sell, and/or sells infringing products and services in the United States, including in this District, and otherwise purposefully directs infringing activities to this District in connection with its iPhones, iPads, Macbooks, iMacs, Mac Pros, Mac minis, Apple TVs, Apple Watches, and other mobile/computer products.

JURISDICTION AND VENUE

13.   This action arises under the patent laws of the United States, Title 35 of the United

States Code. Accordingly, this Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and

1338.

14.   This Court has personal jurisdiction over Apple. Apple has conducted and

continues to regularly conduct business within the State of Texas. Apple has purposefully and

voluntarily availed itself of the privileges of conducting business in the United States, in the State

of Texas, and in this District by continuously and systematically placing goods into the stream of

commerce through an established distribution channel with the expectation that they will be

purchased by consumers in this District. Apple directly and/or through intermediaries (including

distributors, sales agents, and others), makes, ships, distributes, offers for sale, sells, advertises,

and/or uses its products (including, but not limited to, the products that are accused of patent

infringement in this lawsuit) in the United States, the State of Texas, and this District.

15.   Venue is proper in this Court pursuant to 28 U.S.C. §§ 1391 and 1400 because

Apple has committed, and continues to commit, acts of infringement in this District and has a

regular and established place of business in this District. On information and belief, Apple

maintains regular and established places of business in the District at 12545 Riata Vista Cir.,

Austin, Texas 78727.

16.   On information and belief, the majority of Apple's approximately 7,000 employees

currently based in Austin are located in the 1.1 million square-foot Riata Vista campus. Completed

in 2016, the Riata Vista campus features seven office buildings spread across 38 acres making it

Apple's second-largest corporate office. *See Apple checks in with 192-room hotel for billion-dollar*

Northwest   Austin   campus,   CultureMap   Austin   (available   at

https://austin.culturemap.com/news/city-life/05-20-20-apple-adds-surprising-element-to-1-

billion-campus-in-northwest-austin/) ("*Apple checks in*"). To accelerate its growth in Austin, Apple is building a new 133-acre campus at 5501 W. Parmer Ln., less than half a mile away from its Riata Vista campus. *See Apple bites into North Austin with new $1 billion campus and 5,000 potential jobs,* CultureMap Austin (available at https://austin.culturemap.com/news/city-life/12-13-18-apple-bites-into-north-austin-with-new-1-billion-campus-and-5000-jobs/) ("*Apple bites into North Austin*"). Expected to be ready in 2022, the Parmer Lane campus is estimated to cost Apple $1 billion dollars. *See Apple expands in Austin*, Apple (available at https://www.apple.com/newsroom/2019/11/apple-expands-in-austin/) ("*Apple expands in Austin*"). It is projected that the new campus will immediately be able to accommodate 5,000 new employees and be able to grow to 15,000 employees in the future. *Id.* According to Apple, the new campus is expected to host a variety of jobs including "engineering, R&D, operations, finance, sales, and customer support." *Id.* Overall, the Parmer Lane campus will include structures totaling 3 million square-feet, approximately 2 million of which will be dedicated office/research and development space. A recently updated site plan also shows a 192-room hotel as being included in the campus. *See Apple checks in*.

17.   On information and belief, it is expected that completion of the Parmer Lane campus will make Apple the largest private employer in the city of Austin. *See Apple checks in*. As a reward for building this new massive campus, Williamson County agreed to repay 65 percent of Apple's property taxes for the next 15 years. *See Apple getting big tax rebate from Williamson County with Austin expansion,* KVUE ABC (available at https://www.kvue.com/article/news/local/apple-could-get-big-tax-break-from-williamson-county-with-austin-expansion/269-623955430).

18.   Furthermore, Apple's most powerful computer, the Mac Pro, which is among the infringing products, is manufactured in the Flextronics Americas factory in Austin. Apple has been manufacturing the Mac Pro in Flextronics' 244,000 square-foot facility since 2013. As of 2019, Apple employs more than 500 people at this location. *See Apple expands in Austin*.

19.   In addition to the foregoing, Apple has numerous other regular and established physical places of business in this District. Apple has at least the following retail spaces (Apple Stores) located within this District:

Apple Barton Creek
2901 S. Capital of Texas Highway
Austin, TX 78746

Apple North Star
7400 San Pedro Avenue
San Antonio, TX 78216

Apple Domain NORTHSIDE
3121 Palm Way
Austin, TX 78758

Apple La Cantera
15900 La Cantera Parkway
San Antonio, TX 78256

Apple Store
8401 Gateway Blvd West
El Paso, TX 79925

20.   Apple is registered to do business in Texas and maintains an agent for service of process here. Apple maintains places of business within this District, including those mentioned above. Moreover, Apple has authorized retailers that offer and sell the accused infringing products on its behalf in this judicial district. BNR's causes of action arise directly from Apple's business contacts and other activities in the State of Texas and this District.

21.   Currently, Apple is advertising approximately 455 jobs in the Austin-metro area. These include RF design engineer positions, cellular SOC design and verification engineering positions, cellular power engineering positions, display engineering positions, engineering program/project management positions, various software engineering positions including artificial intelligence/machine learning and digital advertising, a number of marketing positions, along with

a host of corporate openings. *Careers at Apple,* Apple (available at https://jobs.apple.com/en-us/search?location=austin-metro-area-AUSMETRO).

22.   Apple has derived substantial revenues from its infringing acts occurring within the State of Texas and within this District.

23.   Venue is also convenient in this District. This is at least true because of this District's close ties to this case—including the technology, relevant witnesses, and sources of proof—and its ability to quickly and efficiently move this case to resolution. Further, this District has familiarity with at least some of the BNR Patents. Several of the patents (*i.e.*, the '129 and '930 Patents) were involved in a recent lawsuit filed in this District. *See* Dkt. 1, *Bell Northern Research, LLC v. Samsung Elecs. Co., Ltd*, No. 6:20-cv-326-ADA (W.D. Tex. Apr. 24, 2020).

THE BNR PATENTS

A. U.S. Patent Nos. 8,204,554 and 7,319,889

24.   BNR is the owner by assignment of the '554 patent. The '554 Patent is entitled "System and Method for Conserving Battery Power in a Mobile Station." The '554 Patent issued on June 19, 2012. A true and correct copy of the '554 Patent is attached as Exhibit A.

25.   BNR is the owner by assignment of the '889 Patent. The '889 Patent is entitled "System and Method for Conserving Battery Power in a Mobile Station." The '889 Patent issued on January 15, 2008. A true and correct copy of the '889 Patent is attached as Exhibit B.

26.   The inventors of both the '554 and '889 Patents are Norman Goris and Wolfgang Scheit.

27.   The '889 Patent is a continuation of U.S. Patent No. 7,113,811, filed on June 17, 2003. The '554 Patent is a continuation of the '889 Patent.

28.   The '554 and '889 Patents generally relate to "mobile station[s]…having a reduced power consumption under certain operating conditions." Ex. A at 1:14-17.

29.   The claimed inventions in the '554 and '889 Patents are directed to methods and

systems that allow a mobile station, such as a cellular phone or tablet, to reduce power

consumption—for example, to extend the amount of time for the mobile station to operate on

battery power.

30.   The background sections of the '554 and '889 Patents describe the need for

reducing power consumption:

> Usually the stand-by time, as well as the talk-time, of a mobile station depend on
> the lifetime of a (rechargeable) battery inserted within the mobile station and hence,
> on the load and/or on the capacity of the battery…Increasing of the capacity of the
> battery would increase the lifetime of the mobile station, but batteries having
> increased capacities are often larger, heavier or more expensive, none of which are
> desirable attributes for a portable, affordable mobile station. Accordingly, what is
> needed in the art is a way to prolong the lifetime of a mobile station without having
> to use a battery with an increased capacity.

Ex. A at 1:27-37; Ex. B at 1:27-37.

31.   The '554 and '889 Patents describe the reduced power consumption resulting from

the invention:

> Thus, by reducing the power consumption of the display of an activated telephone
> set in case the display is not needed, i.e., in particular during a telephone call,
> current is saved instead of needlessly consumed from the (rechargeable) battery.
> Accordingly, the spared available battery power may be significant, especially for
> color displays, resulting in an overall increasement of the stand-by and/or talk time
> of the telephone set.

Ex. A at 1:47-54; Ex. B at 1:48-55.

32.   Reducing a device's power consumption is increasingly important and beneficial,

as devices on the market continue to grow in complexity and functionality, demanding more and

more power to operate their features, such as audiovisual and connectivity tasks.

33.   The preferred embodiments of the invention "sav[e] available battery power of a

mobile station . . . in particular when the display . . . [is] near an object" such as the ear. Ex. A at

2:19-25; Ex. B at 2:18-24.

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34.   The '554 Patent contains three independent claims and fourteen total claims,

covering various methods and systems. Claim 1 reads:

> 1. A mobile station, comprising:
>
> a display;
>
> a proximity sensor adapted to generate a signal indicative of the existence of a first condition, the first condition being that an external object is proximate; and
>
> a microprocessor adapted to:
>
>> (a) determine, without using the proximity sensor, the existence of a second condition independent and different from the first condition, the second condition being that a user of the mobile station has performed an action to initiate an outgoing call or to answer an incoming call;
>>
>> (b) in response to a determination in step (a) that the second condition exists, activate the proximity sensor;
>>
>> (c) receive the signal from the activated proximity sensor; and
>>
>> (d) reduce power to the display if the signal from the activated proximity sensor indicates that the first condition exists.

35.   The '889 Patent contains two independent claims and thirteen total claims, covering

various methods and systems. Claim 1 reads:

> 1. A mobile station, comprising:
>
> a display;
>
> a proximity sensor adapted to generate a signal indicative of proximity of an external object; and
>
> a microprocessor adapted to:
>
>> (a) determine whether a telephone call is active;
>>
>> (b) receive the signal from the proximity sensor; and

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(c) reduce power to the display if the microprocessor determines that a telephone call is active and the signal indicates the proximity of the external object; wherein:

the telephone call is a wireless telephone call; the microprocessor reduces power to the display while the signal indicates the proximity of the external object only if the microprocessor determines that the wireless telephone call is active; and

the proximity sensor begins detecting whether an external object is proximate substantially concurrently with the mobile station initiating an outgoing wireless telephone call or receiving an incoming wireless telephone call.

36.   The above-disclosed claim limitations from the '554 and '889 Patents comprise various elements, including, *e.g.*, a display, a proximity sensor, and a microprocessor adapted to determine whether a call is active, receive signals from the proximity sensor, and reduce power to the display under certain conditions. These claims, as a whole, provide significant benefits and improvements related to reducing a mobile station's power consumption, relative to the prior art.

B. U.S. Patent No. RE48,629

37.   BNR is the owner by assignment of the '629 Patent. The '629 Patent is entitled "Backward-Compatible Long Training Sequences for Wireless Communication Networks." The '629 Patent re-issued on July 6, 2021. A true and correct copy of the '629 Patent is attached as Exhibit C.

38.   The inventors of the '629 Patent are Jason Trachewsky and Rajendra Moorti.

39.   The '629 Patent is a reissue of U.S. Patent No. 7,990,842 ("the '842 Patent"), which issued on August 2, 2011. The '842 Patent was filed on January 8, 2010 and is a continuation of U.S. Patent No. 7,646,703, which was filed on July 26, 2005.

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40.   The '629 Patent claims priority to at least Provisional Application Nos. 60/591,104,

filed on July 27, 2004, and 60/634,102, filed on December 8, 2004.

41.   The '629 Patent is generally related to wireless communication systems. In

particular, the '629 Patent is concerned with the 802.11 standard and helping ensure backward

compatibility with prior versions of that standard. The specification explains the following:

> Different wireless devices in a wireless communication system may be compliant
> with different standards or different variations of the same standard. For example,
> 802.11a an extension of the 802.11 standard, provides up to 54 Mbps in the 5 GHz
> band. 802.11b, another extension of the 802.11 standard, provides 11 Mbps
> transmission (with a fallback to 5.5, 2 and 1 Mbps) in the 2.4 GHz band. 802.11g,
> another extension of the 802.11 standard, provides 20+ Mbps in the 2.4 GHz band.
> 802.11n, a new extension of 802.11, is being developed to address, among other
> [sic] thins, higher throughput and compatibility issues. An 802.11a compliant
> communications device may reside in the same WLAN as a device that is compliant
> with another 802.11 standard. When devices that are compliant with multiple
> versions of the 802.11 standard are in the same WLAN, the devices that are
> compliant with older versions are considered to be legacy devices. To ensure
> backward compatibility with legacy devices, specific mechanisms must be
> employed to insure that the legacy devices know when a device that is compliant
> with a newer version of the standard is using a wireless channel to avoid a collision.
> New implementations of wireless communication protocol enable higher speed
> throughput, while also enabling legacy devices which might be only compliant with
> 802.11a or 802.11g to communicate in Systems which are operating at higher
> speeds.

Ex. C at 1:59-2:17.

42.   The 802.11a and 802.11g standard utilize what is known as the orthogonal

frequency division multiplexing ("OFDM") encoding scheme. "OFDM is a frequency division

multiplexing modulation technique for transmitting large amounts of digital data over a radio

wave" and "works by spreading a single data stream over a band of Sub-carriers, each of which is

transmitted in parallel." Ex. C at 2:20-22.

43.   The 802.11 standard includes "training sequences" that synchronize data transfer

between a wireless sender and a receiver.

44.   The background section of the '629 Patent specifies the "need to create a long training sequence of minimum peak-to-average ratio that uses more Sub-carriers without interfering with adjacent channels." Ex. C at 2:46-48.

45.   The '629 Patent teaches a long training sequence of minimum peak-to average power ratio that is usable by "legacy devices in order to estimate channel impulse response and to estimate carrier frequency offset between a transmitter and a receiver." Ex. C at 2:50-52.

46.   One important technical advance and improvement offered by the inventive expanded long training sequence of minimum peak-to-average power ratio is "decrease[d] power back-off." Ex. C at 4:15-17. The invention may also "be used by 802.11a or 802.11g devices for estimating the channel impulse response and by a receiver for estimating the carrier frequency offset between the transmitter clock and receiver clock." Ex. C at 4:17-21. Further, the invention contributes to higher data throughout by carrying data on multiple subcarriers.

47.   The '629 Patent contains one independent claim and 30 total claims, covering various apparatuses. Claim 1 reads:

> 1. A wireless communications device, comprising:
>
>> a signal generator that generates an extended long training sequence; and
>>
>> an Inverse Fourier Transformer operatively coupled to the signal generator,
>>
>> wherein the Inverse Fourier Transformer processes the extended long training sequence from the signal generator and provides an optimal extended long training sequence with a minimal peak-to-average ratio, and
>>
>> wherein at least the optimal extended long training sequence is carried by a greater number of Subcarriers than a standard wireless networking configuration for an Orthogonal Frequency Division Multiplexing scheme
>>
>> wherein the optimal extended long training sequence is carried by exactly 56 active sub-carriers, and

wherein the optimal extended long training sequence is represented by encodings for indexed sub-carriers -28 to +28, excluding indexed sub-carrier 0 which is set to zero, as follows:

Sub-carrier	-28	-27	-26	-25	-24	-23	-22
Encoding	+1	+1	+1	+1	-1	-1	+1
Sub-carrier	-14	-13	-12	-11	-10	-9	-8
Encoding	+1	+1	+1	-1	-1	+1	+1
Sub-carrier	1	2	3	4	5	6	7
Encoding	+1	-1	-1	+1	+1	-1	+1
Sub-carrier	15	16	17	18	19	20	21
Encoding	+1	+1	-1	-1	+1	-1	+1
Sub-carrier	-21	-20	-19	-18	-17	-16	-15
Encoding	+1	-1	+1	-1	+1	+1	+1
Sub-carrier	-7	-6	-5	-4	-3	-2	-1
Encoding	-1	+1	-1	+1	+1	+1	+1
Sub-carrier	8	9	10	11	12	13	14
Encoding	-1	+1	-1	-1	-1	-1	-1
Sub-carrier	22	23	24	25	26	27	28
Encoding	-1	+1	+1	+1	+1	-1	-1.

48.   The above-disclosed claim limitations from the '629 Patent comprise various elements, including, *e.g.,* a signal generator and an Inverse Fourier Transformer. This claim, as a whole, provides significant benefits and improvements discussed previously that directly impact and improve interoperability with devices operating on legacy versions of the 802.11 standard, relative to the prior art.

C. U.S. Patent No. 8,416,862

49.   BNR is the owner by assignment of the '862 Patent. The '862 Patent is entitled "Efficient Feedback of Channel Information in a Closed Loop Beamforming Wireless Communication System." The '862 Patent issued on April 9, 2013. A true and correct copy of the '862 Patent is attached as Exhibit D.

50.   The inventors of the '862 Patent are Carlos Aldana and Joonsuk Kim.

51.   The '862 Patent, which was filed on September 28, 2005, is a continuation-in-part of U.S. Patent 7,738,583, filed on June 28, 2005. The '862 Patent also claims priority to at least

Provisional Application No. 60/673,451, filed on April 21, 2005, and Provisional Application No. 60/698,686, filed on July 13, 2005.

52.   The '862 Patent is generally related to wireless communication systems and more particularly to wireless communications using beamforming. Ex. D at 1:19–22.

53.   The description of related art section of the patent identifies that, to properly implement beamforming, the transmitter must know the properties of the channel over which the wireless communication is conveyed. Ex. D at 3:14–25. Further, the size of the feedback information required to be sent back to the transmitting wireless device may be so large that the channel may change before the entire feedback information is received by the transmitter. Ex. D at 3:14–25. One approach is to decompose the channel and send information only relating to a calculated value of the transmitter's beamforming matrix as the feedback information. But under this approach, even in a 2x2 MIMO wireless communication system, the data is still too large for practical application. Ex. D at 3:27–47.

54.   Thus, the '862 Patent identifies a need "for a method and apparatus for reducing beamforming feedback information in wireless communications." Ex. D at 3:49–51.

55.   The claimed inventions in the '862 Patent are directed to improved efficiencies in transmitting feedback of transmitter beamforming information, particularly using polar coordinates. Ex. D at 15:34–16:6. One of the important technical advantages and improvements offered by the inventive, improved feedback transmission is a decrease in the amount of data required to send the feedback information to the transmitting wireless transmitter. *See id.*

56.   The '862 Patent contains three independent claims and twenty total claims, covering various methods and systems. Claim 1 reads:

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1. A method for feeding back transmitter beamforming information from a receiving wireless communication device to a transmitting wireless communication device, the method comprising:

> the receiving wireless communication device receiving a preamble sequence from the transmitting wireless device;

> the receiving wireless device estimating a channel response based upon the preamble sequence;

> the receiving wireless device determining an estimated transmitter beamforming unitary matrix (V) based upon the channel response and a receiver beamforming unitary matrix (U);

> the receiving wireless device decomposing the estimated transmitter beamforming unitary matrix (V) to produce the transmitter beamforming information; and

> the receiving wireless device wirelessly sending the transmitter beamforming information to the transmitting wireless device.

57.   The above-disclosed claim limitations from the '862 Patent comprise various elements, including, *e.g.*, a receiving wireless device capable of determining an estimated transmitter beamforming unitary matrix, decomposing an estimated transmitter beamforming unitary matrix to produce transmitter beamforming information, and the ability to send the transmitter beamforming information to the transmitting wireless device. This claim, as a whole, provides significant benefits and improvements discussed previously that directly impact the ability to efficiently transmit beamforming feedback information to the transmitting wireless device, relative to the prior art.

D. **U.S. Patent Nos. 7,957,450 and 7,564,914**

58.   BNR is the owner by assignment of the '450 Patent. The '450 Patent is entitled "Method and System for Frame Formats for MIMO Channel Measurement Exchange." The '450 Patent issued on June 7, 2011. A true and correct copy of the '450 Patent is attached as Exhibit F.

59.   BNR is also the owner by assignment of the '914 Patent. The '914 Patent is entitled "Method and System for Frame Formats for MIMO Channel Measurement Exchange." The '914 Patent issued on July 21, 2009. A true and correct copy of the '914 Patent is attached as Exhibit E.

60.   The inventors of both the '450 and '914 Patents are Christopher Hansen, Carlos Aldana, and Joonsuk Kim.

61.   The '450 Patent, which was filed on July 20, 2009, is a continuation of the '914 Patent, which was filed on February 7, 2005. Both the '914 and '450 Patents claim priority Provisional Application No. 60/636,255, which was filed on December 14, 2004.

62.   The '450 and '914 Patents are generally related to "multiple antenna multiple output (MIMO) systems . . . in which mobile terminals incorporate smart antenna systems comprising multiple transmit antenna and multiple receive antenna." Ex. F at 1:54-57; *see also* Ex. E at 1:55-58. The specifications explain that "[s]ignal fading is a significant problem in wireless communications systems, often leading to temporary loss of communications at mobile terminals." Ex. F at 1:63-65; *see also* Ex. E at 1:65-67.

63.   The specifications also explain that "[o]ne of the most pervasive forms of fading is known as multipath fading, in which dispersion of transmitted signals due to incident reflections from buildings and other obstacles, results in multiple versions of the transmitted signals arriving at a receiving mobile terminal. The multiple versions of the transmitted signal may interfere with each other and may result in a reduced signal level detected at the receiving mobile terminal. When

versions of the transmitted signal are 180° out of phase they may cancel each other such that a signal level of 0 is detected. Locations where this occurs may correspond to 'dead zones' in which communication to the wireless terminal is temporarily lost." Ex. F at 1:65-2:9; *see also* Ex. E at 1:67-2:11.

64.   "Another important type of fading is related to motion. When a transmitting mobile terminal, or a receiving mobile terminal is in motion, the Doppler phenomenon may affect the frequency of the received signal. The frequency of the received signal may be changed by an amount which is a function of the velocity at which a mobile terminal is moving. Because of the Doppler effect, ISI may result when a mobile terminal is in motion, particularly when the mobile terminal is moving at a high velocity." Ex. F at 2:34-37; *see also* Ex. E at 2:37-40.

65.   In order to improve signal reception and reduce interference, certain wireless communication devices use beamforming technology, the aim of which is to focus the transmission of wireless signals in a specific direction to improve reception. Instead of broadcasting wireless signals uniformly in all directions, beamforming devices attempt to direct wireless signals to specific devices to achieve a better signal-to-noise ratio. Ex. F at 1:35-53; *see also* Ex. E at 1:35-54.

66.   "One of the challenges in beamforming is that the multiplicative scale factors which are applied to transmitted and received signals may be dependent upon the characteristics of the communications medium between the transmitting mobile terminal and the receiving mobile terminal. A communications medium, such as a radio frequency (RF) channel between a transmitting mobile terminal and a receiving mobile terminal, may be represented by a transfer system function, H. The relationship between a time varying transmitted signal, x(t), a time varying received signal, y(t), and the systems function may be represented as shown in equation [1]:

y(t)=H $_x$ x(t)+ n(t), where n(t) represents noise which may be introduced as the signal travels through the communications medium and the receiver itself. In MIMO systems, the elements in equation [1] may be represented as vectors and matrices. If a transmitting mobile terminal comprises M transmitting antenna, and a receiving mobile terminal comprises N receiving antenna, then y(t) may be represented by a vector of dimensions Nx1, x(t) may be represented by a vector of dimensions Mx1, n(t) by a vector of dimensions Nx1, and H may be represented by a matrix of dimensions NxM. In the case of fast fading, the transfer function, H, may itself become time varying and may thus also become a function of time, H(t). Therefore, individual coefficients, hij(t), in the transfer function H(t) may become time varying in nature." Ex. F at 3:49-4:9; *see also* Ex. E at 3:54-4:14.

67.   Beamforming is challenging because focusing the transmission of wireless signals must be adjusted as the relative positions of the transmitting and receiving wireless device positions change relative to one another. Thus, information about the RF channel used to transmit information must be adapted or else "information loss between the transmitting mobile terminal and the receiving mobile terminal may result." Ex. F at 4:22-24; *see also* Ex. E at 4:27-29.

68.   Existing methods and techniques, such as channel reciprocity, for estimating RF channel characteristics were insufficient because "differences in the electronic circuitry between the respective transmitting mobile terminal and receiving mobile terminal such that, in some cases, there may not be channel reciprocity." Ex. F at 5:16:25; *see also* Ex. E at 5:21-30.

69.   The '450 and '914 Patents address the shortcomings in the prior art by disclosing "a method for communicating information in a communication system [that] may comprise transmitting data via a plurality of radio frequency (RF) channels utilizing a plurality of transmitting antenna, receiving feedback information via at least one of the plurality of RF

channels, and modifying a transmission mode based on the feedback information. Feedback information may be requested utilizing at least one of the plurality of transmitting antenna via at least one of the plurality of RF channels. The number of transmitting antenna utilized during the transmitting of data may be modified based on the feedback information. The transmission characteristics of data transmitted via at least one of the plurality of transmitting antenna may be modified based on the feedback information. Specific feedback information may be requested in request messages." Ex. F at 5:56-6:3; *see also* Ex. E at 5:59-6:8.

70. Furthermore, the specifications disclose that "a receiving mobile terminal may perform a singular value decomposition (SVD) on the channel estimate matrix, and subsequently transmit SVD-derived feedback information to the transmitting mobile terminal. Utilizing SVD may increase the amount of computation required at the receiving mobile terminal but may reduce the quantity of information which is transmitted to the transmitting mobile terminal via the RF channel in comparison to transmitting the entire channel estimate matrix." Ex. F at 8:1-10; *see also* Ex. E at 8:5-14.

71. The '450 Patent contains four independent claims and 22 total claims, covering various methods and systems. Claim 1 reads:

> A method for communication, the method comprising:
>
>> computing a plurality of channel estimate matrices based on signals received by a mobile terminal from a base station, via one or more downlink RF channels, wherein said plurality of channel estimate matrices comprise coefficients derived from performing a singular value matrix decomposition (SVD) on said received signals; and
>>
>> transmitting said coefficients as feedback information to said base station, via one or more uplink RF channels.

72. The '914 Patent contains nine independent claims and 36 total claims, covering various methods and systems. Claim 13 reads:

A method for communicating information in a communication system, the method comprising:

receiving data via a plurality of RF channels utilizing a plurality of receiving antennas;

transmitting feedback information via at least one of said plurality of RF channels;

requesting modification of a transmission mode for subsequent received data in transmitted response messages comprising said feedback information;

transmitting said feedback information comprising channel estimates based on transmission characteristics of said received data via at least one of said plurality of receiving antennas; and

deriving said feedback information from mathematical matrix decomposition of said channel estimates.

73.   The above-disclosed claim limitations from the '450 and '914 Patents comprise various elements, including, *e.g.*, receiving data via a plurality of RF channels using a plurality of antennas, transmitting feedback information via at least one of the plurality of RF channels, requesting modification of a transmission mode in transmitted response messages comprising said feedback information, transmitting feedback information with channel estimates based on transmission characteristics of data received via at least one of the plurality of receiving antennas, deriving feedback information from mathematical matrix decomposition of channel estimates, and using SVD on received signals to do so. The claims, as a whole, provide significant benefits and improvements discussed previously that directly impact the ability to determine and use channel information, relative to the prior art.

E. U.S. Patent No. 6,963,129

74.   BNR is the owner by assignment of the '129 Patent. The '129 Patent is entitled "Multi-Chip Package Having a Contiguous Heat Spreader Assembly." The '129 Patent was filed

on June 18, 2003 and issued on November 8, 2005. A true and correct copy of the '129 Patent is

attached as Exhibit G.

75.   The inventors of the '129 Patent are Thomas Evans, Stan Mihelcic, Leah M. Miller,

Kumar Nagarajan, and Edwin M. Fulcher.

76.   The '129 Patent is generally related to packages with a heat spreader.

77.   The background of the '129 Patent describes the need for better heat transfer

mechanisms in semiconductor packages. *See, e.g.*, Ex. G at 2:23-26 (noting "the desired package

would also have better thermal characteristics by using an improved heat transfer mechanism.").

78.   The '129 Patent contains one independent claim and six total claims, each covering

a heat spreader assembly. Claim 1 reads:

> 1. A heat spreader assembly, comprising:
>
> > a single, unibody heat spreader configured to extend across substantially the
> > entire first surface of at least two spaced integrated circuits opposite a
> > second surface of the integrated circuits having a bonding pad;
> >
> > adhesive placed between the heat spreader and the first surface for securing
> > the heat spreader to the first surface of the integrated circuits at a spaced
> > distance above at least one passive device arranged in the area between the
> > spaced integrated circuits; and
> >
> > a second heat spreader interposed between the heat spreader and only one
> > of the at least two spaced integrated circuits.

79.   The above-disclosed claim from the '129 Patent provides significant benefits and

improvements to the thermal characteristics of semiconductor packages. For example, by securing

the unibody heat spreader at a spaced distance above a passive device, "[t]he space beneficially

allows greater thermal transfer at the underneath surface of the heat spreader between neighboring

integrated circuits and above any passive devices within that space." Ex. G at 3:10-13; *see also id.*

at 3:26-29 ("By using a heat spreader and purposely applying an air-filled gap or space between

neighboring integrated circuits, greater thermal transfer efficiency can be obtained.").

F. U.S. Patent No. 6,858,930

80.   BNR is the owner by assignment of the '930 Patent. The '930 Patent is entitled "Multi Chip Module." The '930 Patent was filed on August 11, 2003, and is a divisional of the application leading to U.S. Patent No. 6,680,532, which was filed on October 7, 2002. The '930 Patent issued on February 22, 2005. A true and correct copy of the '930 Patent is attached as Exhibit H.

81.   The inventors of the '930 Patent are Leah M. Miller and Kishor Desai.

82.   The '930 Patent generally relates to semiconductor packaging.

83.   The '930 Patent describes the need to address the problems of "heat production and package flexibility" that constrain certain aspects of package design. Ex. H at 1:33-35.

84.   The '930 Patent describes how the invention allows for improved heat dissipation in the package through the use of separate heat spreaders, which improves heat dissipation from the package. *See* Ex. H at 2:16-19.

85.   The '930 Patent contains four independent claims and eighteen total claims, covering semiconductor packages. Claim 1 reads:

> 1. A multi chip package, comprising:
>
>> a package substrate having a first side and an opposing second side, the first side for receiving package electrical connections,
>>
>> integrated circuits each having a first side and an opposing second side, the first side of each of the integrated circuits electrically connected and structurally connected to the second side of the package substrate,
>>
>> heat spreaders each having a first side and an opposing second side, the first side of each of the heat spreaders disposed adjacent the second side of the integrated circuits, where one each of the heat spreaders is associated with one each of the integrated circuits,
>>
>> a single stiffener having a first side and an opposing second side, the stiffener covering all of the integrated circuits and heat spreaders, the first

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side of the stiffener disposed adjacent the second side of the heat spreaders, and

discrete components electrically connected to the second side of the package substrate and coplanar with the integrated circuits.

86.   The above-disclosed claim provides significant benefits and improvements to the heat dissipation and structural support in semiconductor packages, relative to the prior art.

G. U.S. Patent No. 7,039,435

87.   BNR is the owner by assignment of the '435 Patent. The '435 Patent is entitled "Proximity Regulation System for Use with a Portable Cell Phone and a Method of Operation Thereof." The '435 Patent issued on May 2, 2006. A true and correct copy of the '435 Patent is attached as Exhibit I.

88.   The inventors of the '435 Patent are Richard McDowell and Philip Mooney.

89.   The application that resulted in the issuance of the '435 Patent was filed on September 28, 2001.

90.   The '435 Patent is generally related to a proximity regulation system and associated methods that adjust transmit power for a portable cell phone under certain conditions. The specification explains the following:

> To address the [] deficiencies of the prior art, the present invention provides a proximity regulation system for use with a portable cell phone. In one embodiment, the proximity regulation system includes a location sensing subsystem that is configured to determine a location of the portable cell phone proximate a user. A power governing subsystem is coupled to the location sensing subsystem and configured to determine a proximity transmit power level of the portable cell phone based on the location.

Ex. I at 2:1-11.

91.   The background section of the '435 Patent describes the shortcomings of the prior art:

Typically, the quality of service of a cell phone is proportional to the transmit power level of the cell phone. Though no definite proof has been determined, health concerns have arisen due to the power used to transmit the radio frequency of cell phones when operated close to the body of a cell phone user. . . . Cell phone users still want the best possible quality of service from their cell phone. However, health concerns regarding the transmit power of cell phones are now beginning to affect some users. Manufacturers have tried several options to relieve the fears of consumers. One such option involves permanently reducing the power of the transmitter in cellphones. Though this may be perceived as a safety advantage to some customers, unfortunately, this also reduces the quality of service of the cell phone. Another option for consumers is the use of cell phones with a base that typically allows a higher transmit power level of up to three watts….These type of cell phones, however, do not allow the flexibility demanded by consumers that is found in the use of a portable cell phone.

Ex. I at 1:33-62.

92.   The '435 Patent identifies the need "in the art [for] a system and method to automatically reduce the transmit power level of a portable cell phone when located near a human body thereby decreasing the perception of health risks associated with the use thereof." Ex. I at 1:62-67.

93.   The '435 Patent addresses that need by allowing for adjustment of a power governing subsystem based on a location sensing subsystem, to determine a proximity transmit power level of a cell phone based on location. *See, e.g.,* Ex. I at 2:1-39.

94.   The '435 Patent contains one independent claim and nine total claims, covering portable cell phone apparatuses. Claim 1 reads:

> 1. A portable cell phone, comprising:
>
>> a power circuit that provides a network adjusted transmit power level as a function of a position to a communications tower, and
>>
>> a proximity regulation system, including:
>>
>> a location sensing subsystem that determines a location of said portable cell phone
>>
>> proximate a user; and

a power governing subsystem, coupled to said location sensing subsystem, that determines a proximity transmit power level of said portable cell phone based on said location and determines a transmit power level for said portable cell phone based on said network adjusted transmit power level and said proximity transmit power level.

95.   The above-disclosed claim limitations from the '435 Patent comprise various elements, including, *e.g.,* a proximity regulation system that contains both a location sensing subsystem to determine location proximate a user and a power governing subsystem that adjusts the transmit power level of a cell phone based on location. This claim, as a whole, provides significant benefits and improvements discussed previously that relate to adjusting power levels to address certain health concerns and save battery power.

H. **U.S. Patent No. 8,396,072**

96.   BNR is the owner by assignment of the '072 Patent. The '072 Patent is entitled "Method and Apparatus for Channel Traffic Congestion Avoidance in a Mobile Communication System." The '072 Patent issued on March 12, 2013. A true and correct copy of the '072 Patent is attached as Exhibit J.

97.   The inventors of the '072 Patent are Harri Jokinen, David Navratil, and Simon Davis.

98.   The application associated with the '072 Patent was filed on February 21, 2011.

99.   The '072 Patent discloses techniques for dealing with congestion in mobile communication systems. Specifically, the '072 Patent addresses the situation where mobile devices lack information regarding why a base station has not permitted it to use a particular channel. To address this problem, the '072 Patent provides a technique where a mobile device can monitor the traffic on a channel and will only make requests to use the channel upon learning that there is no congestion.

25

100.   The '072 Patent contains three independent claims and twenty-one total claims,

covering various methods and systems. Claim 1 reads:

> 1. An apparatus for use in controlling congestion in a cell of a communications network, the apparatus comprising:
>
>> at least one controller and a memory storing a computer program which are configured to:
>>
>> receive and read a series of blocks on a first channel;
>>
>> determine whether there is congestion based on whether said series of blocks comprises a flag indicating that there is congestion, wherein the flag is in at least one of an IMMEDIATE ASSIGNMENT message or an IMMEDIATE ASSIGNMENT REJECT message; and
>>
>> in the event that the determination is that there is no congestion, initiate an access procedure by transmitting a channel request on a second channel.

101.   The above-disclosed claim limitations from the '072 Patent comprise various

elements, including, *e.g.,* an apparatus that determines if there is congestion based on whether a

series of blocks comprise a flag indicating congestion and then initiating an access procedure in

the event that no congestion exists. This claim, as a whole, provides significant benefits and

improvements discussed previously that relate to avoiding and/or reducing channel traffic

congestion in a mobile communication system.

FIRST CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 8,204,554

102.   BNR re-alleges and incorporates by reference the allegations of the foregoing

paragraphs as if fully set forth herein.

103.   The '554 Patent is valid and enforceable under United States Patent Laws.

104.   BNR owns, by assignment, all right, title, and interest in and to the '554 Patent,

including the right to collect for past damages.

105.   A copy of the '554 Patent is attached as Exhibit A.

'554 Patent Allegations

106.   Apple designs, makes, sells, and currently uses devices that include a proximity sensor. The proximity sensor in Apple's products, including the iPhone and iPad (the "'554 Infringing Products"), detects when a mobile device user (i) is on a call and (ii) has his or her mobile device positioned proximal to their face, ear, or cheek. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing the proximity sensor functionality); https://support.apple.com/kb/SP770?locale=en_US (identifying the "[p]roximity sensor" as one of the technical specifications for the iPhone X); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a (discussing the proximity sensor functionality on an iPhone); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone#:~:text=Your%20iPhone's%20proximity%20sensor%20can,grime%2C%20or%20a%20software%20issue (same); https://discussions.apple.com/thread/8341968 (same); https://developer.apple.com/documentation/uikit/uidevice#//apple_ref/occ/instp/UIDevice/proximityState. When these conditions are detected, the display screen on the mobile device goes dark, which results in battery power savings and prevents the user from accidentally selecting buttons on the screen during an ongoing call.

107.   On information and belief after a reasonable investigation, the '554 Infringing Products infringe the '554 Patent. The '554 Infringing Products are mobile stations that include a display. For instance, the Apple iPhone X is a mobile device that includes a Super Retina HD display, also described by Apple as an "all-screen OLED Multi-Touch display" or "HDR display." *See, e.g.*, https://help.apple.com/iphone/11/#/iphca3d8b4e3 (iPhone User Guide discussing the

Home screen display); https://support.apple.com/kb/SP770?locale=en_US (outlining the technical specification of the iPhone X display).

108.   The '554 Infringing Products also include a proximity sensor adapted to generate a signal indicative of the existence of a first condition, the first condition being that an external object is proximate. For instance, the Apple iPhone X includes a proximity sensor that is adapted to generate a signal indicating whether one's face, ear, or cheek is proximate. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing the proximity sensor functionality); https://support.apple.com/kb/SP770?locale=en_US (identifying the "[p]roximity sensor" as one of the technical specifications for the iPhone X); https://www.ifixit.com/Teardown/iPhone+X+Teardown/98975 (noting that the iPhone X includes an "A11 'Bionic' chip with neural engine and embedded M11 motion coprocessor"); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a (discussing how to fix or reset the proximity sensor on an iPhone); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone#:~:text=Your%20iPhone's%20proximity%20sensor%20can,grime%2C%20or%20a%20software%20issue (same); https://discussions.apple.com/thread/8341968 (same).

109.   The '554 Infringing Products also include a microprocessor that is adapted to determine, without using the proximity sensor, the existence of a second condition independent and different from the first condition, the second condition being that a user of the mobile station has performed an action to initiate an outgoing call or to answer an incoming call. For instance, the Apple iPhone X has a microprocessor that is adapted to determine whether a user has performed an action to initiate or receive a call. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-

not-working-screen-is-not-going-black-fix/ ("Your iPhone uses the proximity sensor to detect the presence of your face, ear and cheek when you are on a call."); https://discussions.apple.com/thread/8341968 (noting that the "[p]roximity sensor should ideally work when we answer phones."); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a; https://support.apple.com/guide/iphone/answer-or-decline-incoming-calls-iph3c9947bf/ios (explaining how users answer or decline incoming calls); https://support.apple.com/guide/iphone/make-a-call-iph3c993cbc/ios (explaining how users make outgoing calls).

110.   The '554 Infringing Products' microprocessor is adapted to activate the proximity sensor in response to a determination that the second condition exists. For instance, the Apple iPhone X's microprocessor is adapted to activate the proximity sensor if the user has performed an action to initiate/receive a call. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/; https://discussions.apple.com/thread/8341968 (noting that the proximity sensor should cause the screen to go black when a user answers the phone); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a (noting that the proximity sensor is "usually used for dimming the screen to preserve battery while [a] user is answering a phone call").

111.   The '554 Infringing Products' microprocessor is adapted to receive the signal from the activated proximity sensor. For instance, the Apple iPhone X's microprocessor is adapted to receive a signal from the activated proximity sensor. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing that activation of the proximity sensor "save[s] battery life by turning off the screen light"); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9 (discussing that the proximity sensor "is

usually used for dimming the screen to preserve battery while [a] user is answering a phone call");

https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone   ("Your   iPhone's

proximity sensor can tell when you're holding the phone up to your ear, and it will shut off the

screen, saving battery and preventing your face from accidentally hitting buttons.");

https://discussions.apple.com/thread/8341968 (same).

112.   The '554 Infringing Products' microprocessor is adapted to reduce power to the

display if the signal from the activated proximity sensor indicates that the first condition exists.

For instance, the Apple iPhone X's microprocessor will reduce power to the display if the signal

from the activated proximity sensor indicates that the Apple iPhone is proximate to the user's face,

ear, or cheek. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-

not-going-black-fix/ (discussing that the "iPhone uses the proximity sensor to detect the presence

of [a user's] face, ear or cheek" and does so to "[r]educe display power consumption");

https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9 (discussing that the

proximity sensor "is usually used for dimming the screen to preserve battery while [a] user is

answering a phone call"); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-

iphone ("Your iPhone's proximity sensor can tell when you're holding the phone up to your ear,

and it will shut off the screen, saving battery and preventing your face from accidentally hitting

buttons."); https://discussions.apple.com/thread/8341968 (same).

113.   Apple has infringed and is infringing, individually and/or jointly, either literally or

under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '554 Patent in

violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for

sale, selling, offering for lease, leasing in the United States, and/or importing into the United States

without authority or license, the '554 Infringing Products.

114.   Apple's infringement is knowing, egregious, consciously wrongful, and willful. Apple learned of its infringement of the '554 Patent no later than June 1, 2018. On June 1, 2018, Mr. Afzal Dean, President of BNR, sent a letter to Mr. Tim Cook, CEO of Apple. Mr. Dean's letter informed Mr. Cook that Apple was selling products that implemented features claimed in BNR's patents. The June 1, 2018 letter specifically identified the '554 Patent as one of BNR's "[e]xemplary patents relevant to mobile handsets, tablets and laptops[.]" The letter specifically called out several of Apple's then-current products, such as the "iPhone X, iPad Pro, MacBook Air, MacBook Pro, iMac Pro." Despite receiving this letter, Apple continued to infringe the '554 Patent by continuing to make, use, sell, and/or offer to sell the '554 Infringing Products in the United States.

115.   Apple's infringement of the '554 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

116.   Apple's infringement of the '554 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

117.   BNR has been damaged by Apple's infringement of the '554 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

118.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '554 Patent, including without limitation and/or not less than a reasonable royalty.

SECOND CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 7,319,889

119.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

120.   The '889 Patent is valid and enforceable under United States Patent Laws.

121.   BNR owns, by assignment, all right, title, and interest in and to the '889 Patent, including the right to collect for past damages.

122.   A copy of the '889 Patent is attached as Exhibit B.

'889 Patent Allegations

123.   Apple designs, makes, sells, and currently uses devices that include a proximity sensor. The proximity sensor on Apple's products, including the iPhone and iPad (the "'889 Infringing Products"), detects when a mobile device user (i) is on a call and (ii) has his or her mobile device positioned proximal to an external object, such as the user's face, ear, or cheek. *See, e.g.,* https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing   the   proximity   sensor   functionality); https://support.apple.com/kb/SP770?locale=en_US (identifying the "[p]roximity sensor" as one of the technical specifications for the iPhone X); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a   (discussing the proximity sensor functionality on an iPhone);   https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone#:~:text=Your%20iPhone's%20proximity%20sensor%20can,grime%2C%20or%20a%20software%20issue   (same);   https://discussions.apple.com/thread/8341968   (same); https://developer.apple.com/documentation/uikit/uidevice#//apple_ref/occ/instp/UIDevice/proximityState . When these conditions are detected, the display screen on the mobile device goes dark,

which results in battery power savings and prevents the user from accidentally selecting buttons on the screen during an ongoing call.

124.   On information and belief after a reasonable investigation, the '889 Infringing Products infringe the '889 Patent. The '889 Infringing Products are mobile stations that include a display. For instance, the Apple iPhone X is a mobile device that includes a Super Retina HD display, also described by Apple as an "all-screen OLED Multi-Touch display" or "HDR display." *See, e.g.*, https://help.apple.com/iphone/11/#/iphca3d8b4e3 (iPhone User Guide discussing the Home screen display); https://support.apple.com/kb/SP770?locale=en_US (outlining the technical specification of the iPhone X display).

125.   The '889 Infringing Products also include a proximity sensor adapted to generate a signal indicative of proximity of an external object. For instance, the Apple iPhone X includes a proximity sensor that detects the presence of one's face, ear, or cheek. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing the proximity sensor functionality); https://support.apple.com/kb/SP770?locale=en_US (identifying the "[p]roximity sensor" as one of the technical specifications for the iPhone X); https://www.ifixit.com/Teardown/iPhone+X+Teardown/98975 (noting that the iPhone X includes an "A11 'Bionic' chip with neural engine and embedded M11 motion coprocessor"); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a (discussing how to fix or reset the proximity sensor on an iPhone); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone#:~:text=Your%20iPhone's%20proximity%20sensor%20can,grime%2C%20or%20a%20software%20issue (same); https://discussions.apple.com/thread/8341968 (same).

126.   The '889 Infringing Products also include a microprocessor that is adapted to determine whether a telephone call is active. For instance, the Apple iPhone X determines whether a user has pressed the call or answer button to initiate an active call. *See, e.g.,* https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ ("Your iPhone uses the proximity sensor to detect the presence of your face, ear and cheek when you are on a call."); https://discussions.apple.com/thread/8341968 (noting that the "[p]roximity sensor should ideally work when we answer phones."); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a.

127.   The '889 Infringing Products' microprocessor is adapted to receive the signal from the proximity sensor. For instance, once the call button is pressed and the mobile device is moved closer to the head, the Apple iPhone X's display goes dark indicating that the microprocessor has ultimately received a signal from the proximity sensor. *See, e.g.,* https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/; https://discussions.apple.com/thread/8341968 (noting that the proximity sensor should cause the screen to go black when a user answers the phone); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a (noting that the proximity sensor is "usually used for dimming the screen to preserve battery while [a] user is answering a phone call").

128.   The '889 Infringing Products' microprocessor is adapted to reduce power to the display if (i) the microprocessor determines that a telephone call is active and (ii) the signal indicates the proximity of the external object. For instance, after a user presses the call or answer button to initiate a wireless telephone call and moves the mobile device closer to his or head, the display on the Apple iPhone X goes dark, indicating that the display has reduced power. *See, e.g.,* https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/

(discussing that activation of the proximity sensor "save[s] battery life by turning off the screen light"); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9 (discussing that the proximity sensor "is usually used for dimming the screen to preserve battery while [a] user is answering a phone call"); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone ("Your iPhone's proximity sensor can tell when you're holding the phone up to your ear, and it will shut off the screen, saving battery and preventing your face from accidentally hitting buttons."); https://discussions.apple.com/thread/8341968 (same); https://support.apple.com/kb/SP770?locale=en_US (identifying the "Cellular and Wireless" technical specifications for the iPhone X).

129.   The '889 Infringing Products' microprocessor reduces power to the display while the signal indicates the proximity of the external object only if the microprocessor determines that the wireless telephone call is active. For instance, the Apple iPhone X's display will go dark if the iPhone is proximate to an external object only if the microprocessor determines there is an active wireless telephone call. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing that the "iPhone uses the proximity sensor to detect the presence of [a user's] face, ear or cheek" and does so to "[r]educe display power consumption"); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9 (discussing that the proximity sensor "is usually used for dimming the screen to preserve battery while [a] user is answering a phone call"); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone ("Your iPhone's proximity sensor can tell when you're holding the phone up to your ear, and it will shut off the screen, saving battery and preventing your face from accidentally hitting buttons."); https://discussions.apple.com/thread/8341968 (same);

https://support.apple.com/kb/SP770?locale=en_US (identifying the "Cellular and Wireless" technical specifications for the iPhone X).

130.   The '889 Infringing Products' proximity sensor begins detecting whether an external object is proximate substantially concurrently with the mobile station initiating an outgoing wireless telephone call or receiving an incoming wireless telephone call. For instance, the Apple iPhone X's proximity sensor will detect whether an external object is proximate substantially concurrently with initiation of an outgoing call or reception of an incoming call. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing that the "iPhone uses the proximity sensor to detect the presence of [a user's] face, ear or cheek" and does so to "[r]educe display power consumption"); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9 (discussing that the proximity sensor "is usually used for dimming the screen to preserve battery while [a] user is answering a phone call"); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone ("Your iPhone's proximity sensor can tell when you're holding the phone up to your ear, and it will shut off the screen, saving battery and preventing your face from accidentally hitting buttons."); https://discussions.apple.com/thread/8341968 (same); https://support.apple.com/kb/SP770?locale=en_US (identifying the "Cellular and Wireless" technical specifications for the iPhone X).

131.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, one or more claims (*e.g.,* claim 1) of the '889 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '889 Infringing Products.

132.   Apple's infringement is knowing, egregious, consciously wrongful, and willful. Apple learned of its infringement of the '889 Patents no later than June 1, 2018. On June 1, 2018, Mr. Afzal Dean, President of BNR, sent a letter to Mr. Tim Cook, CEO of Apple. Mr. Dean's letter informed Mr. Cook that Apple was selling products that implemented features claimed in BNR's patents. The June 1, 2018 letter specifically identified the '889 Patent as one of BNR's "[e]xemplary patents relevant to mobile handsets, tablets and laptops[.]" The letter specifically called out several of Apple's then-current products, such as the "iPhone X, iPad Pro, MacBook Air, MacBook Pro, iMac Pro." Despite receiving this letter, Apple continued to infringe the '889 Patent by continuing to make, use, sell, and/or offer to sell the '889 Infringing Products in the United States.

133.   Apple's infringement of the '889 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

134.   Apple's infringement of the '889 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

135.   BNR has been damaged by Apple's infringement of the '889 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

136.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '889 Patent, including without limitation and/or not less than a reasonable royalty.

THIRD CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. RE 48,629

137.   BNR re-alleges and incorporates by reference the allegations of the foregoing

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paragraphs as if fully set forth herein.

138.   The '629 Patent is valid and enforceable under United States Patent Laws.

139.   BNR owns, by assignment, all right, title, and interest in and to the '629 Patent, including the right to collect for past damages.

140.   A copy of the '629 Patent is attached as Exhibit C.

'629 Patent Allegations

141.   Apple designs, makes, sells, and currently uses devices that operate according to the 802.11ac standard, including its iPhone, iPad, iPod, Mac line, Apple TV products, and the Apple Watch line (the "'629 Infringing Products"). *See* https://support.apple.com/guide/deployment-reference-ios/wi-fi-specifications-iphone-ipad-ipod-touch-ior65f75e248/web (stating that the iPhone, iPad, and iPod touch are compatible with 802.11n); https://support.apple.com/guide/deployment-reference-macos/wi-fi-specifications-for-mac-computers-ior1faf9de44/web#:~:text=Wi%2DFi%20specification%20details%20for,2.4%20GHz%20or%205%20GHz (stating that the Mac line is compatible with 802.11n); https://support.apple.com/guide/deployment-reference-ios/wi-fi-specifications-for-apple-tv-apd7cc1c76ff/web#:~:text=Wi%2DFi%20specification%20details%20for,the%20appendixes%20for%20Apple%20TV.&text=802.11%20compatibility%20and%20frequency%20band,transmit%20data%20over%20Wi%2DFi (stating that the Apple TV products are compatible with 802.11n); https://support.apple.com/en-us/HT204562 (stating that the Apple Watch line is compatible with 802.11n). The 802.11n standard was introduced on or about October 2009, and provides a definition for a High Throughput Long Training Field ("HT-LTF"). The first part of the HT-LTF "consists of one, two, or four HT-LTFs that are necessary for demodulation of the HT-Data portion of the PPDU" (*i.e.,*

Protocol Data Unit). The 802.11n standard provides a specific HT-LTF sequence that is transmitted in the case of 20 MHz operation. *See* 802.11-2016 at 19.3.9.4.6 or 802.11-2009 at 20.3.9.4.6.

142.   On information and belief after a reasonable investigation, the '629 Infringing Products infringe the '629 Patent. The '629 Infringing Products are mobile stations that include a signal generator that generates an extended long training sequence. For instance, the Apple iPhone 12 is 802.11n compliant, and therefore uses a specific HT-LTF sequence that is transmitted in the case of 20 MHz operation. *See* 802.11-2016 at 19.3.9.4.6 or 802.11-2009 at 20.3.9.4.6. This corresponds to the long training sequence with minimum peak-to-average power ratio described in the '629 Patent. *See id.* Devices operating in accordance with the 802.11n standard (known as "wireless stations" or "STAs") must be able to generate the HT-LTF described.

143.   The '629 Infringing Products include an Inverse Fourier Transformer operatively coupled to the signal generator. For instance, the Apple iPhone 12 is 802.11n compliant, and therefore uses an encoding process that requires an inverse Fourier transformer. *See* 802.11-2016 and 19.3.4(b) or 802.11-2009 at 20.3.4(b).

144.   The '629 Infringing Products include an Inverse Fourier Transformer (as explained above) that processes the extended long training sequence from the signal generator and provides an optimal extended long training sequence with a minimal peak-to-average ratio. For instance, the Apple iPhone 12 is 802.11n compliant, and therefore processes the HT-LTF training sequence from the signal generator. *See* 802.11-2016 at Figure 19-9 and 19.3.9.4.6. The Apple iPhone 12 also provides an optimal HT-LTF training sequence with a minimal peak-to-average ratio. *See* 802.11-2016 at 19.3.9.4.6 at Equation 19-23.

145.   The '629 Infringing Products also include an optimal extended long training

sequence (as explained above) that is carried by a greater number of subcarriers than a standard wireless networking configuration for an OFDM scheme. For instance, the Apple iPhone 12 is 802.11n compliant, and therefore includes an optimal HT-LTF training sequence that is carried by a greater number of subcarriers than is standard for an OFDM scheme. *See* 802.11-2016 at 19.3.9.4.6 at Equation 19-23 and additional subcarriers noted therein as compared to L-LT.

146.   The '629 Infringing Products also include an optimal extended long training sequence (as explained above) that is carried by exactly 56 active subcarriers. For instance, the Apple iPhone 12 is 802.11n compliant, and therefore includes an optimal HT-LTF training sequence that is carried by 56 active subcarriers. *See* 802.11-2016 at 19.3.9.4.6.

147.   The '629 Infringing Products also include an optimal extended long training sequence (as explained above) that is represented by encodings for indexed subcarriers -28 to +28, excluding indexed subcarrier 0 which is set to zero, as follows:

Sub-carrier	-28	-27	-26	-25	-24	-23	-22
Encoding	+1	+1	+1	+1	-1	-1	+1
Sub-carrier	-14	-13	-12	-11	-10	-9	-8
Encoding	+1	+1	+1	-1	-1	+1	+1
Sub-carrier	1	2	3	4	5	6	7
Encoding	+1	-1	-1	+1	+1	-1	+1
Sub-carrier	15	16	17	18	19	20	21
Encoding	+1	+1	-1	-1	+1	-1	+1
Sub-carrier	-21	-20	-19	-18	-17	-16	-15
Encoding	+1	-1	+1	-1	+1	+1	+1
Sub-carrier	-7	-6	-5	-4	-3	-2	-1
Encoding	-1	+1	-1	+1	+1	+1	+1
Sub-carrier	8	9	10	11	12	13	14
Encoding	-1	+1	-1	-1	-1	-1	-1
Sub-carrier	22	23	24	25	26	27	28
Encoding	-1	+1	+1	+1	+1	-1	-1.

For instance, the Apple iPhone 12 is 802.11n compliant, and therefore includes an optimal HT-LTF training sequence that is represented by encodings for indexed subcarriers -28 to +28, excluding indexed subcarrier 0 according to the chart above. *See* 802.11-2016 at 19.3.9.4.6 at Equation 19-23.

148.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '629 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '629 Infringing Products.

149.   Apple has been, and currently is, an active inducer of infringement of one or more claims of the '629 Patent under 35 U.S.C. § 271(b). On information and belief, one or more of the '629 Infringing Products directly and/or indirectly infringe (by induced infringement) at least one or more claims (*e.g.,* claim 1) of the '629 Patent, literally and/or under the doctrine of equivalents.

150.   Apple intentionally encourages and aids at least its users to directly infringe the '629 Patent.

151.   Apple provides the '629 Infringing Products and instructions to its users such that they will use the '629 Infringing Products in a directly infringing manner. Apple markets the '629 Infringing Products to its users and provides instructions to its users on how to use the functionality of the '629 Patent on its website and elsewhere. *See, e.g.,* https://support.apple.com/guide/deployment-reference-ios/roaming-iorf0c4eb390/1/web/1.0; https://support.apple.com/guide/deployment-reference-ios/iphone-wi-fi-specification-details-apd1c22e481c/web; https://support.apple.com/en-us/HT202639; https://support.apple.com/en-us/HT201974; https://support.apple.com/en-us/HT204400; https://support.apple.com/en-us/HT204562.

152.   Apple users directly infringe by using the '629 Infringing Products in their intended manner. Apple induces such infringement by providing the '629 Infringing Products and instructions to enable and facilitate infringement. On information and belief, Apple specifically

intends that its actions will result in infringement of the '629 Patent or has taken deliberate actions to avoid learning of infringement.

153.   Apple's infringement is knowing, egregious, consciously wrongful, and willful. Apple learned of its infringement of the '842 Patent, which the '629 Patent reissued from, no later than June 1, 2018. On June 1, 2018, Mr. Afzal Dean, President of BNR, sent a letter to Mr. Tim Cook, CEO of Apple. Mr. Dean's letter informed Mr. Cook that Apple was selling products that implemented features claimed in BNR's patents. The June 1, 2018 letter specifically identified the '842 Patent as one of BNR's "[e]xemplary patents relevant to mobile handsets, tablets and laptops[.]" The letter specifically called out several of Apple's then-current products, such as the "iPhone X, iPad Pro, MacBook Air, MacBook Pro, iMac Pro." Despite receiving this letter, Apple continued to infringe the '842 Patent, and now the '629 Patent, by continuing to make, use, sell, and/or offer to sell the '629 Infringing Products in the United States.

154.   Apple's infringement of the '629 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

155.   Apple's infringement of the '629 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

156.   BNR has been damaged by Apple's infringement of the '629 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

157.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '629 Patent, including without limitation and/or not less than a reasonable royalty.

FOURTH CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 8,416,862

158.   BNR re-alleges and incorporates by reference the allegations of the foregoing

paragraphs as if fully set forth herein.

159.   The '862 Patent is valid and enforceable under United States Patent Laws.

160.   BNR owns, by assignment, all right, title, and interest in and to the '862 Patent,

including the right to collect for past damages.

161.   A copy of the '862 Patent is attached as Exhibit D.

'862 Patent Allegations

162.   Apple designs, makes, sells, and currently uses devices that operate according to

the 802.11ac standard, including its iPhone, iPad, iPod, Mac line, and Apple TV products (the

"'862 Infringing Products"). *See* https://support.apple.com/guide/deployment-reference-ios/wi-fi-

specifications-iphone-ipad-ipod-touch-ior65f75e248/web (stating that the iPhone, iPad, and iPod

touch are compatible with 802.11ac); https://support.apple.com/guide/deployment-reference-

macos/wi-fi-specifications-for-mac-computers-ior1faf9de44/web#:~:text=Wi%

2DFi%20specification%20details%20for,2.4%20GHz%20or%205%20GHz (stating that the Mac

line is compatible with 802.11ac); https://support.apple.com/guide/deployment-reference-ios/wi-

fi-specifications-for-apple-tv-apd7cc1c76ff/web#:~:text=Wi%2DFi%20

specification%20details%20for,the%20appendixes%20for%20Apple%20TV.&text=802.11%20c

ompatibility%20and%20frequency%20band,transmit%20data%20over%20Wi%2DFi   (stating

that the Apple TV products are compatible with 802.11ac). The 802.11ac standard was introduced

on or about December 2013. The 802.11ac standard provides a definition and standardization for

channel sounding for beamforming for Multiple Input Multiple Output ("MIMO") RF radio links,

including how a receiving wireless device communicates channel sounding to a base station. Beamforming requires the use of a steering matrix that improves the reception to the beamformee. The 802.11ac standard provides a specific way to compress the beamforming feedback matrix by the beamformee, and how to determine and decompose the estimated transmitter beamforming unitary matrix and compressed into angles for efficient transmission to the beamformer, which generates a next steering matrix. *See* 802.11-2016 at 21.1.1 & 19.3.12 or 802.11-2013 at 22.1.1 & 20.3.12.

163.   On information and belief after a reasonable investigation, the '862 Infringing Products infringe the '862 Patent. The '862 Infringing Products perform a method for feeding back transmitter beamforming information from a receiving wireless communication device to a transmitting wireless communication device. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device that uses beamforming. Devices implementing beamforming according to 802.11ac and 802.11n provide compressed beamforming feedback to a beamformer. *See* 802.11-2016 at 21.1.1 & 19.3.12 or 802.11-2013 at 22.1.1 & 20.3.12.

164.   The '862 Infringing Products include a receiving wireless communication device that receive a preamble sequence from a transmitting wireless device. For instance, the Apple iPhone 12 includes a number of RF components that are operable to receive and convert RF signals to baseband signals, and includes a baseband processing module:
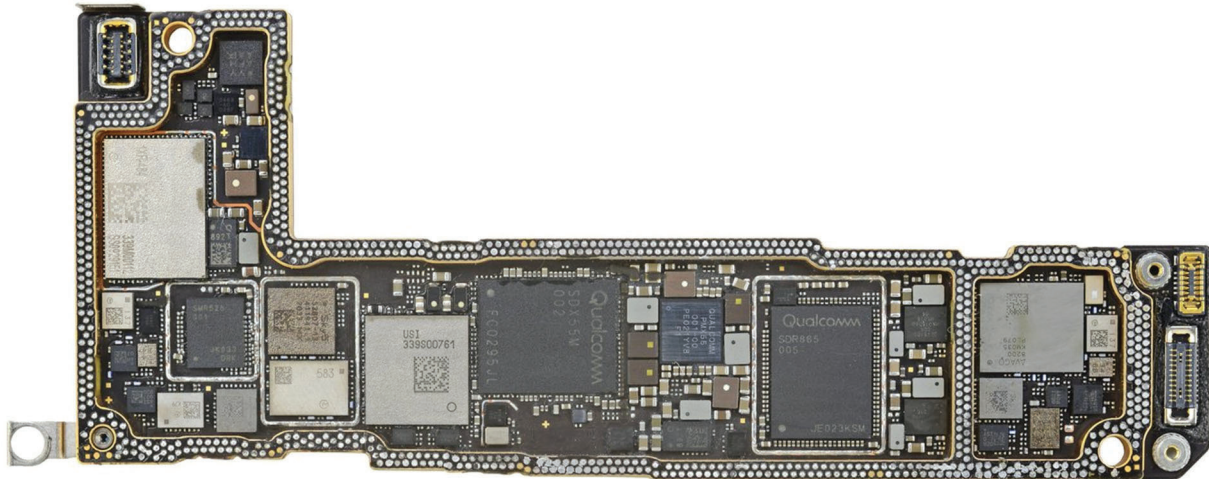
https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669.   Moreover,   the

Apple iPhone 12 is an 802.11ac compliant wireless device, and therefore receives a PHY preamble

with HT-LTFs from a beamformer. *See* 802.11-2016 at 21.1.1 & 19.3.13.1 or 802.11-2013 at

22.1.1 & 20.3.13.1.

165.   The '862 Infringing Products include a receiving wireless communication device

that estimates a channel response based upon the preamble sequence. For instance, the Apple

iPhone 12 is an 802.11ac compliant wireless device, and therefore measures the channel as a result

of receiving the HT-LTF's which are part of the PHY preamble. *See* 802.11-2016 at 21.1.1 &

19.3.13.1 or 802.11-2013 at 22.1.1 & 20.3.13.1

166.   The '862 Infringing Products include a receiving wireless communication device

that determines an estimated transmitter beamforming unitary matrix (V) based upon the channel

response and a receiver beamforming unitary matrix (U). For instance, the Apple iPhone 12 is an

802.11ac compliant wireless device, and therefore calculates a beamforming unitary matrix V

based on a singular value decomposition of the channel response H=UDV*, where D is a diagonal

matrix and U is a receiver unitary matrix. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.6 or 802.11-2013

at 22.1.1 & 20.3.12.3.6.

167.   The '862 Infringing Products include a receiving wireless communication device that decomposes the estimated transmitter beamforming unitary matrix (V) to produce the transmitter beamforming information. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device, and therefore determines beamforming feedback matrices and compresses those into the form of angles. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.6 or 802.11-2013 at 22.1.1 & 20.3.12.3.6.

168.   The '862 Infringing Products include a receiving wireless communication device that wirelessly send the transmitter beamforming information to the transmitting wireless device. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device, and therefore wirelessly sends the compressed beamformed matrices to the beamformer. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.6 or 802.11-2013 at 22.1.1 & 20.3.12.3.6.

169.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '862 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '862 Infringing Products.

170.   Apple has been, and currently is, an active inducer of infringement of one or more claims of the '862 Patent under 35 U.S.C. § 271(b). On information and belief, one or more of the '862 Infringing Products directly and/or indirectly infringe (by induced infringement) at least one or more claims (*e.g.,* claim 1) of the '862 Patent, literally and/or under the doctrine of equivalents.

171.   Apple intentionally encourages and aids at least its users to directly infringe the '862 Patent.

172.   Apple provides the '862 Infringing Products and instructions to its users such that

they will use the '862 Infringing Products in a directly infringing manner. Apple markets the '862 Infringing Products to its users and provides instructions to its users on how to use the functionality of the '862 Patent on its website and elsewhere. *See, e.g.,* https://support.apple.com/guide/deployment-reference-ios/roaming-iorf0c4eb390/1/web/1.0; https://support.apple.com/guide/deployment-reference-ios/iphone-wi-fi-specification-details-apd1c22e481c/web; https://support.apple.com/en-us/HT202639; https://support.apple.com/en-us/HT201974; https://support.apple.com/en-us/HT204400.

173. Apple users directly infringe by using the '862 Infringing Products in their intended manner. Apple induces such infringement by providing the '862 Infringing Products and instructions to enable and facilitate infringement. On information and belief, Apple specifically intends that its actions will result in infringement of the '862 Patent or has taken deliberate actions to avoid learning of infringement.

174. Apple's infringement is knowing, egregious, consciously wrongful, and willful. Apple learned of its infringement of the '862 Patent no later than June 1, 2018. On June 1, 2018, Mr. Afzal Dean, President of BNR, sent a letter to Mr. Tim Cook, CEO of Apple. Mr. Dean's letter informed Mr. Cook that Apple was selling products that implemented features claimed in BNR's patents. The June 1, 2018 letter specifically identified the '862 Patent as one of BNR's "[e]xemplary patents relevant to mobile handsets, tablets and laptops[.]" The letter specifically called out several of Apple's then-current products, such as the "iPhone X, iPad Pro, MacBook Air, MacBook Pro, iMac Pro." Despite receiving this letter, Apple continued to infringe the '862 Patent by continuing to make, use, sell, and/or offer to sell the '862 Infringing Products in the United States.

175. Apple's infringement of the '862 Patent is willful and deliberate, entitling BNR to

enhanced damages and attorneys' fees.

176.   Apple's infringement of the '862 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

177.   BNR has been damaged by Apple's infringement of the '862 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

178.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '862 Patent, including without limitation and/or not less than a reasonable royalty.

FIFTH CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 7,957,450

179.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

180.   The '450 Patent is valid and enforceable under United States Patent Laws.

181.   BNR owns, by assignment, all right, title, and interest in and to the '450 Patent, including the right to collect for past damages.

182.   A copy of the '450 Patent is attached as Exhibit F.

'450 Patent Allegations

183.   Apple designs, makes, sells, and currently uses devices that operate according to the 802.11ac standard, including its iPhone, iPad, iPod, Mac line, and Apple TV products (the "'450 Infringing Products"). *See* https://support.apple.com/guide/deployment-reference-ios/wi-fi-specifications-iphone-ipad-ipod-touch-ior65f75e248/web (stating that the iPhone, iPad, and iPod touch are compatible with 802.11ac); https://support.apple.com/guide/deployment-reference-

macos/wi-fi-specifications-for-mac-computers-ior1faf9de44/web#:~:text=Wi%

2DFi%20specification%20details%20for,2.4%20GHz%20or%205%20GHz (stating that the Mac

line is compatible with 802.11ac); https://support.apple.com/guide/deployment-reference-ios/wi-

fi-specifications-for-apple-tv-apd7cc1c76ff/web#:~:text=Wi%2DFi%20

specification%20details%20for,the%20appendixes%20for%20Apple%20TV.&text=802.11%20c

ompatibility%20and%20frequency%20band,transmit%20data%20over%20Wi%2DFi   (stating

that the Apple TV products are compatible with 802.11ac). The 802.11ac standard was introduced

on or about December 2013. The 802.11ac standard provides for a "compressed beamforming

feedback matrix" and specify that "[i]n compressed beamforming feedback matrix, the

beamformee shall remove the space-time stream CSD in Table 19-10 from the measured channel

before computing a set of matrices for feedback to the beamformer." Furthermore, "[t]he

beamforming feedback matrices, V(k), found by the beamformee are compressed in the form of

angles, which are sent to the beamformer." Devices implementing the beamforming

standardization according to 802.11ac must be capable of providing compressed beamforming

feedback matrices as set forth above. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.6.

184.   On information and belief after a reasonable investigation, the '450 Infringing

Products infringe the '450 Patent. The '450 Infringing Products perform a method for

communication. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device that

uses beamforming. Devices implementing beamforming according to 802.11ac communicate

information in a wireless communication system. *See* 802.11-2016 at 21.1.1 & 19.3.12.

185.   The '450 Infringing Products computes a plurality of channel estimate matrices

based on signals received by a mobile terminal from a base station, via one or more downlink RF

channels. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device, and

therefore computes a compressed beamforming feedback matrix for feedback to a beamformer. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.6.

186.   The '450 Infringing Products' plurality of channel estimate matrices comprise coefficients derived from performing a singular value matrix decomposition (SVD) on said received signals. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device, and therefore (as discussed above) uses beamforming matrices. Upon information and belief, singular value decomposition (SVD) is the most common approach to calculate transmitter weights for beamforming matrices. Furthermore, using the matrix V calculated by SVD results in maximum likelihood performance with a linear receiver, which greatly simplifies receiver design. *See* Eldad Perahia & Robert Stacey, Next Generation Wireless LANs: 802.11n and 802.11ac, 2d ed (USA: Cambridge University Press, 2013), pp. 366, 369, 372.

187.   The '450 Infringing Products transmit said coefficients as feedback information to said base station, via one or more uplink RF channels. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device, and therefore sends the beamformer a beamforming feedback matrix V(k). *See* 802.11-2016 at 21.1.1 & 19.3.12.3.1 & 9.4.1.49 & 19.3.12.3.6.

188.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '450 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '450 Infringing Products.

189.   Apple has been, and currently is, an active inducer of infringement of one or more claims of the '450 Patent under 35 U.S.C. § 271(b). On information and belief, one or more of the '450 Infringing Products directly and/or indirectly infringe (by induced infringement) at least one

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or more claims (*e.g.,* claim 1) of the '450 Patent, literally and/or under the doctrine of equivalents.

190.   Apple intentionally encourages and aids at least its users to directly infringe the '450 Patent.

191.   Apple provides the '450 Infringing Products and instructions to its users such that they will use the '450 Infringing Products in a directly infringing manner. Apple markets the '450 Infringing Products to its users and provides instructions to its users on how to use the functionality of   the   '450   Patent   on   its   website   and   elsewhere.   *See,   e.g.,* https://support.apple.com/guide/deployment-reference-ios/roaming-iorf0c4eb390/1/web/1.0; https://support.apple.com/guide/deployment-reference-ios/iphone-wi-fi-specification-details-apd1c22e481c/web;   https://support.apple.com/en-us/HT202639;   https://support.apple.com/en-us/HT201974; https://support.apple.com/en-us/HT204400.

192.   Apple users directly infringe by using the '450 Infringing Products in their intended manner. Apple induces such infringement by providing the '450 Infringing Products and instructions to enable and facilitate infringement. On information and belief, Apple specifically intends that its actions will result in infringement of the '450 Patent or has taken deliberate actions to avoid learning of infringement.

193.   Apple's infringement is knowing, egregious, consciously wrongful, and willful.

194.   Apple's infringement of the '450 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

195.   Apple's infringement of the '450 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

196.   BNR has been damaged by Apple's infringement of the '450 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues

to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

197.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '450 Patent, including without limitation and/or not less than a reasonable royalty.

<div align="center">

SIXTH CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 7,564,914

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198.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

199.   The '914 Patent is valid and enforceable under United States Patent Laws.

200.   BNR owns, by assignment, all right, title, and interest in and to the '914 Patent, including the right to collect for past damages.

201.   A copy of the '914 Patent is attached as Exhibit E.

<div align="center">

'914 Patent Allegations

</div>

202.   Apple designs, makes, sells, and currently uses devices that operate according to the 802.11ac standard, including its iPhone, iPad, iPod, Mac line, and Apple TV products (the "'914 Infringing Products"). *See* https://support.apple.com/guide/deployment-reference-ios/wi-fi-specifications-iphone-ipad-ipod-touch-ior65f75e248/web (stating that the iPhone, iPad, and iPod touch are compatible with 802.11ac); https://support.apple.com/guide/deployment-reference-macos/wi-fi-specifications-for-mac-computers-ior1faf9de44/web#:~:text=Wi%2DFi%20specification%20details%20for,2.4%20GHz%20or%205%20GHz (stating that the Mac line is compatible with 802.11ac); https://support.apple.com/guide/deployment-reference-ios/wi-fi-specifications-for-apple-tv-apd7cc1c76ff/web#:~:text=Wi%2DFi%20specification%20details%20for,the%20appendixes%20for%20Apple%20TV.&text=802.11%20c

<div align="center">52</div>

ompatibility%20and%20frequency%20band,transmit%20data%20over%20Wi%2DFi   (stating

that the Apple TV products are compatible with 802.11ac). The 802.11ac standard was introduced

on or about December 2013. The 802.11ac standard provides for a "compressed beamforming

feedback matrix" and specifies that "[i]n compressed beamforming feedback matrix, the

beamformee shall remove the space-time stream CSD in Table 19-10 from the measured channel

before computing a set of matrices for feedback to the beamformer." Furthermore, "[t]he

beamforming feedback matrices, V(k), found by the beamformee are compressed in the form of

angles, which are sent to the beamformer." Devices implementing the beamforming

standardization according to 802.11ac must be capable of providing compressed beamforming

feedback matrices as set forth above. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.6.

203.   On information and belief after a reasonable investigation, the '914 Infringing

Products infringe the '914 Patent. The '914 Infringing Products perform a method for

communicating information in a communication system. For instance, the Apple iPhone 12 is an

802.11ac compliant wireless device that uses beamforming. Devices implementing beamforming

according to 802.11ac communicate information in a wireless communication system. *See* 802.11-

2016 at 21.1.1 & 19.3.12.

204.   The '914 Infringing Products receive data via a plurality of RF channels utilizing a

plurality of receiving antennas. For instance, the Apple iPhone 12 is an 802.11ac compliant

wireless device, and therefore receives data transmitted by the VHT beamformer over a number

of RF channels and uses a number of antennas. *See* 802.11-2016 at 21.1.1 & 10.34.5.1 & 10.34.5.2

& Figure 19-14.

205.   The '914 Infringing Products transmit feedback information via at least one of said

plurality of RF channels. For instance, the Apple iPhone 12 is an 802.11ac compliant wireless

device, and therefore sends back a transformed estimate of the channel state to the VHT

beamformer. As a further example, Apple iPhone 12 measures the channel matrices and sends the

beamformer the beamforming feedback matrix V(k). As an additional example, the Apple iPhone

12's VHT Compressed Beamforming Report field is used by the VHT Compressed Beamforming

feedback to carry explicit feedback information *See* 802.11-2016 at 21.1.1 & 10.34.5.1 &

10.34.5.2;& 19.3.12.3.1 & 9.4.1.49.

206.   The '914 Infringing Products request modification of a transmission mode for

subsequent received data in transmitted response messages comprising said feedback information.

For instance, the Apple iPhone 12 is an 802.11ac compliant wireless device, and therefore

measures the channel matrices and sends the beamformer the beamforming feedback matrix V(k)

for the beamformer to determine a steering matrix Q(steer)(k) = Q(k)V(k), and when new steering

matrix Q(steer)(k) is found, steering matrix Q(steer)(k) may replace it for the next beamformed

data transmission. *See* 802.11-2016 at 21.1.1 & 19.3.12.3.1.

207.   The '914 Infringing Products transmit feedback information comprising channel

estimates based on transmission characteristics of said received data via at least one of said

plurality of receiving antennas. For instance, the Apple iPhone 12 is an 802.11ac compliant

wireless device, and therefore sends a VHT Compressed Beamforming Report field in its VHT

Compressed Beamforming feedback to carry explicit feedback information with signal to noise

ratio information for each subcarrier. As a further example, Apple iPhone 12 measures the channel

matrices and sends the beamformer the beamforming feedback matrix V(k). *See* 802.11-2016 at

21.1.1 & 19.3.12.3.1 & 9.4.1.49 & 19.3.12.3.6.

208.   The '914 Infringing Products derive said feedback information from mathematical

matrix decomposition of said channel estimates. For instance, the Apple iPhone 12 is an 802.11ac

compliant wireless device, and therefore (as discussed above) uses beamforming matrices. Upon information and belief, singular value decomposition (SVD) is the most common approach to calculate transmitter weights for beamforming matrices. Furthermore, using the matrix V calculated by SVD results in maximum likelihood performance with a linear receiver, which greatly simplifies receiver design. *See* Eldad Perahia & Robert Stacey, Next Generation Wireless LANs: 802.11n and 802.11ac, 2d ed (USA: Cambridge University Press, 2013), pp. 366, 369, 372.

209.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 13) of the '914 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '914 Infringing Products.

210.   Apple has been, and currently is, an active inducer of infringement of one or more claims of the '914 Patent under 35 U.S.C. § 271(b). On information and belief, one or more of the '914 Infringing Products directly and/or indirectly infringe (by induced infringement) at least one or more claims (*e.g.,* claim 13) of the '914 Patent, literally and/or under the doctrine of equivalents.

211.   Apple intentionally encourages and aids at least its users to directly infringe the '914 Patent.

212.   Apple provides the '914 Infringing Products and instructions to its users such that they will use the '914 Infringing Products in a directly infringing manner. Apple markets the '914 Infringing Products to its users and provides instructions to its users on how to use the functionality of   the   '914   Patent   on   its   website   and   elsewhere.   *See,   e.g.*,
https://support.apple.com/guide/deployment-reference-ios/roaming-iorf0c4eb390/1/web/1.0;
https://support.apple.com/guide/deployment-reference-ios/iphone-wi-fi-specification-details-

apd1c22e481c/web; https://support.apple.com/en-us/HT202639; https://support.apple.com/en-us/HT201974; https://support.apple.com/en-us/HT204400.

213.   Apple users directly infringe by using the '914 Infringing Products in their intended manner. Apple induces such infringement by providing the '914 Infringing Products and instructions to enable and facilitate infringement. On information and belief, Apple specifically intends that its actions will result in infringement of the '914 Patent or has taken deliberate actions to avoid learning of infringement.

214.   Apple's infringement is knowing, egregious, consciously wrongful, and willful.

215.   Apple's infringement of the '914 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

216.   Apple's infringement of the '914 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

217.   BNR has been damaged by Apple's infringement of the '914 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

218.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '914 Patent, including without limitation and/or not less than a reasonable royalty.

<u>**SEVENTH CLAIM FOR RELIEF**</u>

INFRINGEMENT OF U.S. PATENT NO. 6,963,129

219.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

220.   The '129 Patent is valid and enforceable under United States Patent Laws.

221.   BNR owns, by assignment, all right, title, and interest in and to the '129 Patent, including the right to collect for past damages.

222.   A copy of the '129 Patent is attached as Exhibit G.

'129 Patent Allegations

223.   Apple designs, implements, sells, and currently uses devices that include a heat spreader assembly. The assembly allows Apple's products, including the iPhone, iPad, and Mac line (the "'129 Infringing Products") to contain two or more chips packaged together in a manner that allows for better heat dissipation. *See, e.g.,* https://www.apple.com/ipad-pro/specs/ (identifying the technical specifications, including chip components, for the Apple iPad Pro).

224.   On information and belief after a reasonable investigation, the '129 Infringing Products infringe the '129 Patent. The '129 Infringing Products include a heat spreader assembly. For instance, the exemplary 12.9-inch (5th generation) Apple iPad Pro contains a heat spreader assembly (outlined in red), as show below:
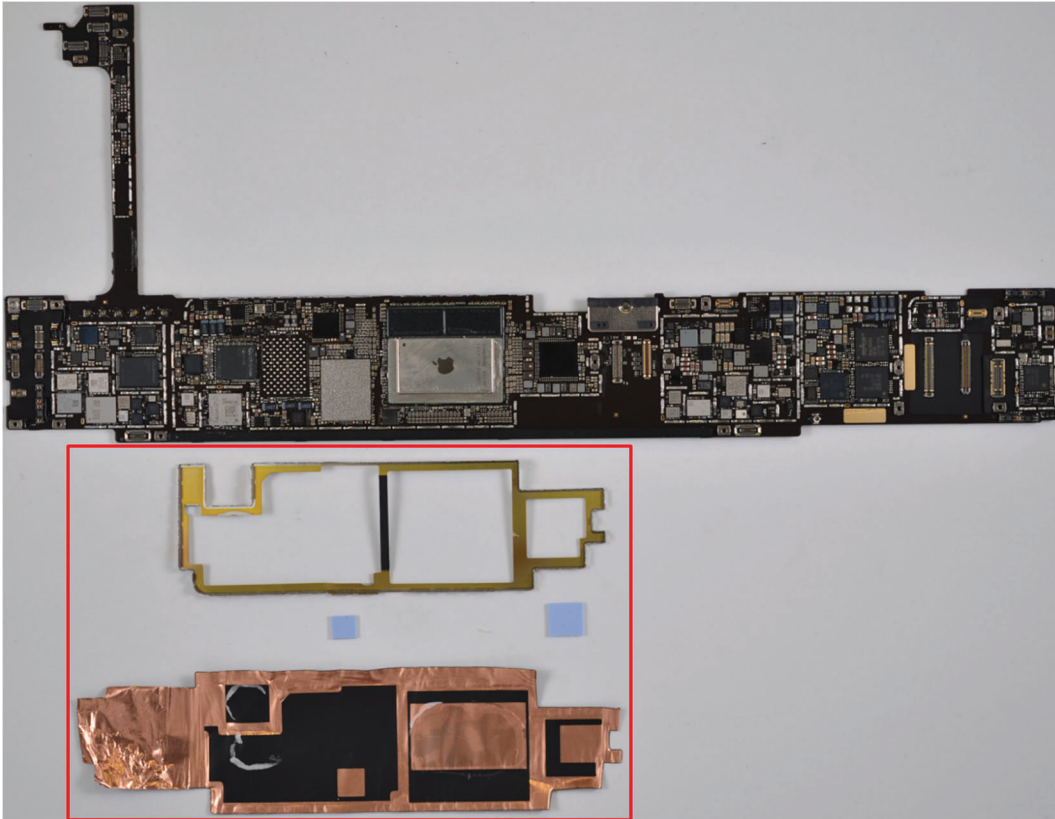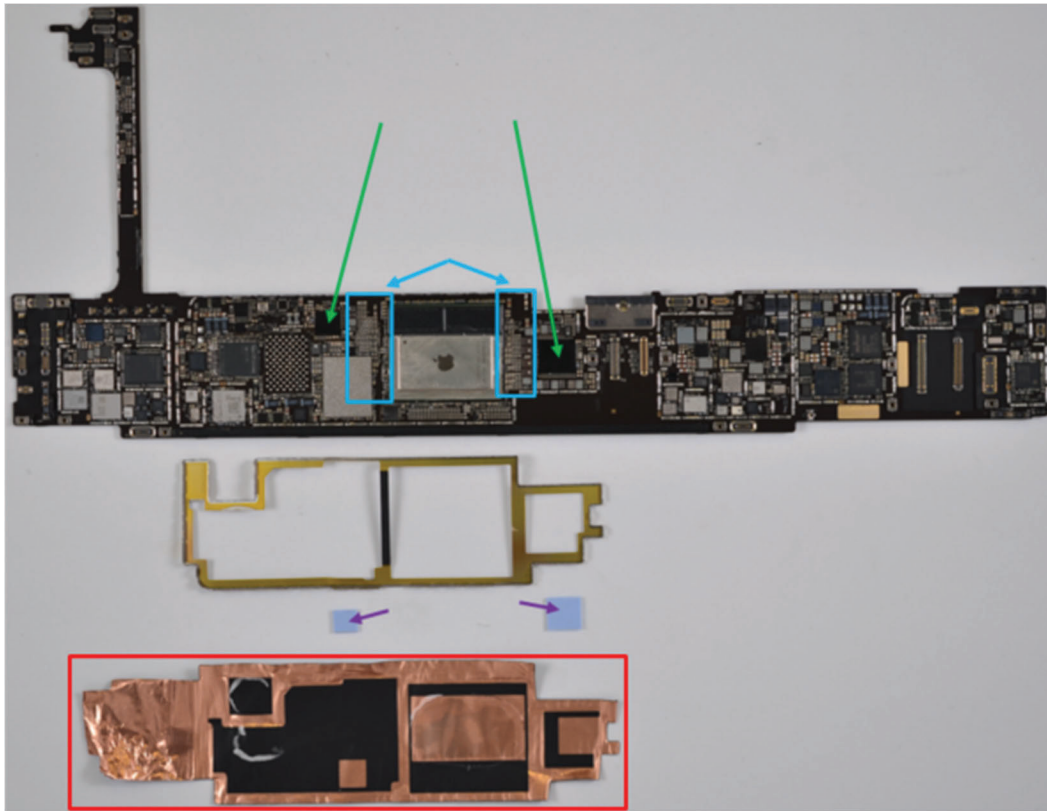
225.   The '129 Infringing Products' heat spreader assembly includes a single, unibody heat spreader configured to extend across substantially the entire first surface of at least two spaced chips opposite a second surface of the chips having a bonding pad. For instance, the Apple iPad Pro's heat spreader assembly includes a single, unibody heat spreader (outlined in red). The single, unibody heat spreader is configured to extend across substantially the entire first surface of at least two spaced chips (indicated by green arrows) opposite a second surface of the chips having a bonding pad (outlined in green), as shown below:
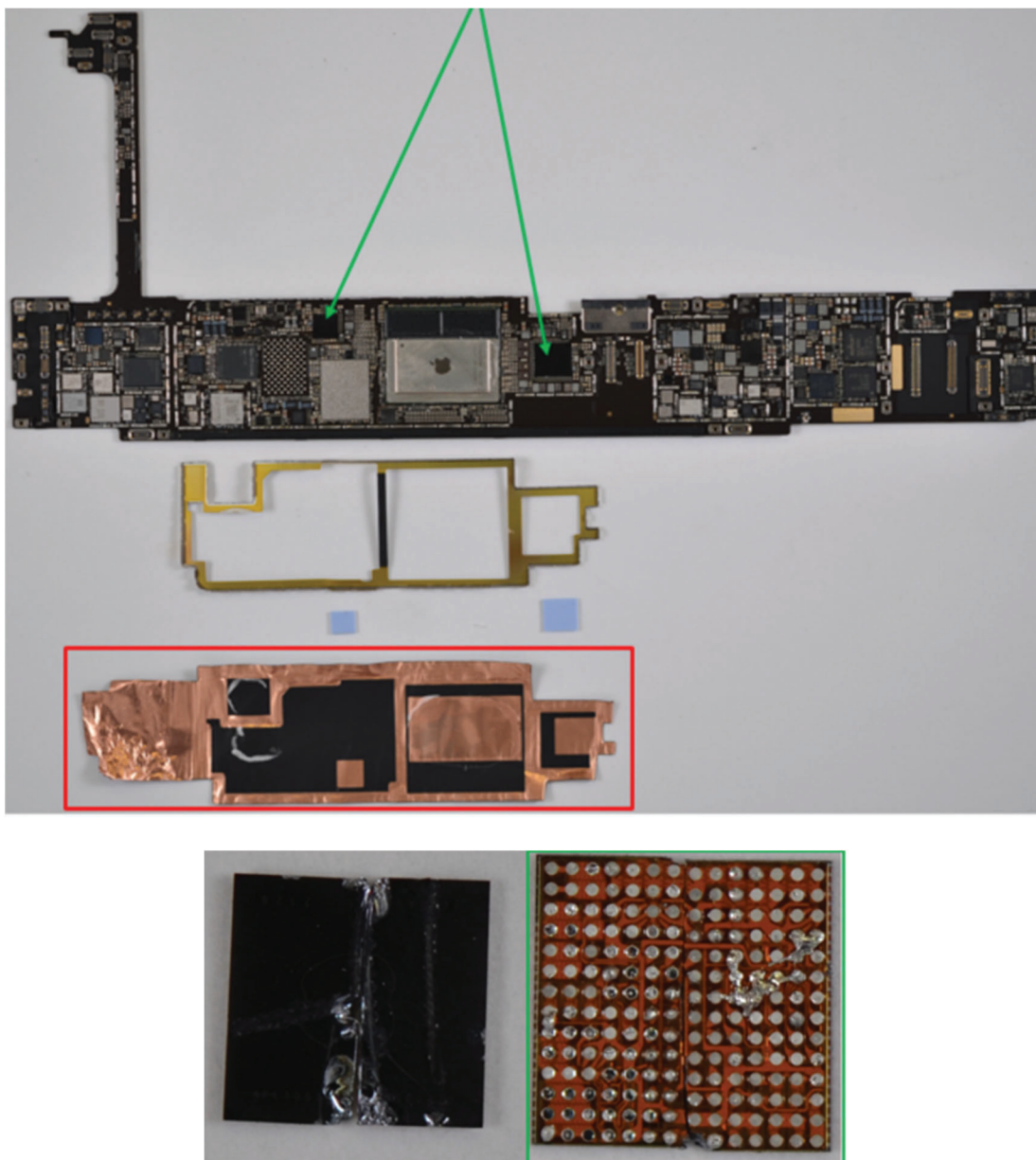
226.   The '129 Infringing Products' heat spreader assembly also includes adhesive placed

between the heat spreader and the first surface for securing the heat spreader to the first surface of

the chips at a spaced distance above at least one passive device arranged in the area between the

spaced chips. For instance, the Apple iPad Pro's heat spreader assembly includes a transparent

adhesive (indicated by purple arrows) that is placed between the heat spreader (outlined in red)

and the first surface to secure the heat spreader to the first surface of the chips spaced at a distance

above at least one passive device (outlined in blue and indicated by blue arrows) and arranged in the area between the spaced chips (indicated by green arrows), as shown below:

227.   The '129 Infringing Products' heat spreader assembly also includes a second heat spreader interposed between the heat spreader and only one of the at least two spaced chips. For instance, the Apple iPad Pro's heat spreader assembly includes a second heat spreader (outlined in orange), which is interposed (indicated with yellow arrows) between the heat spreader and only one of the at least two spaced chips (outlined in green), as shown below:
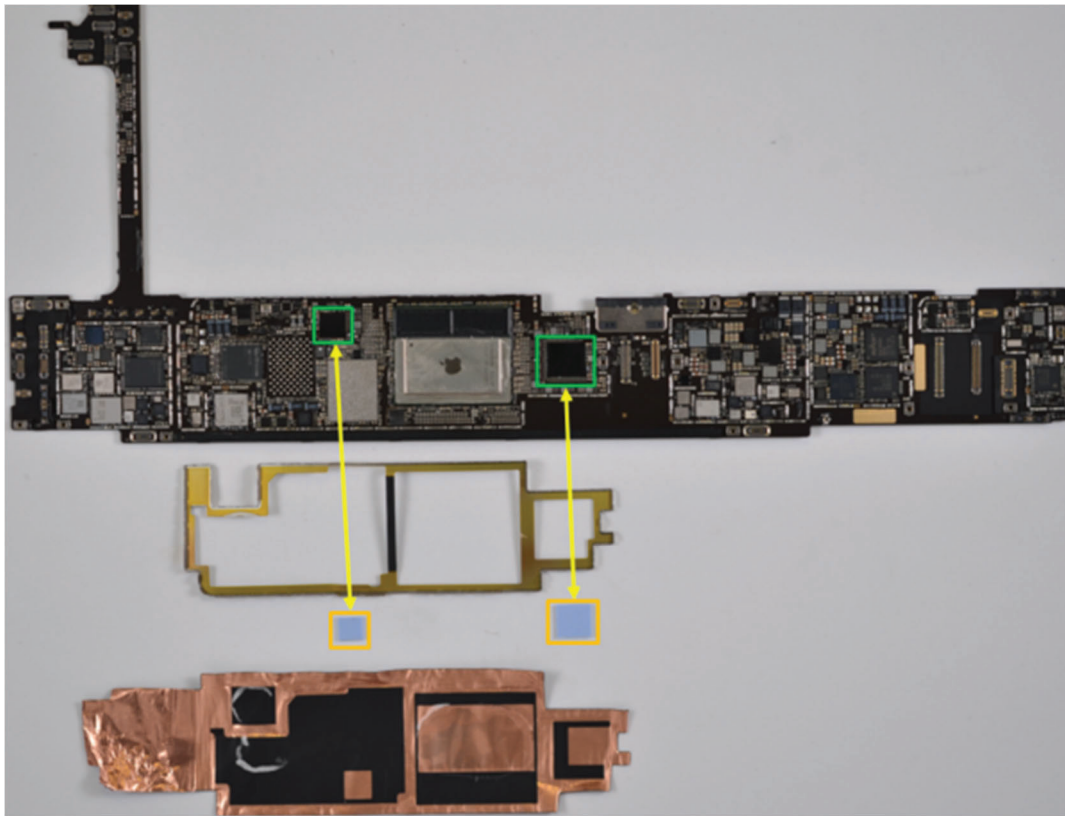
228.   Apple has infringed and is infringing, individually and/or jointly, either literally or

under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '129 Patent in

violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for

sale, selling, offering for lease, leasing in the United States, and/or importing into the United States

without authority or license, the '129 Infringing Products.

229.   Apple's infringement is knowing, egregious, consciously wrongful, and willful.

Apple learned of its infringement of the '129 Patent no later than April 28, 2021. On April 28,

2021, Mr. Afzal Dean, President of BNR, sent an email to Mr. Chris Delgado of Apple. Mr. Dean's

email informed Mr. Delgado that Apple was selling products that implemented features claimed

in BNR's patents. The April 28, 2021 email specifically identified the '129 Patent as one of the

BNR patents being infringed by Apple. The email specifically called out several of Apple's then-

current products, such as the "iPad Pro, MacBook Pro 16 and others." Despite receiving this email,

Apple continued to infringe the '129 Patent by continuing to make, use, sell, and/or offer to sell the '129 Infringing Products in the United States.

230.   Apple's infringement of the '129 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

231.   Apple's infringement of the '129 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

232.   BNR has been damaged by Apple's infringement of the '129 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

233.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '129 Patent, including without limitation and/or not less than a reasonable royalty.

EIGHTH CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 6,858,930

234.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

235.   The '930 Patent is valid and enforceable under United States Patent Laws.

236.   BNR owns, by assignment, all right, title, and interest in and to the '930 Patent, including the right to collect for past damages.

237.   A copy of the '930 Patent is attached as Exhibit H.

### '930 Patent Allegations

238.   Apple   designs,   makes,   sells,   and   currently   uses   devices   that   include   a

semiconductor package with heat spreaders. The heat spreader package allows Apple's products, including the iPhone, iPad, and Mac line (the "'930 Infringing Products") to contain a semiconductor package that allows for adequate heat dissipation and structural support. *See, e.g.,* https://www.apple.com/ipad-pro/specs/ (identifying the technical specifications, including components, for the Apple iPad Pro).

239.   On information and belief after a reasonable investigation, the '930 Infringing Products infringe the '930 Patent. The '930 Infringing Products include a semiconductor package. For instance, the exemplary 12.9-inch (5th generation) Apple iPad Pro contains a semiconductor package, as shown below:
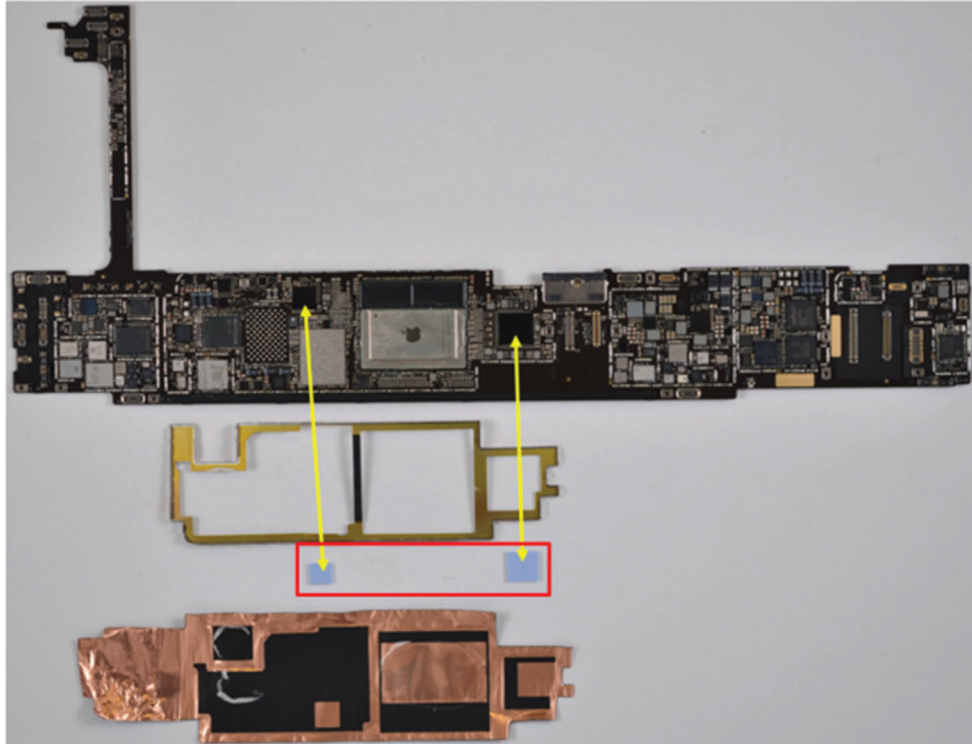

240.   The '930 Infringing Products' semiconductor package includes a package substrate having a first side and an opposing second side, the first side for receiving package electrical connections. For instance, the Apple iPad Pro's semiconductor package includes a package substrate having a first side (outlined in red) and an opposing second side (outlined in green), as shown below:
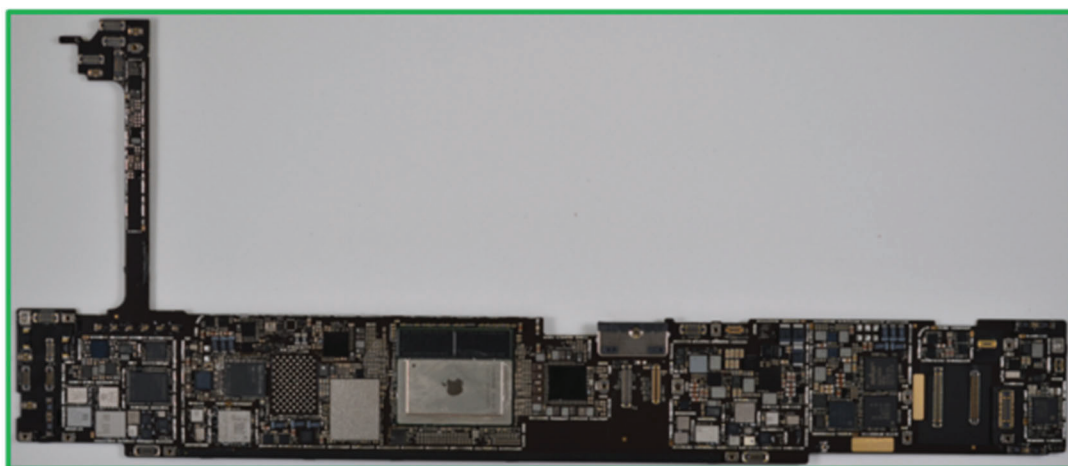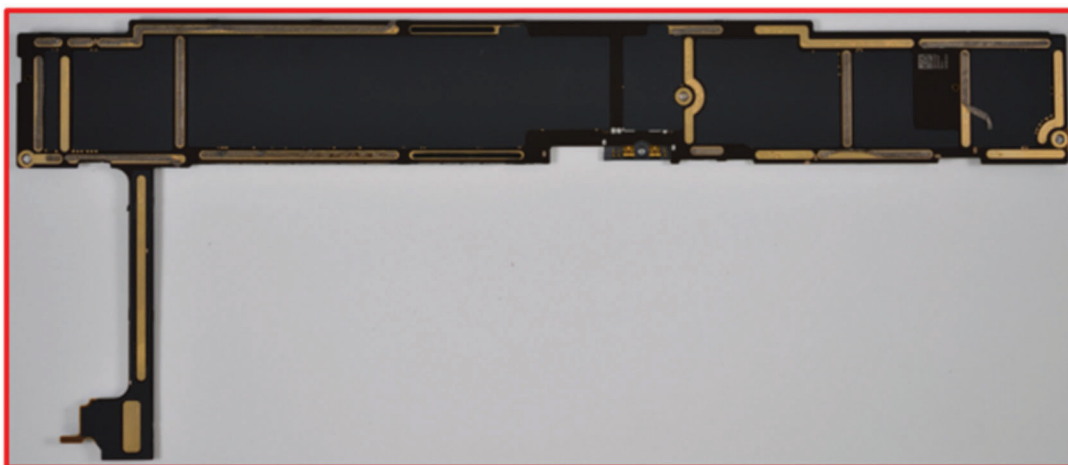
241.   The '930 Infringing Products' semiconductor package also includes chips each having a first side and an opposing second side, the first side of each of the chips electrically connected and structurally connected to the second side of the package substrate. For instance, the Apple iPad Pro's semiconductor package includes chips each having a first side and an opposing second side where the first side of each of the chips are electrically and structurally connected to the second side of the package substrate, as shown below:
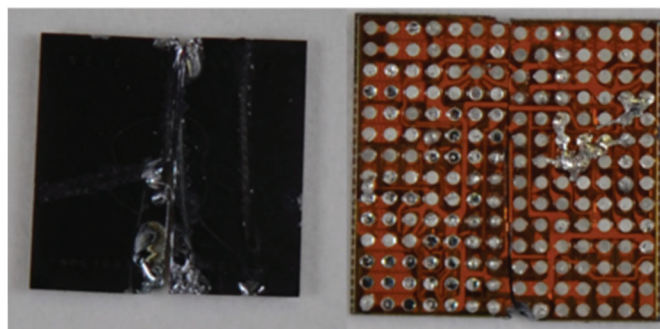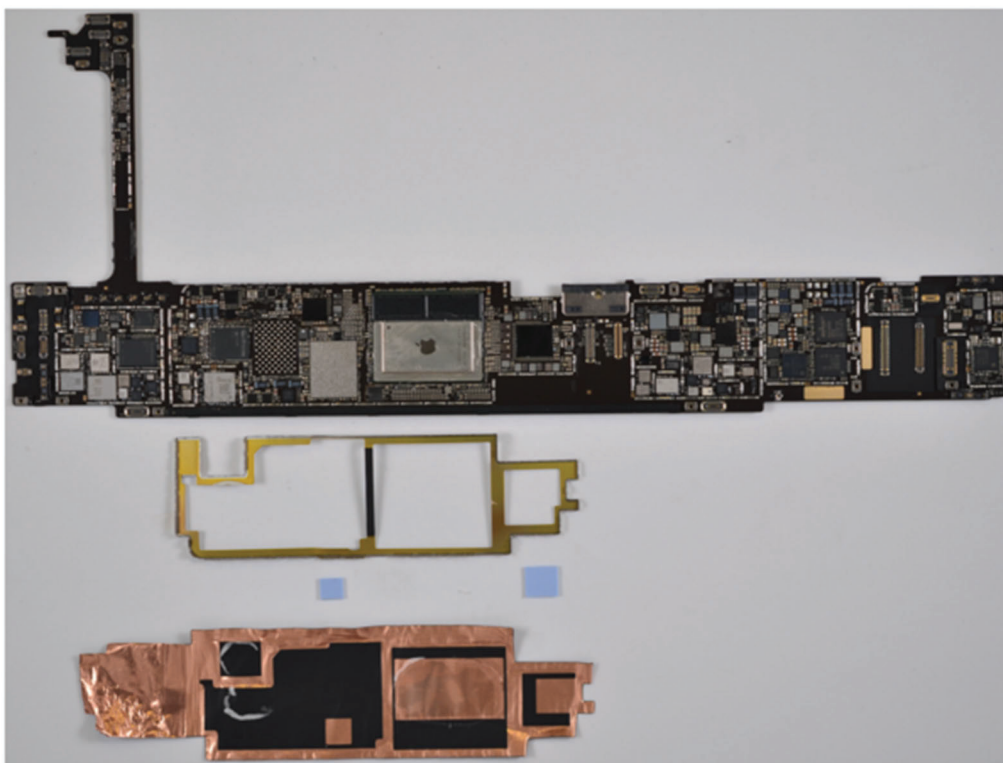
242.   The '930 Infringing Products' semiconductor package also includes heat spreaders each having a first side and an opposing second side, the first side of each of the heat spreaders disposed adjacent the second side of the chips, where one each of the heat spreaders is associated with one each of the chips. For instance, the Apple iPad Pro's semiconductor package includes heat spreaders (outlined in red) each having a first side and an opposing second side, the first side of each of the heat spreaders disposed adjacent to the second side of the chips, where each of the heat spreaders are associated with one each of the chips (indicated by yellow arrows), as shown below:
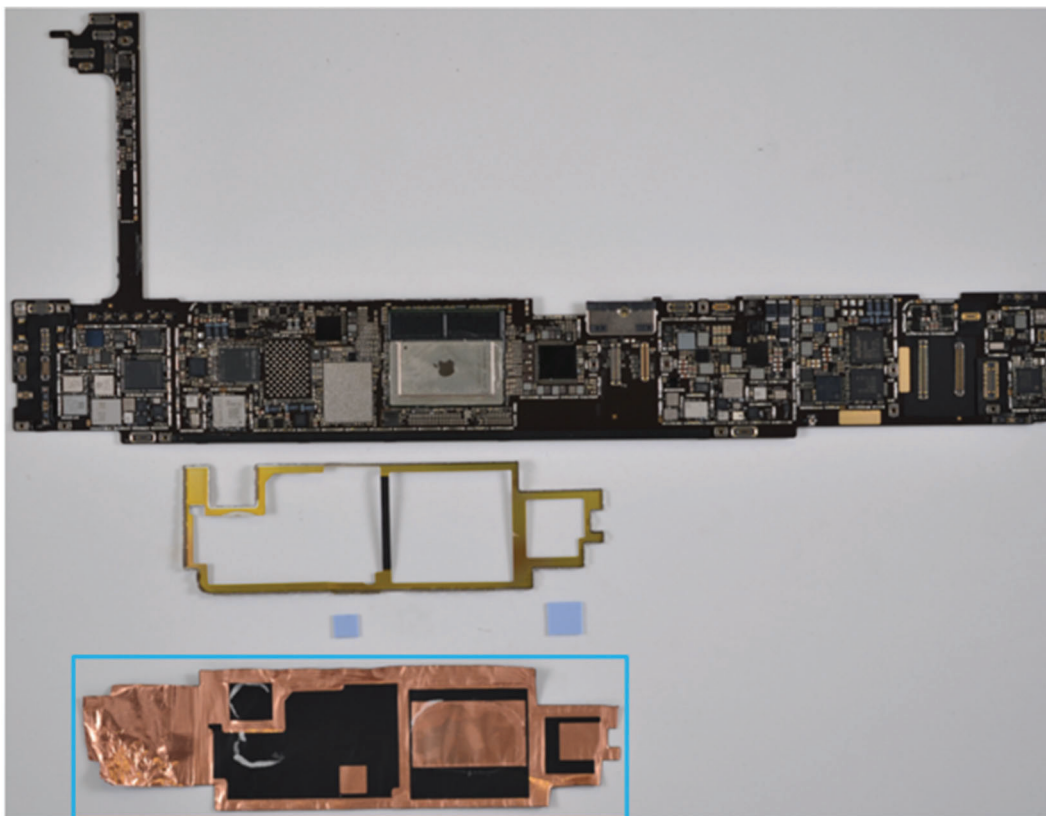
243.   The '930 Infringing Products' semiconductor package also includes a single stiffener having a first side and an opposing second side, the stiffener covering all of the chips and heat spreaders, the first side of the stiffener disposed adjacent the second side of the heat spreaders. For instance, the Apple iPad Pro's semiconductor package includes a single stiffener (outlined in blue) having a first side and an opposing second side covering all chips and heat spreaders with the first side of the stiffener adjacent to the second side of the heat spreaders, as shown below:

244.   The '930 Infringing Products' semiconductor package also includes discrete components electrically connected to the second side of the package substrate and coplanar with the chips. For instance, the Apple iPad Pro's semiconductor package includes discrete components (outlined in red) electrically connected to the second side of the package substrate and coplanar with the chips, as shown below:
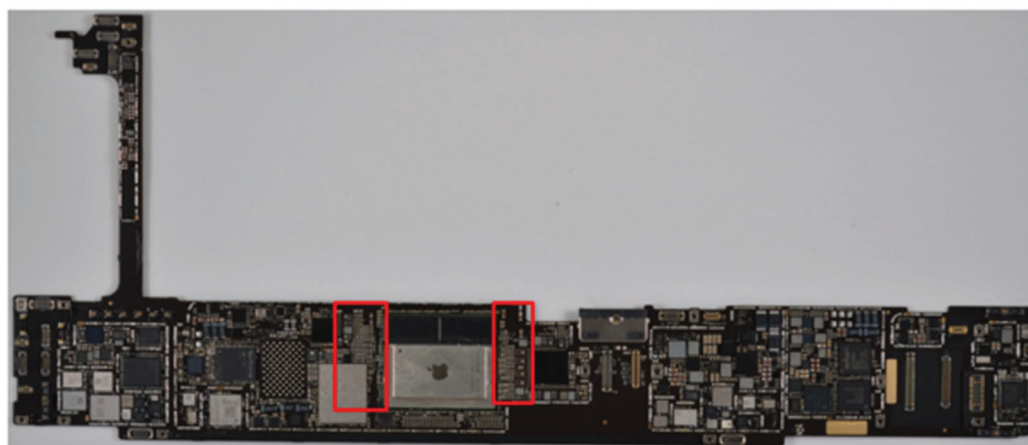
245.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '930 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '930 Infringing Products.

246.   Apple's infringement is knowing, egregious, consciously wrongful, and willful. Apple learned of its infringement of the '930 Patent no later than April 28, 2021. On April 28, 2021, Mr. Afzal Dean, President of BNR, sent an email to Mr. Chris Delgado of Apple. Mr. Dean's email informed Mr. Delgado that Apple was selling products that implemented features claimed in BNR's patents. The April 28, 2021 email specifically identified the '930 Patent as one of the BNR patents being infringed by Apple. The email specifically called out several of Apple's then-current products, such as the "iPad Pro, MacBook Pro 16 and others." Despite receiving this email, Apple continued to infringe the '930 Patent by continuing to make, use, sell, and/or offer to sell the '930 Infringing Products in the United States.

247.   Apple's infringement of the '930 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

248.   Apple's infringement of the '930 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

249.   BNR has been damaged by Apple's infringement of the '930 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

250.   BNR is entitled to recover from Apple all damages that BNR has sustained as a

result of Apple's infringement of the '930 Patent, including without limitation and/or not less than a reasonable royalty.

NINTH CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 7,039,435

251.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

252.   The '435 Patent is valid and enforceable under United States Patent Laws.

253.   BNR owns, by assignment, all right, title, and interest in and to the '435 Patent, including the right to collect for past damages.

254.   A copy of the '435 Patent is attached as Exhibit I.

'435 Patent Allegations

255.   Apple designs, makes, sells, and currently uses devices that include a proximity-based power regulation system that combines portions of the LTE standard with various device positioning technologies. For example, Apple's products, including the iPhone and iPad (the "'435 Infringing Products"), are LTE compliant and include systems, such as various sensor(s) and setting(s), that determine the location of the mobile device proximate to the user and adjusts the transmit power level of the mobile device accordingly. These sensors and settings include one or more of a proximity sensor, ambient light sensor, Face ID sensor, gyro, accelerometer, antenna reactance, Bluetooth settings, and/or Call Audio Routing settings. *See, e.g.*, https://macreports.com/iphone-proximity-sensor-not-working-screen-is-not-going-black-fix/ (discussing the proximity sensor functionality); https://support.apple.com/kb/SP770?locale=en_US (identifying the "[p]roximity sensor," "Face ID," "Three-axis gyro," "Accelerometer," and "Ambient light sensor" as part of the technical

specifications for the iPhone X); https://itnext.io/ios-proximity-sensor-as-simple-as-possible-a473df883dc9?gi=42625062c33a (discussing the proximity sensor functionality on an iPhone); https://www.businessinsider.com/how-to-turn-off-proximity-sensor-iphone#:~:text=Your%20 iPhone's%20proximity%20sensor%20can,grime%2C%20or%20a%20software%20issue (same); https://discussions.apple.com/thread/8341968 (same); https://support.apple.com/en-us/HT207532 (discussing headphone mode); https://appletoolbox.com/iphone-stuck-in-headphones-mode-fix/#Check_Some_Settings (discussing "Call Audio Routing" and "Bluetooth" settings). These positioning systems allow the mobile device's transmit power level to be reduced when the device is operated close to the user. This system for reducing power levels based on the proximity of a mobile device to the user is beneficial because, among other things, it reduces power consumption and helps alleviate the health concerns related to the effects of a user being exposed to high transmit power levels. *See* Ex. I at 1:33-50.

256.   On information and belief after a reasonable investigation, the '435 Infringing Products infringe the '435 Patent. The '435 Infringing Products are portable cell phones that include a power circuit that provides a network adjusted transmit power level as a function of a position to a communications tower. For instance, the Apple iPhone X is a portable cell phone that includes a power circuit that provides a network adjusted transmit power level as a function of a position to a communications tower (*e.g.,* the circuity coupled to the antenna). The claimed power signal is part of the Long-Term Evolution ("LTE") standard, which is utilized by the Apple iPhone X. *See* https://support.apple.com/kb/sp770?locale=en_US (noting that the Apple iPhone X is compliant with the LTE standard). More specifically, section 5.1.1 of the LTE standard addresses "UE behaviour" and states the following:

> If the UE transmits PUSCH without a simultaneous PUCCH for the serving cell c, then the UE transmit power $P_{PUSCH,c}(i)$ for PUSCH transmission in subframe i for the serving cell c is given by

$$P_{\text{PUSCH},c}(i) = \min \begin{cases} P_{\text{CMAX},c}(i), \\ 10\log_{10}(M_{\text{PUSCH},c}(i)) + P_{\text{O\_PUSCH},c}(j) + \alpha_c(j) \cdot PL_c + \Delta_{\text{TF},c}(i) + f_c(i) \end{cases} \text{[dBm]}$$

https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/10.04.00_60/ts_136213v100400p.p df at 5.1.1. The Apple iPhone X is LTE compliant, and therefore includes a power circuit that provides a network adjusted transmit power level as a function of a position to a communications tower.

257.   The '435 Infringing Products have a power regulation system that includes a location sensing subsystem that determines a location of said portable cell phone proximate to a user. As part of its submissions to the Federal Communications Commission ("FCC"), Apple disclosed test results from Specific Absorption Rate ("SAR") Testing. Those test results indicate that the '435 Infringing Products have a location sensing subsystem that determines the location of a mobile device proximate to the user. For instance, the SAR test results for the Apple iPhone X state that "[t]he device utilizes three power modes: Mode A, Mode B and Mode C. Power selection is determined by the device's positioning and use case[.]" *See* https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout =500&calledFromFrame=N&application_id=4yOVUk8rMYUXhlgmJ%2Fh9tA%3D%3D&fcc_ id=BCG-E3175A at "11792137-S1V5 FCC Report SAR," p. 17 (also available at https://fccid.io/BCG-E3175A/RF-Exposure-Info/11792137-S1V5-FCC-Report-SAR-3546735.pdf at 17); *see also id.* at 7 (noting that "proprietary detection mode [is] used to determine proximity to head or body and set power accordingly for Wi-Fi and Cellular Transmitters.").

258.   The '435 Infringing Products also have a power governing subsystem, coupled to said location sensing subsystem, that determines a proximity transmit power level of said portable cell phone based on said location and determines a transmit power level for said portable cell phone based on said network adjusted transmit power level and said proximity transmit power level. The

SAR test results confirm that the '435 Infringing Products have a location sensing subsystem and a power governing subsystem, the latter of which determines a transmit power level based on a proximity transmit power level determined by the location of the mobile phone proximate to a user and the network adjusted transmit power level. For instance, the SAR test results for the Apple iPhone X include the following table, which indicates that power is adjusted based on proximity:

LAT 1

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offset	Power (dBm) Tune-up limit	Power (dBm) Meas.	1-g SAR (W/kg) Meas.	1-g SAR (W/kg) Scaled	10-g SAR (W/kg) Meas.	10-g SAR (W/kg) Scaled	Plot No.
Head	QPSK	0	Left Touch	26365	1882.5	1	49	25.3	25.3	0.385	0.385	0.238	0.238	
						50	24	24.3	24.3	0.313	0.313	0.194	0.194	
			Left Tilt	26365	1882.5	1	49	25.3	25.3	0.195	0.195	0.119	0.119	
						50	24	24.3	24.3	0.159	0.159	0.097	0.097	
			Right Touch	26365	1882.5	1	49	25.3	25.3	0.337	0.337	0.215	0.215	
						50	24	24.3	24.3	0.270	0.270	0.173	0.173	
			Right Tilt	26365	1882.5	1	49	25.3	25.3	0.277	0.277	0.163	0.163	
						50	24	24.3	24.3	0.226	0.226	0.133	0.133	
Body-worn & Hotspot	QPSK	5	Rear	26140	1860.0	1	49	22.5	22.5	0.720	0.720	0.355	0.355	
						50	24	22.5	22.5	0.854	0.854	0.419	0.419	
				26365	1882.5	1	49	22.5	22.4	1.060	1.085	0.508	0.520	21
						50	24	22.5	22.2	0.981	1.051	0.477	0.511	
						100	0	22.5	22.2	0.749	0.803	0.366	0.392	
				26590	1905.0	1	49	22.5	22.2	0.850	0.911	0.411	0.440	
						50	24	22.5	22.3	1.010	1.058	0.485	0.508	
			Front	26365	1882.5	1	49	22.5	22.4	0.458	0.469	0.243	0.249	
						50	24	22.5	22.2	0.436	0.467	0.233	0.250	
			Edge 2	26365	1882.5	1	49	22.5	22.4	0.425	0.435	0.229	0.234	
						50	24	22.5	22.2	0.394	0.422	0.213	0.228	
Hotspot	QPSK	5	Edge 3	26140	1860.0	1	49	22.5	22.5	0.902	0.902	0.421	0.421	
						50	24	22.5	22.5	0.885	0.885	0.402	0.402	
				26365	1882.5	1	49	22.5	22.4	1.050	1.074	0.465	0.476	
						50	24	22.5	22.2	0.987	1.058	0.446	0.478	
						100	0	22.5	22.2	0.962	1.031	0.426	0.456	
				26590	1905.0	1	49	22.5	22.2	0.995	1.066	0.448	0.480	
						50	24	22.5	22.3	0.911	0.954	0.400	0.419	
			Edge 4	26365	1882.5	1	49	22.5	22.4	0.270	0.276	0.148	0.151	
						50	24	22.5	22.2	0.267	0.286	0.146	0.156	

Id. at 135 (emphasis added); *see also* 17 (identifying when each of the three power modes are utilized by the Apple iPhone X).

259.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '435 Patent in violation of 35 U.S.C. §§ 271, *et seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States

without authority or license, the '435 Infringing Products.

260.   Apple's infringement is knowing, egregious, consciously wrongful, and willful. Apple learned of its infringement of the '435 Patent no later than January 3, 2020. On January 3, 2020, Mr. Afzal Dean, President of BNR, sent an email to Ms. Heather Mews of Apple. BNR's email informed Ms. Mews that Apple was selling products that implemented features claimed in BNR's patents. The January 3, 2020 email specifically identified the '435 Patent as one of the BNR patents being infringed by Apple. The email specifically called out "the Apple products identified in [Mr. Dean's] June 1, 2018 letter providing notice of infringement, as well as similar products including all iPhone variants beginning with the iPhone 7 family and all iPad variants beginning with iPad Wi-Fi (Original)." Despite receiving this email, Apple continued to infringe the '435 Patent by continuing to make, use, sell, and/or offer to sell the '435 Infringing Products in the United States.

261.   Apple's infringement of the '435 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

262.   Apple's infringement of the '435 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

263.   BNR has been damaged by Apple's infringement of the '435 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

264.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '435 Patent, including without limitation and/or not less than a reasonable royalty.

TENTH CLAIM FOR RELIEF

INFRINGEMENT OF U.S. PATENT NO. 8,396,072

265.   BNR re-alleges and incorporates by reference the allegations of the foregoing paragraphs as if fully set forth herein.

266.   The '072 Patent is valid and enforceable under United States Patent Laws.

267.   BNR owns, by assignment, all right, title, and interest in and to the '072 Patent, including the right to collect for past damages.

268.   A copy of the '072 Patent is attached as Exhibit J.

'072 Patent Allegations

269.   Apple designs, makes, sells, and currently uses devices that operate according to the GSM/EDGE standard, including its iPhone and iPad (the "'072 Infringing Products"). *See* https://www.apple.com/iphone/cellular/ (identifying the iPhone models that are compatible with the GSM standard); https://www.apple.com/iphone-12/specs/ (noting that the iPhone 12 models are compliant with GSM/EDGE); https://www.apple.com/ipad/cellular/.

270.   The GSM standard, which was introduced in 1991, establishes protocols for 2G digital cellular networks. By the mid-2010s, GSM was the global standard for mobile communications and accounted for more than 90% of cellular networks worldwide. The '072 Patent reads on version 10.4.0 of the GSM standard, which was published in October 2010. *See* https://www.etsi.org/deliver/etsi_ts/144000_144099/144018/10.04.00_60/ts_144018v100400p.pdf. The GSM standard sets forth a protocol for channeling traffic congestion detection and management in a mobile communication system. *See id.* at 3.3.1.1.1a.

271.   On information and belief after a reasonable investigation, the '072 Infringing Products infringe the '072 Patent. The '072 Infringing Products constitute apparatuses for use in

controlling congestion in a cell of a communications network. For instance, the Apple iPhone 12

is GSM compliant and utilizes the implicit reject indication described in 3.3.1.1.11. *See id.* at

3.3.1.1.1a; https://www.apple.com/iphone-12/specs/. The implicit reject indication from the

network corresponds to the channel traffic congestion detection described in the '072 Patent. *See*

https://www.etsi.org/deliver/etsi_ts/144000_144099/144018/10.04.00_60/ts_144018v100400p.p

df at 3.3.1.1.1a ("The network may at any time include an implicit reject indication for the PS

domain or the CS domain within an IMMEDIATE ASSIGNMENT message using the *IA Rest*

Octets IE (see sub-clause 10.5.2.16) or within an IMMEDIATE ASSIGNMENT REJECT or an

IMMEDIATE ASSIGNMENT EXTENDED message using the *Feature Indicator* IE (see sub-

clause 10.5.2.76)[.]"). Devices operating in accordance with the GSM standard are apparatuses

embodying the described traffic congestion detection.

272.   The '072 Infringing Products include at least one controller and a memory storing

a computer. For instance, the Apple iPhone 12 is GSM/EDGE compliant, and therefore includes

at least one controller and a memory storing a computer program. *See id*. (discussing the roles and

functionalities of the involved base station controllers and mobile stations).

273.   The '072 Infringing Products are configured to receive and read a series of blocks

on a first channel. For instance, the Apple iPhone 12 is GSM/EDGE compliant, and therefore is

configured to receive and read a series of blocks on a first channel. *See*

https://www.etsi.org/deliver/etsi_ts/144000_144099/144018/10.04.00_60/ts_144018v100400p.p

df at 3.3.1.1.2 (noting that "[t]he RR [(Radio Resource)] entity of a mobile state is configured for

'low access priority'…[and] initiates the immediate assignment procedure by leaving idle mode

and listening to the downlink CCCH [(Common Control Channel),]" which indicates receipt of

the first channel.).

274.   The '072 Infringing Products are configured to determine whether there is congestion based on whether said series of blocks comprises a flag indicating that there is congestion, wherein the flag is in at least one of an IMMEDIATE ASSIGNMENT message or an IMMEDIATE ASSIGNMENT REJECT message. For instance, the Apple iPhone 12 is GSM/EDGE compliant and therefore is configured to determine whether there is congestion based on whether said series of blocks comprises a flag indicating that there is congestion. *See id.* at 3.3.1.1.2 (noting that "[i]f the RR message indicates an implicit reject for the CS [(Circuit Switched)] domain (see sub-clause 3.3.1.1.1a) the mobile station shall abort the immediate assignment procedure and initiate the Implicit Reject procedure (see sub-clause 3.3.1.1.3.2a)."). Since the Apple iPhone 12 is GSM/EDGE compliant, the flag is in at least one of an IMMEDIATE ASSIGNMENT message or an IMMEDIATE ASSIGNMENT REJECT message. *See id.* at 3.3.1.1.1a (noting that "[t]he network may at any time include an implicit reject indication for the PS domain or the CS domain within an IMMEDIATE ASSIGNMENT message…or within an IMMEDIATE ASSIGNMENT REJECT.").

275.   In the event that the determination is that there is no congestion, the '072 Infringing Products are configured to initiate an access procedure by transmitting a channel request on a second channel. For instance, the Apple iPhone 12 is GSM/EDGE compliant and therefore in the event that there is a determination that there is no congestion, the device initiates an access procedure by transmitting a channel request on a second channel. *See id.* at 3.3.1.1.2. The GSM standard specifies the following in the event that a determination is reached that there is no congestion: "the RR entity of the mobile station schedules the sending of CHANNEL REQUEST (or EGPRS PACKET CHANNEL REQUEST) messages on the RACH and proceeds according to the remainder of this subclause." *Id.* The RACH (Random Access Channel) constitutes the claimed

second channel. *See id.*

276.   Apple has infringed and is infringing, individually and/or jointly, either literally or under the doctrine of equivalents, at least one or more claims (*e.g.,* claim 1) of the '072 Patent in violation of 35 U.S.C. §§ 271, et *seq.*, directly and/or indirectly, by making, using, offering for sale, selling, offering for lease, leasing in the United States, and/or importing into the United States without authority or license, the '072 Infringing Products.

277.   Apple has been, and currently is, an active inducer of infringement of one or more claims of the '072 Patent under 35 U.S.C. § 271(b). On information and belief, one or more of the '072 Infringing Products directly and/or indirectly infringe (by induced infringement) at least one or more claims (*e.g.,* claim 1) of the '072 Patent, literally and/or under the doctrine of equivalents.

278.   Apple intentionally encourages and aids at least its users to directly infringe the '072 Patent.

279.   Apple provides the '072 Infringing Products and instructions to its users such that they will use the '072 Infringing Products in a directly infringing manner. Apple markets the '072 Infringing Products to its users and provides instructions to its users on how to use the functionality of the '072 Patent on its website and elsewhere. *See, e.g.*, https://www.apple.com/iphone/cellular/; https://www.apple.com/iphone-12/specs/.

280.   Apple users directly infringe by using the '072 Infringing Products in their intended manner. Apple induces such infringement by providing the '072 Infringing Products and instructions to enable and facilitate infringement. On information and belief, Apple specifically intends that its actions will result in infringement of the '072 Patent or has taken deliberate actions to avoid learning of infringement.

281.   Apple's infringement is knowing, egregious, consciously wrongful, and willful.

Apple learned of its infringement of the '072 Patent no later than June 1, 2018. On June 1, 2018, Mr. Afzal Dean, President of BNR, sent a letter to Mr. Tim Cook, CEO of Apple. Mr. Dean's letter informed Mr. Cook that Apple was selling products that implemented features claimed in BNR's patents. The June 1, 2018 letter specifically identified the '072 Patent as one of BNR's "[e]xemplary patents relevant to mobile handsets, tablets and laptops[.]" The letter specifically called out several of Apple's then-current products, such as the "iPhone X, iPad Pro, MacBook Air, MacBook Pro, iMac Pro." Despite receiving this letter, Apple continued to infringe the '072 Patent by continuing to make, use, sell, and/or offer to sell the '072 Infringing Products in the United States. Apple intentionally encourages and aids at least its users to directly infringe the '072 Patent.

282.   Apple's infringement of the '072 Patent is willful and deliberate, entitling BNR to enhanced damages and attorneys' fees.

283.   Apple's infringement of the '072 Patent is exceptional and entitles BNR to attorneys' fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

284.   BNR has been damaged by Apple's infringement of the '072 Patent and will continue to be damaged unless Apple is enjoined by this Court. BNR has suffered and continues to suffer irreparable injury for which there is no adequate remedy at law. The balance of hardships favors BNR, and public interest is not disserved by an injunction.

285.   BNR is entitled to recover from Apple all damages that BNR has sustained as a result of Apple's infringement of the '072 Patent, including without limitation and/or not less than a reasonable royalty.

PRAYER FOR RELIEF

WHEREFORE, BNR respectfully requests that this Court enter judgment in its favor as follows and award BNR the following relief:

(a)   a judgment declaring that Apple has infringed one or more claims of each of the BNR Patents in this litigation pursuant to 35 U.S.C. §§ 271(a) and/or (b);

(b)   an award of damages adequate to compensate BNR for infringement of the BNR Patents by Apple, in an amount to be proven at trial, including supplemental post-verdict damages until such time as Apple ceases its infringing conduct;

(c)   a permanent injunction, pursuant to 35 U.S.C. § 283, prohibiting Apple and its officers, directors, employees, agents, consultants, contractors, suppliers, distributors, all affiliated entities, and all others acting in privity with Apple, from committing further acts of infringement;

(d)   a judgment requiring Apple to make an accounting of damages resulting from Apple's infringement of the BNR Patents;

(e)   enhanced damages for willful infringement;

(f)   the costs of this action, as well as attorneys' fees as provided by 35 U.S.C. § 285;

(g)   pre-judgment and post-judgment interest at the maximum amount permitted by law;

(h)   all other relief, in law or equity, to which BNR is entitled.

DEMAND FOR JURY TRIAL

Plaintiff hereby demands a jury trial for all issues so triable.

Dated: October 4, 2021.

MCKOOL SMITH, P.C.

/s/ David Sochia
David Sochia
Texas State Bar No. 00797470
dsochia@McKoolSmith.com
Ashley N. Moore
Texas State Bar No. 24074748
amoore@McKoolSmith.com
Alexandra F. Easley
Texas State Bar No. 24099022
aeasley@mckoolsmith.com
MCKOOL SMITH, P.C.
300 Crescent Court Suite 1500
Dallas, TX 75201
Telephone: (214) 978-4000
Telecopier: (214) 978-4044

Kathy H. Li
Texas State Bar No. 24070142
kli@McKoolSmith.com
James E. Quigley
Texas State Bar No. 24075810
jquigley@McKoolSmith.com
MCKOOL SMITH, P.C.
303 Colorado Street, Suite 2100
Austin, Texas 78701
Telephone: (512) 692-8700
Facsimile: (512) 692-8744

**ATTORNEYS FOR PLAINTIFF
BELL NORTHERN RESEARCH, LLC**

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the above and foregoing document has been served on all counsel of record via email and the Court's ECF system on October 4, 2021.

/s/ David Sochia
David Sochia