

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

GENERAL ACCESS SOLUTIONS, LTD.,

Plaintiff,

v.

VERIZON COMMUNICATIONS, INC.,
CELLCO PARTNERSHIP D/B/A VERIZON
WIRELESS, VERIZON SERVICES CORP.,
VERIZON BUSINESS GLOBAL, LLC,
VERIZON BUSINESS NETWORK SERVICES,
LLC, VERIZON CORPORATE SERVICES
GROUP, INC., VERIZON DATA SERVICES,
LLC, VERIZON ONLINE, LLC.

Defendants.

CIVIL ACTION NO. 2:22-cv-394

JURY TRIAL DEMANDED

**DISCLOSURE OF INITIAL INFRINGEMENT CONTENTIONS
PURSUANT TO P.R.3-1 AND 3-2**

Pursuant to P.R. 3-1 and 3-2, Plaintiff General Access Solutions, Ltd. (“General Access”) hereby discloses its Initial Infringement Contentions against Defendants Verizon Communications, Inc., Cellco Partnership d/b/a Verizon Wireless, Verizon Services Corp., Verizon Business Global, LLC, Verizon Business Network Services, LLC, Verizon Corporate Services Group Inc., Verizon Data Services, LLC, and Verizon Online, LLC (collectively, “Defendants” or “Verizon”). General Access’s disclosures are based on publicly available information regarding the accused instrumentalities. Fact discovery has not begun, and General Access reserves the right to supplement or amend these disclosures based on additional information obtained through further investigation, discovery, claim construction, expert analysis, or in response to any position taken by Defendants.

I. DISCLOSURE OF ASSERTS CLAIMS AND PRELIMINARY INFRINGEMENT CONTENTIONS

A. Asserted Patent Claims

The patents-in-suit are United States Patent No. 7,230,931 (“the ’931 patent”) and United States Patent No. 9,426,794 (“the ’794 patent”). General Access asserts claims 28 and 29 of the ’931 patent and claims 1-2 and 4-6 of the ’794 patent.

B. Infringing Instrumentalities

General Access asserts that the following instrumentalities (the “Verizon Accused 5G Products”) directly infringe the ’931 patent: Verizon’s 5G base station equipment that utilizes Time Division Duplexing (“TDD”) and beamforming. More specifically, Verizon’s Accused 5G Products include hardware, software, and firmware that enable 5G wireless communication, including but not limited to gNB equipment, base stations, micro cells, pico cells, femto cells, remote radio heads, antennae systems, radio transceiver systems, radio resource management systems, radio network and controller systems.

General Access also asserts that the following Verizon instrumentalities (the “Verizon Accused Wi-Fi Products”) directly infringe the ’794 patent: Mobile phones, MiFi devices, Home Internet devices, Tablets, Laptops, and other devices capable of communicating with Verizon’s 4G and/or 5G network and of routing information to mobile stations using Wi-Fi. Attached hereto as Exhibit C is a list of the Verizon Accused Wi-Fi Products that General Access has identified to date. General Access contends that any other Verizon products made, used, sold, offered for sale, and/or imported into the United States during the relevant period, and that operated similarly to the accused Wi-Fi Products listed in Exhibit C, also infringed the ’794 patent.

General Access reserves the right to amend and/or supplement its identification of infringing products based upon additional information as set forth above.

C. Claim Charts

Pursuant to Patent Rule 3-1(c), attached as Exhibit A is a chart containing General Access's detailed preliminary infringement contentions for the Verizon Accused 5G Products that infringe the '931 patent. Also, attached as Exhibit B is a chart containing General Access's detailed preliminary infringement contentions for the Verizon Accused Wi-Fi Products that infringe the '794 patent.

Exhibits A and B identify specifically where each element of each asserted claim is found within the Verizon Accused 5G Products and Verizon Accused Wi-Fi Products. However, the claim charts and the citations included in Exhibits A and B are exemplary, and are based on the limited publicly-available information regarding the accused instrumentalities and without the benefit of discovery. General Access reserves the rights under P.R. 3-6, Fed. R. Civ. Proc. 26(e), or any other applicable rule, standard, or court order, to modify, amend and/or supplement its preliminary claim chart based upon additional information as set forth above.

D. Doctrine of Equivalents

Pursuant to Patent Rule 3-1(d), General Access alleges that Verizon infringes claims 28 and 29 of the '931 patent and claims 1-2 and 4-6 of the '794 patent. To the extent Verizon asserts that any differences exist between the above-identified claims and Defendants' accused instrumentalities, such differences are insubstantial and the features or components of the accused instrumentalities identified as meeting that element perform substantially the same function, in substantially the same way, to yield substantially the same result as the recited element, and therefore Defendants infringe under the doctrine of equivalents.

In the claim charts attached as Exhibits A and B, General Access has undertaken to identify the specific claim limitations where it anticipates the potential application of the Doctrine of Equivalents, depending on the positions taken by Verizon, evidence produced in discovery and any

applicable claim construction decisions. General Access reserves the right to amend and/or supplement its contentions regarding the doctrine of equivalents in response to the positions taken by Verizon, evidence produced in discovery and any applicable claim construction decisions.

E. Priority Claim to an Earlier Application

Pursuant to Patent Rule 3-1(e), Plaintiff asserts that the patents in suit claim priority to the following applications:

The '931 patent claims priority to provisional application No. 60/273,757, filed on Mar. 5, 2001, provisional application No. 60/273,689, filed on Mar. 5, 2001, provisional application No. 60/273,579, filed on Mar. 5, 2001, provisional application No. 60/270,378, filed on Feb. 21, 2001, provisional application No. 60/270,385, filed on Feb. 21, 2001, provisional application No. 60/270,430, filed on Feb. 21, 2001, provisional application No. 60/262,708, filed on Jan. 19, 2001, provisional application No. 60/262,955, filed on Jan. 19, 2001, provisional application No. 60/263,097, filed on Jan. 19, 2001, provisional application No. 60/263,101, filed on Jan. 19, 2001, provisional application No. 60/262,824, filed on Jan. 19, 2001, provisional application No. 60/262,951, filed on Jan. 19, 2001, provisional application No. 60/262,826, filed on Jan. 19, 2001, provisional application No. 60/262,827, filed on Jan. 19, 2001, provisional application No. 60/262,698, filed on Jan. 19, 2001, provisional application No. 60/262,825, filed on Jan. 19, 2001, provisional application No. 60/262,712, filed on Jan. 19, 2001.

General Access contends that the asserted claims of the '931 patent are each entitled to a priority date of at least as early as January 19, 2001, which is the filing date of the earliest provisional applications identified in the '931 patent. In prior litigation against Sprint, Sprint obtained summary judgment that there was insufficient evidence to support the finding of a priority date earlier than the filing date of the '931 patent. General Access's investigation is ongoing, and to the extent additional evidence of conception and reduction to practice is developed or the applicable legal

standards change, General Access intends to assert the earliest priority date supported by the evidence.

The '794 patent claims priority to provisional application No. 60/262,825, filed on Jan. 19, 2001, provisional application No. 60/262,698, filed on Jan. 19, 2001, provisional application No. 60/262,827, filed on Jan. 19, 2001, provisional application No. 60/262,826, filed on Jan. 19, 2001, provisional application No. 60/262,951, filed on Jan. 19, 2001, provisional application No. 60/262,824, filed on Jan. 19, 2001, provisional application No. 60/263,101, filed on Jan. 19, 2001, provisional application No. 60/263,097, filed on Jan. 19, 2001, provisional application No. 60/273,579, filed on Mar. 5, 2001, provisional application No. 60/262,955, filed on Jan. 19, 2001, provisional application No. 60/273,689, filed on Mar. 5, 2001, provisional application No. 60/273,757, filed on Mar. 5, 2001, provisional application No. 60/270,378, filed on Feb. 1, 2001, provisional application No. 60/270,385, filed on Feb. 21, 2001, provisional application No. 60/270,430, filed on Feb. 21, 2001, provisional application No. 60/262,708, filed on Jan. 19, 2001, provisional application No. 09/713,684, filed on Nov. 15, 2000.

General Access contends that the Asserted Claims of the '794 patent are each entitled to a priority date of at least as early as November 15, 2000, which is the filing date of the earliest provisional applications identified in the '794 patent. General Access's investigation is ongoing, and it reserves the right to amend or supplement this portion of its disclosure based upon additional information as set forth above.

F. Practice of the Claimed Invention

Pursuant to Patent Rule 3-1(f), General Access states that it does not practice the asserted claims of the '931 and '794 patents. General Access further states that its predecessors-in-interest to the patents, specifically Raze Technologies, Inc. (both the Texas and Delaware entities) ("Raze"), may have practiced the asserted claims. Before ceasing operations, Raze developed and/or was

working to develop prototypes that practiced the asserted claims. The overall system developed and/or in development by Raze was sometimes referred to as SkyFire, and the beamforming technology was sometimes referred to as SkyBeam. General Access is continuing to investigate this issue, and reserves the right to amend or supplement this portion of its disclosure based upon additional information as set forth above. The above statements are not intended to suggest that the asserted claims should in any way be limited to or construed as being co-extensive with any prototypes developed by Raze.

II. DOCUMENT PRODUCTION ACCOMPANYING DISCLOSURE

A. Disclosure Prior to Application Date

Consistent with P.R. 3-2(a), General Access has produced communications with third parties about technology related to the patents in suit that predate the application of the patent that it has located to date, including the documents listed in Exhibit D. By identifying these documents, General Access does not concede that it disclosed the claimed invention to any third party prior to the filing the patents in suit or any related provisional applications. General Access's production and disclosure does not constitute an admission that the identified documents evidence or constitute prior art under 35 U.S.C. § 102.

B. Conception and Reduction to Practice

Consistent with P.R. 3-2(b), General Access has produced documents related to the conception, reduction to practice, design, and/or development of the claimed inventions that it has located to date, including the documents listed in Exhibit E.

C. File History for Patents-in-Suit

The patent file history for the '931 patent has been produced at GA0200754 - GA0201080. The file history for the '794 patent has been produced at GA0200000 - GA0200753.

Dated: January 5, 2023

Respectfully submitted,

/s/ Glen E. Summers

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing document was filed electronically in compliance with Local Rule CV-5(a) on January 5, 2023.

/s/ Glen E. Summers

EXHIBIT A

Exhibit A

Verizon's 5G Infringement

Verizon has directly infringed the '931 patent—either literally or under the doctrine of equivalents—by making, using, selling, offering for sale, and/or importing into the United States Verizon's Accused 5G Products, which are covered by claims 28 and 29 of the '931 patent (the "Asserted Claims"). General Access contends that each limitation of the Asserted Claims is literally present in the Defendants' Accused 5G Products. To the extent that any limitation is not literally present, General Access contends that it is present under the doctrine of equivalents.

This exhibit addresses how Verizon's 5G network operates utilizing beamforming and TDD to infringe the Asserted Claims when transmitting in dual mode and/or standalone 5G mode.

Verizon has long touted its use of 5G technology:

Verizon has been at the forefront of developing 5G standards. In 2015, Verizon created the [5G Technology Forum](#) (5GTF) to spearhead the development of the 5G ecosystem, bringing together partners like Ericsson, Intel, Samsung and Qualcomm. The 5G Technology Forum accelerated the release of the 3GPP [5G New Radio](#) (NR) standard in December of 2017.

<https://www.verizon.com/about/news/5g-standards>.

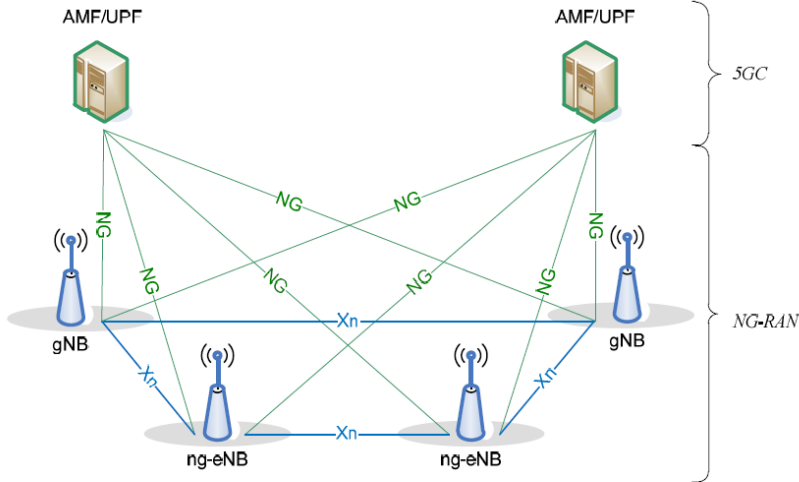
	Claim	Infringement Contentions
1.	CLAIM 1 NOT ASSERTED. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:	<p>The preamble is non-limiting. To the extent the preamble may be construed as a limitation, Verizon's Accused 5G Products are transceivers for use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, where a transceiver associated with a first of said plurality of base stations includes all elements of claim 1.</p> <p>Verizon's 5G network is a wireless network. That network includes base stations, which, in turn, include radio transceivers that operate utilizing bidirectional TDD to communicate with wireless access devices on the network. The network is capable of communicating with wireless access devices disposed at a variety of locations. <i>See, e.g.:</i></p> <p>5G is the 5th generation of mobile technology – the next step that will eventually replace 4G throughout the world. For consumers and businesses, 5G can provide a faster, more responsive, and overall better experience. What does that mean in real terms? Uploading pictures, or videos faster, even when connected in crowded areas. It also means downloading</p>

	Claim	Infringement Contentions
		<p>can be quicker. For home internet, it means replacing fiber-optic cable with a fast wireless connection that comes right through your window.</p> <p>https://www.verizon.com/coverage-map/ (“What is 5G”).</p> <p>Verizon offers two types of 5G service: 5G Ultra Wideband and 5G Nationwide. 5G Ultra Wideband is Verizon’s fastest 5G. Compared to typical 4G speeds, it runs up to 10x as fast, and responds quicker. Coverage is now expanding to more parts of the country (see map above). 5G Nationwide runs alongside 4G LTE, and delivers a similar experience to Verizon’s 4G LTE network to provide a widely available 5G network that offers convenience and reliability. Only our top Unlimited plans provide access to both 5G Ultra Wideband and 5G Nationwide. All other plans provide access to 5G Nationwide only.</p> <p><i>Id.</i> (“What is the difference between Verizon 5G Ultra Wideband and 5G Nationwide?”).</p> <p><i>See also</i>, https://www.verizon.com/coverage-map/ (depicting the locations covered by Verizon’s Accused 5G Products); https://beebom.com/list-5g-bands-us-verizon-att-sprint-t-mobile/ (listing TDD spectrum utilized in Verizon’s 5G network).</p> <p>Verizon’s Accused 5G Products are capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises. Verizon recently boasted that its 5G Home customers “[e]xperience max download speeds up to 1Gbps, with typical download speeds of 300 Mbps.” <i>See</i> https://www.verizon.com/about/news/verizon-expands-5g-homeinternet. Verizon has also noted that its customers experience “[t]ypical upload speeds around 50Mbps.” <i>Id.</i> Verizon has similarly touted its mobile users’ communication speeds. <i>See id.</i></p> <p><i>See also</i>, ETSI TS 138 201 V17.0.0 2022-05 p. 7:</p>

	Claim	Infringement Contentions
		<div>3GPP TS 38.201 version 17.0.0 Release 177ETSI TS 138 201 V17.0.0 (2022-05)</div> <p>a transport channel to MAC. The transport channel is characterized by how the information is transferred over the radio interface. MAC offers different logical channels to the Radio Link Control (RLC) sub-layer of Layer 2. A logical channel is characterized by the type of information transferred.</p> <p>4.1.2 Service provided to higher layers</p> <p>The physical layer offers data transport services to higher layers. The access to these services is through the use of a transport channel via the MAC sub-layer. Details are specified in [2].</p> <p>4.2 General description of layer 1</p> <p>4.2.1 Multiple access</p> <p>The multiple access scheme for the NR physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP). For uplink, Discrete Fourier Transform-spread-OFDM (DFT-s-OFDM) with a CP is also supported. To support transmission in paired and unpaired spectrum, both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) are enabled.</p> <p><i>See also</i> ETSI TS 138 201 V16.0.0 2020-09 p.7.</p> <p>5G NR base stations are capable of bidirectional time division duplex (TDD) as discussed in Dahlman:</p>

	Claim	Infringement Contentions
		<p>7.8 Duplex Schemes</p> <p>Spectrum flexibility is one of the key features of NR. In addition to the flexibility in transmission bandwidth, the basic NR structure also supports separation of uplink and downlink in time and/or frequency subject to either half duplex or full duplex operation, all using the same single frame structure. This provides a large degree of flexibility (Fig. 7.15):</p> <ul style="list-style-type: none"> • TDD—uplink and downlink transmissions use the same carrier frequency and are separated in time only; <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition pp. 120-121</i></p> <p>3GPP 5G networks, like Verizon’s 5G network, are wireless access networks comprising a plurality of base stations:</p> <p>4.2.1 The Base Station System (BSS)</p> <p>The Base Station System (BSS) is the system of base station equipments (transceivers, controllers, etc.) which is viewed by the MSC through a single A and/or Iu-CS interface as being the entity responsible for communicating with Mobile Stations in a certain area. Similarly, in PLMNs supporting GPRS, the BSS is viewed by the SGSN through a single Gb or Iu-PS interface. When Intra Domain Connection of RAN Nodes to Multiple CN Nodes is applied, a BSS may connect to several MSCs by several A and/or Iu-CS interfaces, and a BSS may connect to several SGSNs by several Gb and/or Iu-PS interfaces. The functionality for the A interface is described in TS 48.002 [14] and for the Gb interface in TS 23.060 [9a]. The functionality for the Iu-CS interface is described in TS 25.410 [14a] and for the Iu-PS interface in TS 23.060 [9a].</p> <p>The radio equipment of a BSS may support one or more cells. A BSS may consist of one or more base stations. Where an Abis-interface is implemented, the BSS consists of one Base Station Controller (BSC) and one or more Base Transceiver Station (BTS). The split of functions between BSS and CN for a Iu interface is described in the 25-series of UMTS Technical Specifications.</p> <p><i>See ETSI TS 123 002 V17.0.0 2022-05 p. 36. See also ETSI TS 123 002 V16.0.0 2020-07 p. 34-35.</i></p>

	Claim	Infringement Contentions
		<p>3GPP 5G base stations that use TDD bands, like Verizon’s Accused 5G Products, are capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network:</p> <p>3GPP TS 23.002 version 17.0.0 Release 17 38 ETSI TS 123 002 V17.0.0 (2022-05)</p> <p>4.4 User Equipment (UE)</p> <p>The User Equipment Allows a user access to network services. For the purpose of 3GPP specifications the interface between the UE and the network is the radio interface. A User Equipment can be subdivided into a number of domains, the domains being separated by reference points. Currently the User Equipment is subdivided into the UICC domain and the ME Domain. The ME Domain can further be subdivided into one or more Mobile Termination (MT) and Terminal Equipment (TE) components showing the connectivity between multiple functional groups.</p> <p><i>See ETSI TS 123 002 V17.0.0 2022-05 pp. 37-38. See also, ETSI TS 123 002 V16.0.0 2020-07 pp. 36-37.</i></p> <hr/> <p>4 Overall Architecture and Functional Split</p> <p>4.1 Overall Architecture</p> <p>An NG-RAN node is either:</p> <ul style="list-style-type: none"> - a gNB, providing NR user plane and control plane protocol terminations towards the UE; or - an ng-eNB, providing E-UTRA user plane and control plane protocol terminations towards the UE. <p>The gNBs and ng-eNBs are interconnected with each other by means of the Xn interface. The gNBs and ng-eNBs are also connected by means of the NG interfaces to the 5GC, more specifically to the AMF (Access and Mobility Management Function) by means of the NG-C interface and to the UPF (User Plane Function) by means of the NG-U interface (see TS 23.501 [3]).</p> <p>NOTE: The architecture and the F1 interface for a functional split are defined in TS 38.401 [4].</p> <p>The NG-RAN architecture is illustrated in Figure 4.1-1 below.</p>

	Claim	Infringement Contentions
		 <p style="text-align: center;">Figure 4.1-1: Overall Architecture</p> <p>See ETSI TS 138 300 V17.2.0 2022-10 p. 20. See also ETSI TS 138 300 V16.2.0 2020-07 p.15-16.</p> <p>The transceivers in the Defendants’ Accused 5G Products include the remaining elements of Claim 1.</p>
1.1	transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals	<p>Verizon’s 5G Accused Products contain transceivers that include transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals. For example, Verizon’s 5G base stations includes beamforming technology that is capable of transmitting directed scanning beam signals. <i>See, e.g.:</i></p> <p>https://www.verizon.com/business/resources/5g/5g-business-mobility-capabilities/:</p> <ul style="list-style-type: none"> • “Beamforming is a technology used by cellular base stations to handle the high speeds and traffic of 5G.” • Beamforming “refers to the process of concentrating transmit power to a small area using multiple antennas to increase coverage and capacity.” <i>Id.</i> “This process identifies the most

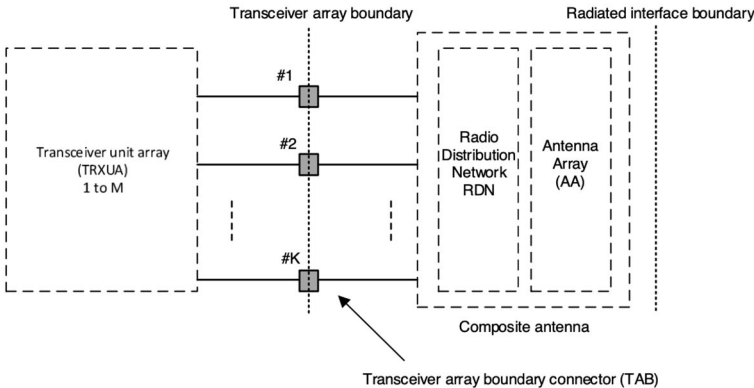
	Claim	Infringement Contentions
		<p>efficient route for data delivery to a specific user, while reducing interference for nearby users at the same time.” <i>Id.</i></p> <p><i>See also:</i> https://www.verizon.com/business/resources/articles/5g-beamforming-massive-mimo/:</p> <ul style="list-style-type: none"> • “Beamforming is a foundational technology that works hand in glove with massive MIMO to direct beams of transmission data both horizontally and vertically toward user devices.” • “Thanks to our vast expertise in beamforming, massive MIMO and general technology innovation, Verizon is uniquely situated to scale the rollout of 5G Ultra Wideband and offer users a breadth of network capabilities.” <p><i>See also:</i> https://www.verizon.com/about/news/verizon-starts-c-band-equipment-deployment:</p> <p>Ericsson is partnering with Verizon to provide its industry-leading Antenna-Integrated Radio (AIR) product from the Ericsson Radio System portfolio to support Verizon’s network deployment. Ericsson’s solution leverages a superior massive Multiple Input Multiple Output (MIMO) architecture offering high performance through Ericsson Uplink Booster and advanced beamforming technology to provide a better user experience. Recent C-band performance tests have demonstrated record-breaking data rates in both uplink and downlink on a single user device.</p> <p>“Ericsson has the expertise and track record to deliver best-performing 5G networks globally, and we continue to push technological advancements with our long-standing partner Verizon in delivering on their 5G ambitions,” said Graham Osborne, Vice President and Head of Customer Unit Verizon, Ericsson North America.</p> <p>Samsung’s Massive MIMO radios and fully virtualized RAN (vRAN) are among the first solutions the company is providing for Verizon’s C-band commercial network. To deliver optimal 5G user experiences, Samsung’s Massive MIMO radio is designed to support high-capacity and throughput, and includes field-proven advanced beamforming technology. By leveraging the two companies’ prior collaboration – on the industry’s first wide-scale commercial vRAN – Samsung’s new C-band Massive MIMO radios can be deployed faster</p>

	Claim	Infringement Contentions
		<p>and more efficiently via their software-driven management and commissioning in Verizon’s virtualized network architecture.</p> <p>"Samsung and Verizon continue to expand our network collaboration – from delivering CDMA to introducing 5G Home and vRAN commercialization. Today, we are proud to support Verizon in their C-band deployment to further expand 5G Ultra Wideband service,” said Magnus Ojert, Senior Vice President and Head of Verizon Division, Networks Business at Samsung Electronics America. “Samsung’s C-Band and true virtualized solutions deliver the power and flexibility required to bring forward the full potential of 5G and enhance user experiences for Verizon’s customers.”</p> <p><i>See also</i> https://www.lightreading.com/5g/samsungs-\$66b-5g-deal-with-verizon-bodes-ill-for-nokia/d/d-id/763713 (discussing \$6.6 billion deal related to Samsung’s supply of 5G equipment to Verizon).</p> <p>The relevant 5G standards also discuss beamforming capabilities of 5G base stations. <i>See, e.g.</i>, ETSI TS 138 101-4 V16.10.0 2022-10 p. 493:</p>

	Claim	Infringement Contentions
		<hr/> <h2 data-bbox="667 289 1822 337">B.4 Physical signals, channels mapping and precoding</h2> <h3 data-bbox="667 386 953 427">B.4.1 General</h3> <p data-bbox="667 456 1877 618">Unless otherwise stated, the transmission on antenna port(s) $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1$ is defined by using a precoder matrix $W(i)$ of size $N_{ANT} \times N_p$, where N_{ANT} is the number of physical transmit antenna elements configured per test, N_p is the number of ports for a reference signal or physical channel configured per test, and p_0 is the first port for that reference signal or physical channel as defined in clauses 7.3 and 7.4 in TS 38.211 [9]. This precoder takes as an input a block of signals for antenna port(s) $p = p_0, p_0 + 1, \dots, p_0 + N_p - 1$, $y^{(p)}(i) = [y^{(p_0)}(i) \ y^{(p_0+1)}(i) \ \dots \ y^{(p_0+N_p-1)}(i)]^T$, $i = 0, 1, \dots, M_{\text{synt}}^{\text{ap}} - 1$, with $M_{\text{synt}}^{\text{ap}}$ being the number of modulation symbols per antenna port including the reference signal symbols, and generates a block of signals $y_{bf}^{(q)}(i) = [y_{bf}^{(0)}(i) \ y_{bf}^{(1)}(i) \ \dots \ y_{bf}^{(N_{ANT}-1)}(i)]^T$ the elements of which are to be mapped onto the frequency-time index pair (k, l) as per the test configuration but transmitted on different physical antenna elements:</p> $y_{bf}^{(q)}(i) = W(i)y^{(p)}(i)$ <p data-bbox="667 907 1341 943"><i>See also</i> 3GPP TS 38.104 version 17.7.0 (2022-10) p. 198:</p>

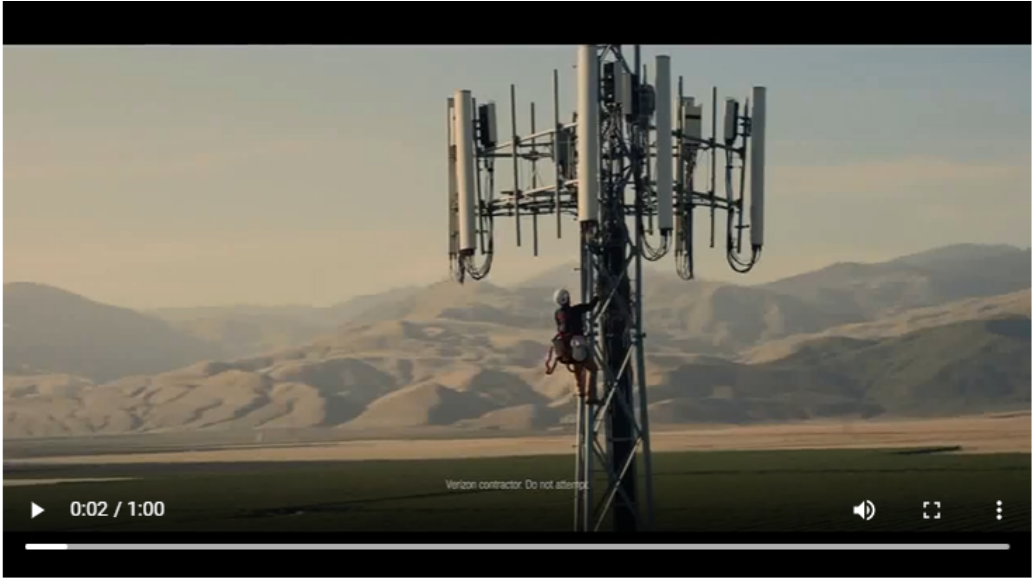
	Claim	Infringement Contentions
		<p>9.2 Radiated transmit power</p> <p>9.2.1 General</p> <p><i>BS type 1-H, BS type 1-O and BS type 2-O</i> are declared to support one or more beams, as per manufacturer's declarations specified in TS 38.141-2 [6]. Radiated transmit power is defined as the EIRP level for a declared beam at a specific <i>beam peak direction</i>.</p> <p>For each beam, the requirement is based on declaration of a beam identity, <i>reference beam direction pair</i>, beamwidth, <i>rated beam EIRP</i>, <i>OTA peak directions set</i>, the <i>beam direction pairs</i> at the maximum steering directions and their associated <i>rated beam EIRP</i> and beamwidth(s).</p> <p>For a declared beam and <i>beam direction pair</i>, the <i>rated beam EIRP</i> level is the maximum power that the base station is declared to radiate at the associated <i>beam peak direction</i> during the <i>transmitter ON period</i>.</p> <p>For each <i>beam peak direction</i> associated with a <i>beam direction pair</i> within the <i>OTA peak directions set</i>, a specific <i>rated beam EIRP</i> level may be claimed. Any claimed value shall be met within the accuracy requirement as described below. <i>Rated beam EIRP</i> is only required to be declared for the <i>beam direction pairs</i> subject to conformance testing as detailed in TS 38.141-2 [6].</p> <p>NOTE 1: <i>OTA peak directions set</i> is set of <i>beam peak directions</i> for which the EIRP accuracy requirement is intended to be met. The <i>beam peak directions</i> are related to a corresponding contiguous range or discrete list of <i>beam centre directions</i> by the <i>beam direction pairs</i> included in the set.</p> <p>NOTE 2: A <i>beam direction pair</i> is data set consisting of the <i>beam centre direction</i> and the related <i>beam peak direction</i>.</p> <p>NOTE 3: A declared EIRP value is a value provided by the manufacturer for verification according to the conformance specification declaration requirements, whereas a claimed EIRP value is provided by the manufacturer to the equipment user for normal operation of the equipment and is not subject to formal conformance testing.</p> <p><i>See also</i> TSI TS 138 101-4 V16.10.0 2022-10 p. 26:</p>

	Claim	Infringement Contentions
		<p>4.4 Base station classes</p> <p>The requirements in this specification apply to Wide Area Base Stations, Medium Range Base Stations and Local Area Base Stations unless otherwise stated. The associated deployment scenarios for each class are exactly the same for BS with and without connectors.</p> <p>For BS <i>type 1-O</i> and 2-O, BS classes are defined as indicated below:</p> <ul style="list-style-type: none"> - Wide Area Base Stations are characterised by requirements derived from Macro Cell scenarios with a BS to UE minimum distance along the ground equal to 35 m. - Medium Range Base Stations are characterised by requirements derived from Micro Cell scenarios with a BS to UE minimum distance along the ground equal to 5 m. - Local Area Base Stations are characterised by requirements derived from Pico Cell scenarios with a BS to UE minimum distance along the ground equal to 2 m. <p>For BS <i>type 1-C</i> and 1-H, BS classes are defined as indicated below:</p> <ul style="list-style-type: none"> - Wide Area Base Stations are characterised by requirements derived from Macro Cell scenarios with a BS to UE minimum coupling loss equal to 70 dB. - Medium Range Base Stations are characterised by requirements derived from Micro Cell scenarios with a BS to UE minimum coupling loss equals to 53 dB. - Local Area Base Stations are characterised by requirements derived from Pico Cell scenarios with a BS to UE minimum coupling loss equal to 45 dB.

	Claim	Infringement Contentions
		<p>4.3.2 BS type 1-H</p> <p>For <i>BS type 1-H</i>, the requirements are defined for two points of reference, signified by radiated requirements and conducted requirements.</p>  <p>Figure 4.3.2-1: Radiated and conducted reference points for <i>BS type 1-H</i></p> <p>Radiated characteristics are defined over the air (OTA), where the <i>operating band</i> specific radiated interface is referred to as the <i>Radiated Interface Boundary</i> (RIB). Radiated requirements are also referred to as OTA requirements. The (spatial) characteristics in which the OTA requirements apply are detailed for each requirement.</p> <p>Conducted characteristics are defined at individual or groups of <i>TAB connectors</i> at the <i>transceiver array boundary</i>, which is the conducted interface between the transceiver unit array and the composite antenna.</p> <p>The transceiver unit array is part of the composite transceiver functionality generating modulated transmit signal structures and performing receiver combining and demodulation.</p> <p>The transceiver unit array contains an implementation specific number of transmitter units and an implementation specific number of receiver units. Transmitter units and receiver units may be combined into transceiver units. The transmitter/receiver units have the ability to transmit/receive parallel independent modulated symbol streams.</p> <p>The composite antenna contains a radio distribution network (RDN) and an antenna array. The RDN is a linear passive network which distributes the RF power generated by the transceiver unit array to the antenna array, and/or distributes the radio signals collected by the antenna array to the transceiver unit array, in an implementation specific way.</p> <p>How a conducted requirement is applied to the <i>transceiver array boundary</i> is detailed in the respective requirement clause.</p> <p>The base stations used in Verizon's 5G network include transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals. Transmit path circuitry associated with a beam forming network may comprise circuitry of one or more antenna</p>

	Claim	Infringement Contentions
		<p>arrays, each capable of transmitting one or more directed scanning beam signals to one or more sectors. As discussed below, the transmit path circuitry of Verizon's Accused 5G Products also includes the other capabilities described in Claim 1.</p> <p>For all the reasons discussed above, General Access contends that transmit path circuitry in Verizon's 5G base stations literally satisfies this claim limitation. To the extent that circuitry is found not to literally satisfy this limitation, General Access contends that it satisfies this limitation under the doctrine of equivalents.</p>
1.1.a	each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station,	<p>In Verizon's Accused 5G Products, directed scanning beam signal are each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station.</p> <p>For example, in Verizon's network, beamforming is used to direct scanning beam signals to a subset of user equipment. <i>See, e.g.</i>:</p> <p>https://www.verizon.com/business/resources/5g/5g-business-mobility-capabilities/:</p> <ul style="list-style-type: none"> • “Beamforming is a technology used by cellular base stations to handle the high speeds and traffic of 5G.” Beamforming “refers to the process of concentrating transmit power to a small area using multiple antennas to increase coverage and capacity.” <i>Id.</i> “This process identifies the most efficient route for data delivery to a specific user, while reducing interference for nearby users at the same time.” <i>Id.</i> • “Beamforming is a foundational technology that works hand in glove with massive MIMO to direct beams of transmission data both horizontally and vertically toward user devices.” <p>https://www.verizon.com/business/resources/articles/5g-beamforming-massive-mimo/:</p> <p>Ericsson is partnering with Verizon to provide its industry-leading Antenna-Integrated Radio (AIR) product from the Ericsson Radio System portfolio to support Verizon's network deployment. Ericsson's solution leverages a superior massive Multiple Input Multiple Output (MIMO) architecture offering high performance through Ericsson Uplink Booster and advanced beamforming technology to provide a better user experience. Recent C-band</p>

	Claim	Infringement Contentions
		<p>performance tests have demonstrated record-breaking data rates in both uplink and downlink on a single user device.</p> <p>...</p> <p>Samsung's Massive MIMO radios and fully virtualized RAN (vRAN) are among the first solutions the company is providing for Verizon's C-band commercial network. To deliver optimal 5G user experiences, Samsung's Massive MIMO radio is designed to support high-capacity and throughput, and includes field-proven advanced beamforming technology.</p> <p>https://www.samsung.com/global/business/networks/insights/press-release/0419-verizon-starts-c-band-equipment-deployment/</p> <p>Verizon's base stations typically have multiple antenna arrays, each of which transmits substantially only to wireless access devices in a geographic portion of the cell site. For example, the 5G cell tower shown in the following image from Verizon's "This is 5G Built Right" ad depicts numerous antenna arrays, each pointed in a different direction and serving users located in different geographic areas of the cell site:</p>

	Claim	Infringement Contentions
		<div data-bbox="751 250 1776 824"></div> <p data-bbox="646 862 1749 898">Available at: https://www.ispot.tv/ad/OSES/verizon-5g-5g-built-right-network-mission.</p> <p data-bbox="646 935 1898 1109">Verizon’s 5G antenna arrays also direct focused, beamformed signals substantially only to wireless access devices in smaller geographic portions of the cell site. For example, Verizon’s field tests of its 5G equipment have shown the significant downlink data speeds it achieved by transmitting directed scanning beam signals to substantially only wireless access devices within a different one of a plurality of sectors of a cell site:</p>

	Claim	Infringement Contentions
		 <p>See https://www.cnet.com/pictures/heres-what-verizons-5g-field-test-looks-like-pictures/8/. In the above image, an antenna array in a Verizon 5G base station directs a scanning beam signal to substantially only wireless access devices within the geographic area highlighted in orange, and directs a different directed scanning beam signal to substantially only wireless access devices within the geographic area highlighted in blue.</p>

1.1.1	<p>wherein said transmit path circuitry transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and</p>	<p>Verizon's 5G Accused Products include said transmit path circuitry transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field.</p> <p>As discussed above, Verizon's 5G network utilizes TDD. TDD transmissions in 5G include a broadcast beam signal comprising information contained within the PBCH, PSS, and SSS (collectively, the "SS Block" or "SS/PBCH Block") at a start of a repeating logical data frame. This signal is broadcast to multiple sectors. The SS Block comprises a start of frame field. The SS/PBCH block provides a reference for the UE to detect a start of frame as well as to locate resources to allow the UE to decode the rest of the frame.</p> <p>When decoding information received in a given frame, a wireless device starts by decoding the broadcast information received in a transmitted TDD frame. <i>See, e.g.:</i></p> <p>16.1.5.1 The Primary Synchronization Sequence (PSS) The PSS is the first signal that a device entering the system will search for. At that stage, the device has no knowledge of the system timing.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition pp. 317-318.</i></p> <p>16.1.5.2 The Secondary Synchronization Sequence (SSS) Once a device has detected a PSS it knows the transmission timing of the SSS. By detecting the SSS, the device can determine the PCI of the detected cell.</p> <p><i>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 319). Elsevier Science. Kindle Edition.</i></p> <p>16.1.5.3 PBCH While the PSS and SSS are physical signals with specific structures, the PBCH is a more conventional physical channel on which explicit channel-coded information is transmitted. The PBCH carries the master information block (MIB), which contains a small amount of information that the device needs in order to be able to acquire the remaining system information broadcast by the network.</p> <p><i>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 319). Elsevier Science. Kindle Edition.</i></p>
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		<p>The contents of the PBCH include SIB1 numerology and SIB1 configuration.</p> <p>The SIB1 numerology provides information about the subcarrier spacing used for the transmission of the so-called SIB1, which is part of the system information (see Section 16.1.6).</p> <p><i>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 321). Elsevier Science. Kindle Edition.</i></p> <p>16.1.6 Providing Remaining System Information</p> <p>System information is a joint name for all the common (non-device-specific) information that a device needs in order to properly operate within the network. In general, the system information is carried within different System Information Blocks (SIBs), each consisting of different types of system information. In LTE, all system information is periodically broadcast over the entire cell area making it always available but also implying that it is transmitted even if there is no device within the cell. For NR, a different approach has been adopted where the system information, beyond the very limited information carried within the MIB, has been divided into two parts.</p> <p>SIB1, sometimes also referred to as the remaining minimum system information (RMSI) consists of the system information that a device needs to know before it can access the system. SIB1 is always periodically broadcast over the entire cell area. One important task of SIB1 is to provide the information the device needs in order to carry out an initial random access (see Section 16.2).</p> <p><i>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 322). Elsevier Science. Kindle Edition.</i></p> <p>3GPP 38.211 (clause 7.4.3) defines the SS/PBCH block for 5GNR as containing the PSS (primary synchronization signal) located in the first OFDM symbol of the SS/PBCH block. See Table 7.4.3.1-1 from 38.211:</p>
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Table 7.4.3.1-1: Resources within an SS/PBCH block for PSS, SSS, PBCH, and DM-RS for PBCH.

Channel or signal	OFDM symbol number l relative to the start of an SS/PBCH block	Subcarrier number k relative to the start of an SS/PBCH block
PSS	0	56, 57, ..., 182
SSS	2	56, 57, ..., 182
Set to 0	0	0, 1, ..., 55, 183, 184, ..., 239
	2	48, 49, ..., 55, 183, 184, ..., 191
PBCH	1, 3	0, 1, ..., 239
	2	0, 1, ..., 47, 192, 193, ..., 239
	1, 3	$0 + v, 4 + v, 8 + v, \dots, 236 + v$
DM-RS for PBCH		$0 + v, 4 + v, 8 + v, \dots, 44 + v$
	2	$192 + v, 196 + v, \dots, 236 + v$

The locations of the remainder of the SS/PBCH block are included in the above table.

The SS/PBCH block allows the UE to synchronize to the base station as described in 38.213 §4:

3GPP TS 38.213 version 17.3.0 Release 17

10

ETSI TS 138 213 V17.3.0 (2022-09)

4 Synchronization procedures

4.1 Cell search

Cell search is the procedure for a UE to acquire time and frequency synchronization with a cell and to detect the physical layer Cell ID of the cell.

A UE receives the following synchronization signals (SS) in order to perform cell search: the primary synchronization signal (PSS) and secondary synchronization signal (SSS) as defined in [4, TS 38.211].

A UE assumes that reception occasions of a physical broadcast channel (PBCH), PSS, and SSS are in consecutive symbols, as defined in [4, TS 38.211], and form a SS/PBCH block. The UE assumes that SSS, PBCH DM-RS, and PBCH data have same EPRE. The UE may assume that the ratio of PSS EPRE to SSS EPRE in a SS/PBCH block is either 0 dB or 3 dB. If the UE has not been provided dedicated higher layer parameters, the UE may assume that the ratio of PDCCH DMRS EPRE to SSS EPRE is within -8 dB and 8 dB when the UE monitors PDCCHs for a DCI format 1_0 with CRC scrambled by SI-RNTI, P-RNTI, or RA-RNTI, or for a DCI format 2_7.

The SS/PBCH block is also used for radio link monitoring as described in 3GPP 38.213 §5:

5 Radio link monitoring

The downlink radio link quality of the primary cell is monitored by a UE for the purpose of indicating out-of-sync/in-sync status to higher layers. The UE is not required to monitor the downlink radio link quality in DL BWPs other than the active DL BWP, as described in Clause 12, on the primary cell. If the active DL BWP is the initial DL BWP and for SS/PBCH block and CORESET multiplexing pattern 2 or 3, as described in Clause 13, the UE is expected to perform RLM using the associated SS/PBCH block when the associated SS/PBCH block index is provided by *RadioLinkMonitoringRS*.

An example of the structure and location of the SS/PBCH block is shown below:

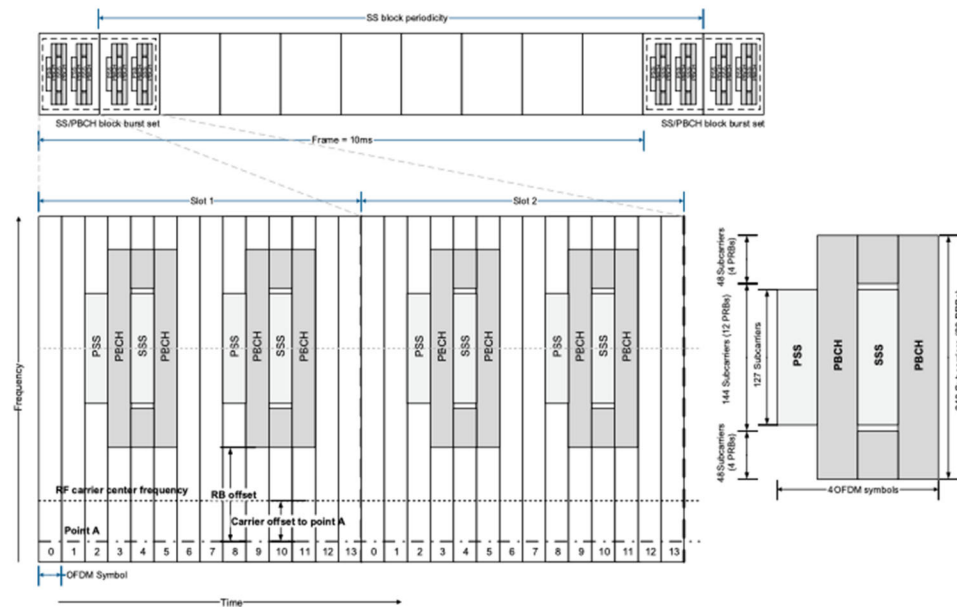


Figure 4.29

Time-frequency structure of the PSS within an SS block [6,56].

See “5G NR Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards”, Sassan Ahmadi (2009) p. 480.

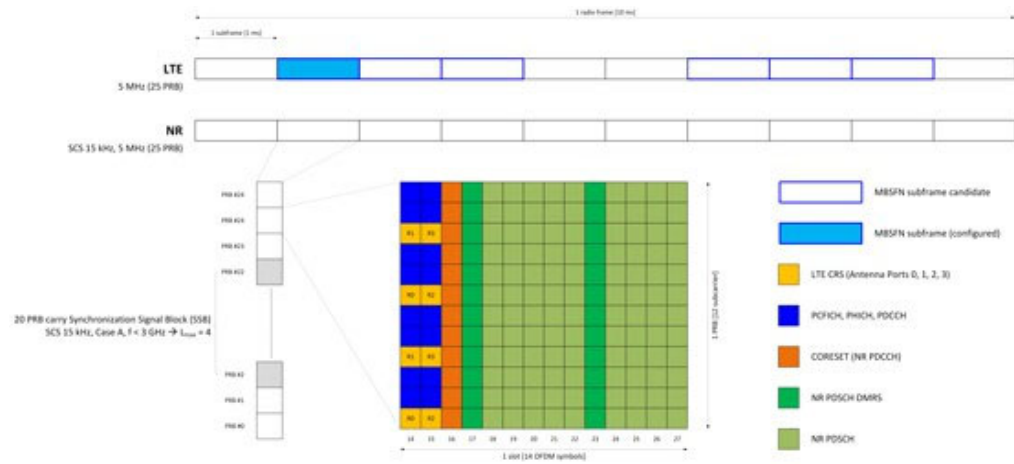


Figure 1 NR signal configuration within the MBSFN subframe.

NR and LTE Coexistence Through Dynamic Spectrum Sharing | Microwave Journal | 2019-12-09.

5.2.4 Synchronization signal and PBCH block

The Synchronization Signal and PBCH block (SSB) consists of primary and secondary synchronization signals (PSS, SSS), each occupying 1 symbol and 127 subcarriers, and PBCH spanning across 3 OFDM symbols and 240 subcarriers, but on one symbol leaving an unused part in the middle for SSS as show in Figure 5.2.4-1. The possible time locations of SSBs within a half-frame are determined by sub-carrier spacing and the periodicity of the half-frames where SSBs are transmitted is configured by the network. During a half-frame, different SSBs may be transmitted in different spatial directions (i.e. using different beams, spanning the coverage area of a cell).

Within the frequency span of a carrier, multiple SSBs can be transmitted. The PCIs of SSBs transmitted in different frequency locations do not have to be unique, i.e. different SSBs in the frequency domain can have different PCIs. However, when an SSB is associated with an RMSI, the SSB is referred to as a Cell-Defining SSB (CD-SSB). A PCell is always associated to a CD-SSB located on the synchronization raster.

		<p>3GPP TS 38.300 version 17.2.0 Release 17</p> <p>35</p> <p>ETSI TS 138 300 V17.2.0 (2022-10)</p> <p>Figure 5.2.4-1: Time-frequency structure of SSB</p> <p>ETSI TS 138 300 V17.2.0 2022-10 pp. 34-35</p> <p>The PBCH, MIB, PSS, and SSS are broadcast. <i>See, e.g.:</i></p> <p>To enable devices to find a cell when entering a system, as well as to find new cells when moving within the system, a synchronization signal consisting of two parts, the Primary Synchronization Signal (PSS) and the Secondary Synchronization Signal (SSS), is periodically transmitted on the downlink from each NR cell. The PSS/SSS, together with the Physical Broadcast Channel (PBCH), is jointly referred to as a Synchronization Signal Block or SS block.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition pp. 311-312</i></p> <p>The downlink broadcast signal was described in technical reports leading up to the development of</p>
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		<p>NR standards. For example, TR 138.912 describes in §8.2.2.3.1 “synchronization signal and DL broadcast signal/channel structure”, including the broadcast channel:</p> <p>At least one broadcast channel (NR-PBCH) is defined. NR-PBCH decoding is based on the fixed relationship with NR-PSS and/or NR-SSS resource position irrespective of duplex mode and beam operation type at least within a given frequency range and CP overhead. NR-PBCH is a non-scheduled broadcast channel carrying at least a part of minimum system information with fixed payload size and periodicity predefined in the specification depending on carrier frequency range.</p> <p>ETSI TR 138 912 V17.0.0 2022-05 p. 31. <i>See also</i> ETSI TR 138.912 V16.0.0 2020-07 p. 31.</p> <p>As described in 3GPP 138.202, the broadcast channel is carried on the PBCH. The management information block (MIB) is carried on the PBCH (physical broadcast channel) and provides parameters to monitor and decode control information and data in the frame:</p> <p>5.2.5.5 Reception of SIB1</p> <p>The Master Information Block (MIB) on PBCH provides the UE with parameters (e.g. CORESET#0 configuration) for monitoring of PDCCH for scheduling PDSCH that carries the System Information Block 1 (SIB1). PBCH may also indicate that there is no associated SIB1, in which case the UE may be pointed to another frequency from where to search for an SSB that is associated with a SIB1 as well as a frequency range where the UE may assume no SSB associated with SIB1 is present. The indicated frequency range is confined within a contiguous spectrum allocation of the same operator in which SSB is detected.</p> <p><i>See</i> ETSI TS 138 300 V17.2.0 2022-10 p. 36. <i>See also</i> ETSI TS 138.300 V16.5.0 (2021-04) p. 31.</p> <p>The SS Block is broadcast to the entire coverage area of a cell:</p>
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5.5 Transport Channels

The physical layer offers information transfer services to MAC and higher layers. The physical layer transport services are described by *how* and with what characteristics data are transferred over the radio interface. An adequate term for this is "Transport Channel". This should be clearly separated from the classification of *what* is transported, which relates to the concept of logical channels at MAC sublayer.

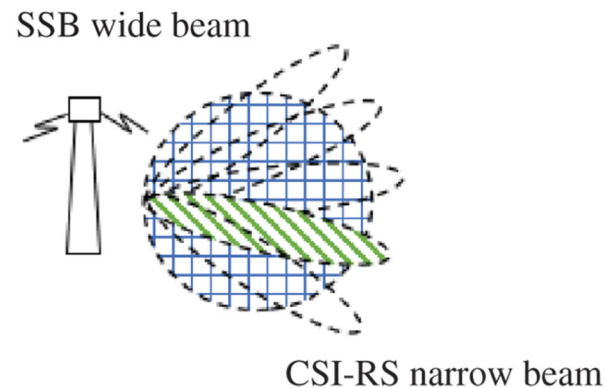
Downlink transport channel types are:

1. **Broadcast Channel (BCH)** characterised by:

- fixed, pre-defined transport format;
- requirement to be broadcast in the entire coverage area of the cell, either as a single message or by beamforming different BCH instances.

ETSI TS 138 300 V17.2.0 | 2022-10 | p. 41.

While initial beam acquisition may be done on a wider initial access beam containing the SS Block, this beam can be further refined (narrowed) for data transmission. However, the same beam width may be used for data transmission as it has been used for initial access transmission. In Figure 6.35, we depict an example of such beam refinement. The wide beam of initial access is further narrowed when transmitting CSI-RS. The transmission of CSI-RS is necessary as all the CSI components, such as the PMI, rank, and CQI, are measured on this reference signal. In addition, the so-called TRS (tracking reference signal) is also transmitted via such beams. The TRS is needed for establishing fine time and frequency synchronization at the UE. In some sense, the functionality of LTE CRS has been now split into TRS and CSI-RS, this decoupling bringing more flexibility to the system.



		<p>Figure 6.35 Beam refinement.</p> <p><i>5G technology: 3GPP new radio edited by Harri Holma, et al. Wiley Kindle Edition Kindle locations 4067-4078.</i></p> <p>The PSS and SSS are identical throughout the cell:</p> <p>The PSS and SSS of an SS block only depend on the physical cell identity (see below). Thus, the PSS and SS of all SS blocks within a cell are identical and cannot be used by the device to determine the relative location of an acquired SS block within the set of possible SS-block locations.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition p. 317</i></p> <p>16.1.5 Details of PSS, SSS, and PBCH</p> <p>Above we have described the overall structure of an SS block and how it consists of three parts: PSS, SSS, and PBCH. We have also described how multiple SS blocks in the time domain constitute an SS burst set and how an SS block is mapped to certain OFDM symbols. In this section we will describe the detailed structure of the different SS-block components.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition pp. 317-318</i></p>
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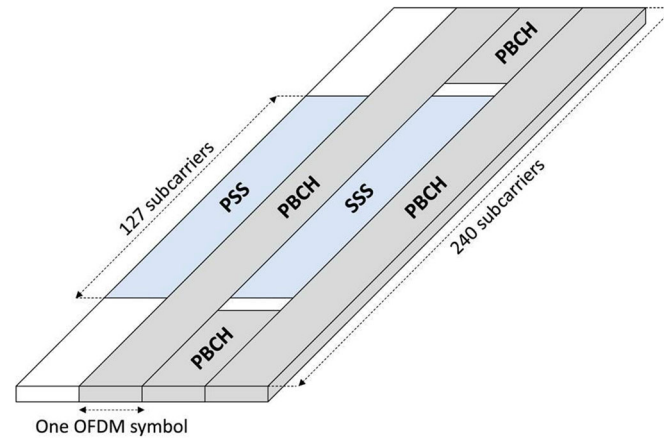


Figure 16.1 Time/frequency structure of a single SS block consisting of PSS, SSS, and PBCH.

Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology | Elsevier Science Kindle Edition | p. 313

For all the reasons discussed above, General Access contends that the structure of the frame, including PBCH, PSS, and/or SSS, literally satisfy this claim limitation. To the extent they are found not to literally satisfy this limitation, General Access contends that they satisfy this limitation under the doctrine of equivalents.

	Claim	Infringement Contentions
1.1.2	subsequently transmits, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals.	<p>Verizon's Accused 5G Products "subsequently transmit, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals."</p> <p>As discussed above, Verizon's 5G network uses beamforming to direct scanning beam signals to substantially only wireless access devices located within a sector of the cell site.</p> <p>In 5G, downlink data traffic follows control signaling and is beamformed. <i>See, e.g.:</i></p> <p>Each PDCCH has its own reference signal, which means that the PDCCH can make full use of the antenna setup, for example, be beamformed in a particular direction.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition p. 186</i></p> <p>The PDCCH (physical downlink control channel) is used to schedule data transmissions (on the PDSCH) to user equipment.</p> <p>Each device monitors several physical downlink control channels (PDCCHs), typically once per slot, although it is possible to configure more frequent monitoring to support traffic requiring very low latency. Upon detection of a valid PDCCH, the device follows the scheduling decision and receives (or transmits) one unit of data known as a transport block in NR.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition p. 66</i></p> <p>In the downlink, a scheme similar to semipersistent scheduling in LTE is used. A semi-static scheduling pattern is signaled in advance to the device. Upon activation by L1/L2 control signaling, which also includes parameters such as the time–frequency resources and coding-and-modulation scheme to use, the device receives downlink data transmissions according to the preconfigured pattern.</p>

	Claim	Infringement Contentions
		<p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition p. 92</i></p> <p>Following detection and decoding of the broadcast signals (sent omnidirectionally or on wide beams), beamforming may be used to transmit data to UEs.</p> <p>While initial beam acquisition may be done on a wider initial access beam containing the SS Block, this beam can be further refined (narrowed) for data transmission. However, the same beam width may be used for data transmission as it has been used for initial access transmission. In Figure 6.35, we depict an example of such beam refinement. The wide beam of initial access is further narrowed when transmitting CSI-RS. The transmission of CSI-RS is necessary as all the CSI components, such as the PMI, rank, and CQI, are measured on this reference signal. In addition, the so-called TRS (tracking reference signal) is also transmitted via such beams. The TRS is needed for establishing fine time and frequency synchronization at the UE. In some sense, the functionality of LTE CRS has been now split into TRS and CSI-RS, this decoupling bringing more flexibility to the system.</p> <div data-bbox="1024 873 1617 1258" data-label="Image"> <p>The diagram shows a base station antenna on the left. It emits two beams towards the right. The first is a wide, circular beam labeled 'SSB wide beam', represented by a blue dashed grid. The second is a narrower, rectangular beam labeled 'CSI-RS narrow beam', represented by a green solid grid. The narrow beam is contained within the wider beam, illustrating the process of beam refinement.</p> </div> <p>Figure 6.35 Beam refinement.</p> <p><i>5G technology: 3GPP new radio edited by Harri Holma, et al. Wiley Kindle Edition Kindle Locations 4067-4078</i></p>

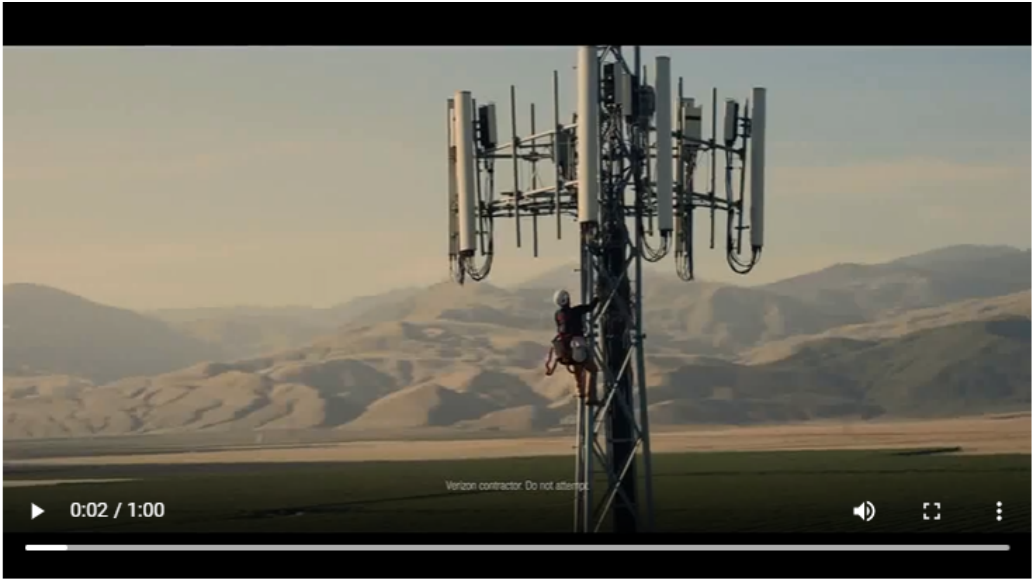
	Claim	Infringement Contentions
		<div data-bbox="905 310 1640 651"> <p>Subframe = 1 ms</p> <p>DL control and data</p> <p>UL control and data</p> <p>DL control DL data GP UL control</p> <p>DL control GP UL data UL control</p> <p>DL control DL data GP UL data UL control</p> </div> <p data-bbox="884 675 1671 708">Figure 3.45 Different NR TDD-based subframe structures [53].</p> <div data-bbox="747 740 1787 1114"> <p>nrofDownlinkSymbols</p> <p>nrofUplinkSymbols</p> <p>nrofDownlinkSlots</p> <p>nrofUplinkSlots</p> <p>dl-UL-TransmissionPeriodicity</p> <p>nrofDownlinkSymbols</p> <p>nrofUplinkSymbols</p> <p>dl-UL-Transmission Periodicity Specified in tdd-UL-DL-configurationCommon n (SlotIndex)</p> </div> <p data-bbox="873 1130 1682 1162">Figure 3.46 TDD UL/DL common and dedicated configurations</p> <p data-bbox="642 1195 1472 1235"><i>Abmadi, Sassan. 5G NR Elsevier Science Kindle Edition pp. 389-390</i></p> <p data-bbox="642 1268 1902 1414">The 5G standards describe beamforming for downlink connections. In 5G, the Downlink Shared Channel (DL-SCH) is a downlink data channel. Specifically, it identifies availability of beamforming for downlink connections in the Downlink Shared Channel (DL-SCH). The DL-SCH is the transport channel for downlink data. For example, see:</p>

Claim	Infringement Contentions												
	<p>“Downlink Shared Channel (DL-SCH) characterised by:</p> <ul style="list-style-type: none">- support for HARQ;- support for dynamic link adaptation by varying the modulation, coding and transmit power;- possibility to be broadcast in the entire cell;- possibility to use beamforming”. <p>ETSI TS 138 300 V17.2.0 2022-10 p. 4.</p> <p>The DL-SCH is mapped to the PDSCH (physical downlink shared channel) as indicated in §4 of Technical Specification 38.212:</p> <p>4.2 Downlink</p> <p>Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.</p> <p>Table 4.2-1</p> <table><tr><th>TrCH</th><th>Physical Channel</th></tr><tr><td>DL-SCH</td><td>PDSCH</td></tr><tr><td>BCH</td><td>PBCH</td></tr><tr><td>PCH</td><td>PDSCH</td></tr></table> <p>Table 4.2-2</p> <table><tr><th>Control information</th><th>Physical Channel</th></tr><tr><td>DCI</td><td>PDCCH</td></tr></table> <p>ETSI TS 138 212 V17.3.0 2022-09 p. 9.</p> <p>5G NR downlink data transmissions may be beamformed. See, for example:</p> <p>11.1 Introduction</p> <p>The use of multiple antennas for transmission and/or reception can provide substantial benefits in a mobile-communication system. Multiple antennas at the transmitter and/or receiver side can be used to provide diversity against fading by utilizing the fact that the channels experienced by different antennas may be at least partly uncorrelated, either due to sufficient inter-antenna distance or due to different polarization between the antennas.</p>	TrCH	Physical Channel	DL-SCH	PDSCH	BCH	PBCH	PCH	PDSCH	Control information	Physical Channel	DCI	PDCCH
TrCH	Physical Channel												
DL-SCH	PDSCH												
BCH	PBCH												
PCH	PDSCH												
Control information	Physical Channel												
DCI	PDCCH												

	Claim	Infringement Contentions
		<p>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 225). Elsevier Science. Kindle Edition.</p> <p>11.2 Downlink Multi-Antenna Precoding All NR downlink physical channels rely on channel-specific DMRSs to support coherent demodulation. Furthermore, a device can assume that the DMRSs are jointly precoded with the data in line with Fig. 11.7. Consequently, any downlink multi-antenna precoding is transparent to the device and the network can, in principle, apply any transmitter-side precoding with no need to inform the device what precoding is applied. The specification impact of downlink multi-antenna precoding is therefore mainly related to the measurements and reporting done by the device to support network selection of precoder for downlink PDSCH transmission.</p> <p>Furthermore, by carefully adjusting the phase, and possibly also the amplitude, of each antenna element, multiple antennas at the transmitter side can be used to provide directivity, that is, to focus the overall transmitted power in a certain direction (beam forming) or, in the more general case, to specific locations in space. Such directivity can increase the achievable data rates and range due to higher power reaching the target receiver. Directivity will also reduce the interference to other links, thereby improving the overall spectrum efficiency.</p> <p>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (pp. 230-231). Elsevier Science. Kindle Edition.</p> <p>For all the reasons discussed above, General Access contends that beamformed downlink transmissions in Verizon's 5G network literally satisfy this claim limitation. To the extent they are found not to literally satisfy this limitation, General Access contends that they satisfy this limitation under the doctrine of equivalents.</p>
19	CLAIM NOT ASSERTED For use in a wireless access network comprising a plurality	The preamble is non-limiting. To the extent the preamble may be construed as a limitation, Verizon's Accused 5G Products perform the method of Claim 19. Verizon's 5G Accused Products are used "in a wireless access network comprising a plurality of base stations, each of said plurality of base stations

	Claim	Infringement Contentions
	of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a method of communicating with a first of said plurality of base stations comprising the steps of:	capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network.” As discussed below, Verizon’s Accused 5G Products perform “a method of communicating with a first of said plurality of base stations comprising the steps” of Claim 19. See disclosures for the preamble of claim 1, which are incorporated here by reference.
19.1	transmitting, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of a plurality of sectors within said associated cell site, the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and	Verizon’s 5G Accused Products transmit “at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of a plurality of sectors within said associated cell site, the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices.” See disclosures for claim element 1.1.1, which are incorporated here by reference.
19.1.2	transmitting, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices in a first of said sectors using a first directed scanning beam signal.	Verizon’s 5G Accused Products transmit “in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices in a first of said sectors using a first directed scanning beam signal.” See disclosures for claim element 1.1.2, which is incorporated here by reference.

	Claim	Infringement Contentions
28	The transceiver as set forth in claim 1 wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals.	<p>See disclosures for claim 1, above. In addition, the transceivers in Verizon's 5G Accused Products include "wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals."</p> <p>In Defendants' 5G networks, downlink transmissions may be beamformed to different wireless access devices within different sectors in the same frame. <i>See, e.g.:</i></p> <p>Beamforming is a foundational technology that works hand in glove with massive MIMO to direct beams of transmission data both horizontally and vertically toward user devices.</p> <p>https://www.verizon.com/business/resources/articles/5g-beamforming-massive-mimo/</p> <p>Ericsson is partnering with Verizon to provide its industry-leading Antenna-Integrated Radio (AIR) product from the Ericsson Radio System portfolio to support Verizon's network deployment. Ericsson's solution leverages a superior massive Multiple Input Multiple Output (MIMO) architecture offering high performance through Ericsson Uplink Booster and advanced beamforming technology to provide a better user experience. Recent C-band performance tests have demonstrated record-breaking data rates in both uplink and downlink on a single user device.</p> <p>...</p> <p>Samsung's Massive MIMO radios and fully virtualized RAN (vRAN) are among the first solutions the company is providing for Verizon's C-band commercial network. To deliver optimal 5G user experiences, Samsung's Massive MIMO radio is designed to support high-capacity and throughput, and includes field-proven advanced beamforming technology.</p> <p>https://www.samsung.com/global/business/networks/insights/press-release/0419-verizon-starts-c-band-equipment-deployment/</p>

	Claim	Infringement Contentions
		<p>As discussed above, transmit path circuitry in Verizon's Accused 5G Products transmit directed scanning beam signals, each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site. That transmit path circuitry also transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals. The transmit path circuitry may comprise circuitry of one or more antenna arrays, each capable of transmitting one or more directed scanning beam signals to one or more sectors.</p> <p>For example, Verizon's base stations typically have multiple antenna arrays, each of which transmits substantially only to wireless access devices in a geographic portion of the cell site. For example, the 5G cell tower shown in the following image from Verizon's "This is 5G Built Right" ad depicts numerous antenna arrays, each pointed in a different direction and serving users located in different geographic areas of the cell site in the same TDD frame:</p>  <p>Available at: https://www.ispot.tv/ad/OSES/verizon-5g-5g-built-right-network-mission.</p>

	Claim	Infringement Contentions
		<p>Verizon's 5G antenna arrays may also direct focused, beamformed signals substantially only to wireless access devices in smaller geographic portions of the cell site. For example, Verizon's field tests of its 5G equipment have shown the significant downlink data speeds it achieved by transmitting directed scanning beam signals to substantially only wireless access devices within a different one of a plurality of sectors of a cell site:</p>  <p>See https://www.cnet.com/pictures/heres-what-verizons-5g-field-test-looks-like-pictures/8/. In the above image, an antenna array in a Verizon 5G base station directs a scanning beam signal to substantially only wireless access devices within the geographic area highlighted in orange, and directs a different directed scanning beam signal to substantially only wireless access devices within the geographic area highlighted in blue. Those directed scanning beam signals are both transmitted in a downlink portion of the same TDD frame.</p> <p>As discussed above, the PDCCH is used to schedule data transmissions (on the PDSCH) to user equipment. A given subframe will typically include multiple PDCCH, each scheduling downlink data transmissions for different devices:</p>

	Claim	Infringement Contentions
		<p>The scheduling decisions are provided to the device through the Physical Downlink Control Channel (PDCCH). If there are multiple devices scheduled in the same subframe, which is a common scenario, there are multiple PDCCHs, one per scheduled device.</p> <p>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 41). Elsevier Science. Kindle Edition.</p> <p>As discussed above, base stations in Verizon’s 5G network communicate with a plurality of wireless access devices. In addition, they communicate with a plurality of wireless access devices within the same frame. <i>See, e.g.</i> ETSI TR 138 913 V17.0.0 2022-05 p. 28:</p> <p>3GPP TR 38.913 version 17.0.0 Release 17 28 ETSI TR 138 913 V17.0.0 (2022-05)</p> <p>NOTE1: Non-full buffer simulations are preferred for the evaluation of this KPI.</p> <p>For non-full buffer traffic, user experienced data rate is the 5%-percentile (5%) of the user throughput. User throughput (during active time) is defined as the size of a burst divided by the time between the arrival of the first packet of a burst and the reception of the last packet of the burst.</p> <p>For full buffer traffic, user experienced data rate is calculated as:</p> $\text{user experienced data rate} = 5\% \text{ user spectrum efficiency} \times \text{bandwidth}$ <p>Here it should be noted that the 5% user spectrum efficiency depends on the number of active users sharing the channel (assumed to be 10 in the ITU evaluations ITU-R report M.2135 [5]), and that the 5% user spectrum efficiency for a fixed transmit power may vary with bandwidth. To keep a high 5% user spectrum efficiency and a few users sharing the channel, a dense network is beneficial, i.e. 5% user spectrum efficiency may vary also with site density (Site here refers to single TRxP).</p> <p>To improve user experienced data rates, 3GPP can develop standards with means for high 5% user spectrum efficiency. To this end, 5% user spectrum efficiency gains in the order of three times IMT-Advanced are proposed. Furthermore, 3GPP can develop standards with means for large bandwidth support. To this end, it is proposed that at least 1GHz aggregated bandwidth shall be supported.</p> <p>As discussed above, the downlink data transmissions in Verizon’s 5G network utilize beamforming. Within a TDD frame, beamformed downlink transmissions are directed to different wireless access devices within different sectors.</p> <p>The “TRxP” is defined in TR 138.913:</p>

	Claim	Infringement Contentions						
		<p>3.1 Definitions</p> <p>For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].</p> <p>Transmission Reception Point (TRxP): Antenna array with one or more antenna elements available to the network located at a specific geographical location for a specific area.</p> <p>ETSI TR 138 913 V17.0.0 2022-05 p. 7</p> <p>The standards explain that a given TRxP may handle “high user densities and traffic loads” as follows:</p> <table><tr><td>3GPP TR 38.913 version 17.0.0 Release 17</td><td>11</td><td>ETSI TR 138 913 V17.0.0 (2022-05)</td></tr></table> <p>6.1.2 Dense urban</p> <p>The dense urban microcellular deployment scenario focuses on macro TRxPs with or without micro TRxPs and high user densities and traffic loads in city centres and dense urban areas. The key characteristics of this deployment scenario are high traffic loads, outdoor and outdoor-to-indoor coverage. This scenario will be interference-limited, using macro TRxPs with or without micro TRxPs. A continuous cellular layout and the associated interference shall be assumed.</p> <p>ETSI TR 138 913 V17.0.0 2022-05 p. 11. <i>See also</i>, ETSI TR 138 913 V17.0.0 2022-05 p. 13:</p> <table><tr><td>3GPP TR 38.913 version 17.0.0 Release 17</td><td>13</td><td>ETSI TR 138 913 V17.0.0 (2022-05)</td></tr></table> <p>6.1.4 Urban macro</p> <p>The urban macro deployment scenario focuses on large cells and continuous coverage. The key characteristics of this scenario are continuous and ubiquitous coverage in urban areas. This scenario will be interference-limited, using macro TRxPs (i.e. radio access points above rooftop level).</p> <p>Some of its attributes are listed in Table 6.1.4-1.</p>	3GPP TR 38.913 version 17.0.0 Release 17	11	ETSI TR 138 913 V17.0.0 (2022-05)	3GPP TR 38.913 version 17.0.0 Release 17	13	ETSI TR 138 913 V17.0.0 (2022-05)
3GPP TR 38.913 version 17.0.0 Release 17	11	ETSI TR 138 913 V17.0.0 (2022-05)						
3GPP TR 38.913 version 17.0.0 Release 17	13	ETSI TR 138 913 V17.0.0 (2022-05)						

	Claim	Infringement Contentions
		<p>More than one antenna array may also be deployed at a given base station and transmit beamformed downlink signals to different wireless access devices within different sectors in the same frame.</p> <p>The PSS and SSS of an SS block only depend on the physical cell identity (see below). Thus, the PSS and SS of all SS blocks within a cell are identical and cannot be used by the device to determine the relative location of an acquired SS block within the set of possible SS-block locations.</p> <p>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 5G NR: The Next Generation Wireless Access Technology (p. 317). Elsevier Science. Kindle Edition.</p> <p>The PSS and SSS are identical throughout the cell:</p> <p>The PSS and SSS of an SS block only depend on the physical cell identity (see below). Thus, the PSS and SS of all SS blocks within a cell are identical and cannot be used by the device to determine the relative location of an acquired SS block within the set of possible SS-block locations.</p> <p><i>Dahlman, Erik. 5G NR: The Next Generation Wireless Access Technology Elsevier Science Kindle Edition p. 317</i></p> <p>The cell identity broadcast using the PSS and SSS are based on the cell group number (common to the cell site), as described in Ahmadi:</p> <p>“The objective of initial cell search is to find a strong cell signal for connection establishment, to obtain an estimate of frame timing, to obtain cell identification, and to find the reference signals for coherent demodulation of PBCH and PDCCH. For this purpose, the PSS and SSS are used. The PSS and SSS are transmitted in SSBs together with PBCH. The blocks are transmitted per slot at a fixed slot location. During initial cell search, the UE correlates the received signals and the synchronization signal sequences by means of matched filtering and attempts to locate the PSS in order to obtain symbol and half-frame timing. It then attempts to find the SSS in order to detect the cyclic prefix length as well as the duplexing scheme and to obtain the exact frame timing based on matched filter results for the PSS and SSS. It then proceeds to detect the cell identity from the reference signals sequence index and to decode</p>

	Claim	Infringement Contentions
		<p>the PBCH for the purpose of obtaining the minimum SI. The synchronization signal (SS) blocks are organized into SS bursts and SS bursts are organized into SS burst sets that are periodically transmitted in order to support beamforming operation.”</p> <p>...</p> <p>“Each NR cell ID can be jointly represented by a PSS/SSS combination.”</p> <p>...</p> <p>“A physical-layer cell identity is uniquely defined by a number in the range of 0-335, representing the physical-layer cell-identity group, and a number in the range of 0-2, representing the physical-layer identity within the physical-layer cell-identity group as in the following formula $N_{ID}^{cell} = 3N_{ID}^{(1)} + N_{ID}^{(2)}$ where $N_{ID}^{(1)} \in \{0, 1, \dots, 335\}$ and $N_{ID}^{(2)} \in \{0, 1, 2\}$. The cell number information is carried in PSS, whereas the cell group number is carried in SSS.”</p> <p><i>See</i> “5G NR Architecture, Technology, Implementation, and Operation of 3GPP New Radio Standards”, Sassan Ahmadi (2009) p. 480.</p> <p>For all the reasons discussed above, General Access contends that beamformed downlink transmissions in Verizon’s 5G network literally satisfy this claim limitation. To the extent they are found not to literally satisfy this limitation, General Access contends that they satisfy this limitation under the doctrine of equivalents.</p>
29	The method as set forth in claim 19, further comprising: transmitting, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices in a second of	<p>See disclosures for claim 19, above. In addition, Verizon’s 5G Accused Products transmit “in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices in a second of said sectors using a second directed scanning beam signal.”</p> <p>See disclosures for claim 28, which are incorporated here by reference.</p>

	Claim	Infringement Contentions
	said sectors using a second directed scanning beam signal.	

EXHIBIT B

Exhibit B

’794 Patent Infringement Contentions

Verizon directly infringed the ’794 patent—either literally or under the doctrine of equivalents—by making, using, selling, offering for sale, and/or importing into the United States Verizon’s Accused Wi-Fi Products, which were covered by claims 1-2 and 4-6 of the ’794 patent. General Access contends that each limitation of the Asserted Claims was literally present in Verizon’s Accused Wi-Fi Products. To the extent that any limitation was not literally present, General Access contends that it was present under the doctrine of equivalents.

Verizon’s Accused Wi-Fi Products that General Access has identified to date are listed in Exhibit C. General Access contends that any other Verizon products made, used, sold, offered for sale, and/or imported into the United States during the relevant period, and that operated similarly to the accused Wi-Fi Products, also infringed the ’794 patent. General Access reserves the right to update these contentions, and its list of the Accused Wi-Fi Products, as discovery progresses.

Verizon’s website highlights the following benefits of utilizing a Wi-fi hotspot:

- “Gone are the days of relying on public Wi-Fi for your laptop or tablet. Today, most smartphones from Verizon include a built-in mobile hotspot function that allows you to work and browse the Internet while you’re on the go.”
- “With a mobile hotspot, you can connect multiple devices on a 5G capable or 4G LTE capable smartphone. After a few quick steps, the phone creates its own secure Wi-Fi network for your devices to join. There’s no need for a USB cable, and multiple users can share your phone’s mobile data plan at once.”

See <https://www.verizon.com/articles/Wi-Fi-hotspot-service-data-plans/how-to-use-your-smartphone-as-a-mobile-hotspot/>. See also <https://www.verizon.com/home/> (“Verizon Home Internet provides Internet access to the home without the need to install cable or fiber optic lines. Verizon Home Internet allows Verizon customers to add home internet to their existing plan.”).

From the Verizon website <https://www.verizon.com/home/lte-home-internet/>:

- Verizon Home Internet provides “Fast and reliable internet for your family.”
- Verizon’s “LTE Home Internet is home broadband internet service that brings the Verizon 4G LTE network to your residence. It is available in certain areas where there are no other Verizon broadband options (Fios, 5G Home, etc.). With LTE Home Internet you can stream video at 1080p, plus you can enjoy unlimited data with no data usage caps.”

From the Verizon website <https://www.verizon.com/5g/home/>:

- “Verizon 5G Home is ultra-fast, ultra-simple wireless home internet powered by 5G Ultra Wideband, giving you the ultra-powerful network performance and speed you need with none of the hassles of cable.”

The below charts describe, in detail, how the following exemplary Verizon products infringe the Asserted Claims of the '794 Patent:

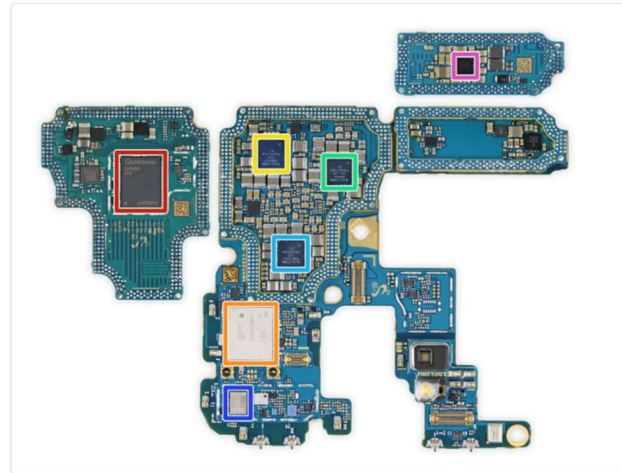
- Samsung Galaxy S20
- iPhone 12
- Jetpack MiFi 8800L
- Verizon 4G LTE Broadband Router with Voice (by NovAtel Wireless)

The remaining Verizon Accused Wi-Fi products are, with regard to infringement, substantially similar to one or more of the four exemplary products addressed here.

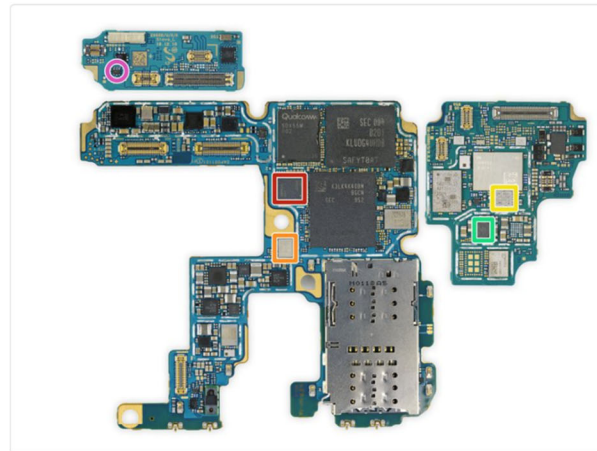
	Claim Language	Infringement Contentions
Claim 1 Preamble	A wireless communication device, comprising:	The preamble is non-limiting. To the extent the preamble is limiting, Verizon's Accused Wi-Fi Products are wireless communication devices. As discussed below, Verizon's Accused Wi-Fi Products include the remaining limitations of Claim 1.
1.1	a first wireless transceiver operable to communicate with a base station, wherein the base station communicates with the first wireless transceiver and a plurality of other wireless communication devices according to a wide area wireless communication protocol; and	<p>Verizon's Accused Wi-Fi Products include a first wireless transceiver operable to communicate with a base station. Each of the Accused Wi-Fi Products is operable to communicate with Verizon's cellular base stations. Those communications are performed by the "first wireless transceiver."</p> <p>The "first transceiver" communicates with a base station, wherein the base station communicates with the first wireless transceiver and a plurality of other wireless communication devices according to a wide area wireless communication protocol. Verizon's base stations use 4G and/or 5G protocols. Base stations utilizing 4G and/or 5G protocols communicate with a plurality of wireless communication devices according to a wide area wireless communication protocol.</p> <p>From TR 138.913:</p> <p>3.1 Definitions</p> <p>For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].</p> <p>Transmission Reception Point (TRxP): Antenna array with one or more antenna elements available to the network located at a specific geographical location for a specific area.</p>

		<p>See 3GPP TR 38.913 version 16.0.0 Release 16</p> <p>For 5G NR, document “ETSI TR 138 913 V16.0.0” describes requirements for 5G deployment, including §6.1.2, which describes requirements for dense urban deployment:</p> <p style="text-align: center;">6.1.2 Dense urban</p> <p style="text-align: center;">The dense urban microcellular deployment scenario focuses on macro TRxPs with or without micro TRxPs and high user densities and traffic loads in city centres and dense urban areas. The key characteristics of this deployment scenario are high traffic loads, outdoor and outdoor-to-indoor coverage. This scenario will be interference-limited, using macro TRxPs with or without micro TRxPs. A continuous cellular layout and the associated interference shall be assumed.</p> <p>See 3GPP TR 38.913 version 16.0.0 Release 16</p> <p>“ETSI TR 138 913 V16.0.0” also defines requirements for rural deployments in §6.1.3:</p> <p style="text-align: center;">6.1.3 Rural</p> <p style="text-align: center;">The rural deployment scenario focuses on larger and continuous coverage. The key characteristics of this scenario are continuous wide area coverage supporting high speed vehicles. This scenario will be noise-limited and/or interference-limited, using macro TRxPs.</p> <p>See also, https://www.verizon.com/coverage-map/ (depicting locations covered by Verizon’s 4G and 5G base stations).</p> <p>4G and/or 5G base stations communicate according to a wide area wireless communication protocol. See, e.g., “4G LTE-Advanced Pro and The Road to 5G”:</p> <p style="text-align: center;">3.7. New Scenarios</p> <p style="text-align: center;">LTE was originally designed as a mobile broadband system, aiming at providing high data rates and high capacity over wide areas. The evolution of LTE has added features improving capacity and data rates, but also enhancements making LTE highly relevant also for new use cases, for example, massive machine-type communication.</p> <p>Dahlman, Erik; Parkvall, Stefan; Skold, Johan. 4G, LTE-Advanced Pro and The Road to 5G (p. 50).</p>
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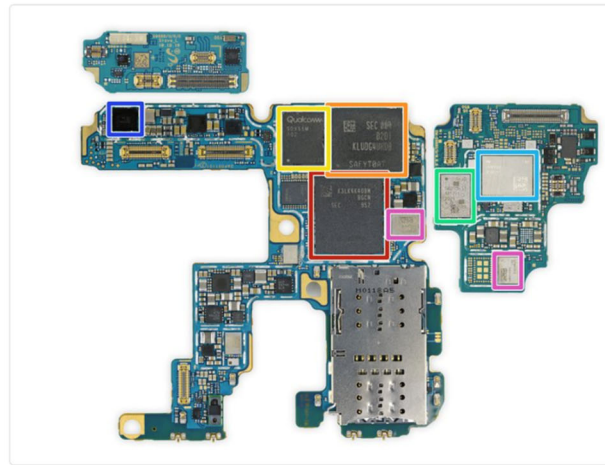
		<p>Verizon defines a “wide-area network” or “WAN” as “a telecommunication network.” They state that “Given that WANs aren’t bound by geography, a wide-area network example can include an entire country or continent. Mobile-area networks, such as 5G, also fall under this category.” <i>See</i> https://www.verizon.com/business/resources/articles/s/what-is-a-wide-area-network-and-what-organizations-need-it.</p> <p>The exemplar products include the following specific components comprising the “first wireless transceiver” of Claim 1.</p> <p>For example, the Samsung Galaxy S20 Ultra 5G includes a first wireless transceiver operable to communicate with a base station. The first wireless transceiver comprises the Qualcomm SDR865 transceiver module along with the SMR526 IF (intermediate frequency) module, the SDX55 RF module, and other support modules, antenna modules, and related circuitry.</p> <p>A publicly available picture of a “teardown” of the Samsung Galaxy S20 Ultra 5G reveals that it included a Qualcomm SDR865 (5G & LTE) chipset used in a cellular transceiver. That chipset includes, among other things, the following components:</p> <ul style="list-style-type: none"> ○ Qualcomm Snapdragon X55 5G Modem (SDX55) ○ Qualcomm SMR526 IF transceiver (5G mmWave) ○ Qualcomm QDM5872 or QDM5873 “diversity” front end module ○ Qualcomm QDM4820 and/or QDM4870 front end module ○ Qualcomm QPM 6585 PA module (band 41) ○ Qualcomm QPM5677 module (band N77/N78)
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- Qualcomm SDR865 RF Tranceiver
- Murata KM9D19075 Wi-Fi & Bluetooth Module
- Qualcomm PM8250 power management IC
- Qualcomm PMX55 power management IC
- Qualcomm PM8150C power management IC
- Qualcomm QDM4870 front-end module
- Silicon Mitus SM3080 power management IC



- Qualcomm SMR526 RF transceiver
- Qualcomm QDM5872 front end module
- Skyworks SKY77365-11 quad-band GSM/GPRS/EDGE power amplifier module
- Qualcomm QET5100 envelope tracker module
- NXP Semiconductor [SN110U](#) NFC controller w/ Secure Element and eSIM
- NXP Semiconductor [BGU8103](#) GPS/GLONASS/Galileo/BeiDou low noise amplifier
- NXP Semiconductor [NCX2200](#) low voltage comparator



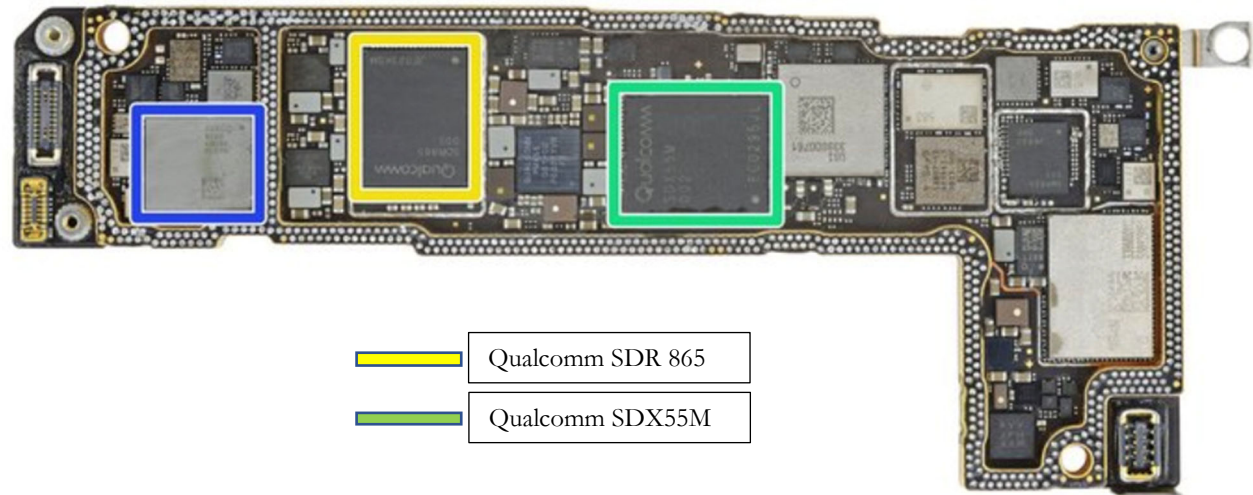
- Samsung K3LK4K40BM-BGCN 12 GB LPDDR5 RAM layered over Qualcomm 865 SoC
- Samsung KLUDG4UHDB-B2D1 128 GB UFS 3.0 flash storage
- Qualcomm SDX55M 2nd-gen 5G modem
- Skyworks SKY58210-11 RF Front-End Module
- Qorvo QM78092 Front-End Module
- Maxim MAX77705C power management IC
- Qualcomm QPM5677 and QPM6585 5G power amplification modules

See <https://www.ifixit.com/Teardown/Samsung+Galaxy+S20+Ultra+Teardown/131607>.

The chipset depicted above, in combination with support modules, antenna modules, and related circuitry, comprise the “first transceiver” of Claim 1.

Similarly, the iPhone 12 includes a first wireless transceiver operable to communicate with a base station. The first wireless transceiver in the iPhone 12 also comprises the Qualcomm SDR865 transceiver module along with the SMR526 IF (intermediate frequency) module, the SDX55 RF module, and other support modules including power management and antenna modules, and related circuitry. A publicly available picture of a “teardown” of the iPhone 12 shows the following components:

- Qualcomm SDR865 (5G & LTE) transceiver, and:
 - Qualcomm Snapdragon X55 5G Modem (SDX55M)
 - Qualcomm SMR526 IF transceiver (5G mmWave)



See <https://www.ifixit.com/Teardown/iPhone+12+and+12+Pro+Teardown/137669>.

The NovAtel/Verizon 4G LTE Broadband Router is a home internet modem that utilizes a 4G LTE network to provide Wi-Fi and Ethernet services to a location. The NovAtel/Verizon 4G LTE Broadband Router includes a first wireless transceiver operable to communicate with a base station. The first wireless transceiver in the NovAtel/Verizon 4G LTE Broadband Router comprises the following components, in combination with support modules, antenna modules, and related circuitry:

- a Band 4 transceiver operating at 1700/2100 MHz and Band 13 operating at 700 MHz, and
- a CDMA 1xRTT transceiver operating at 800/900 MHz

4G LTE Broadband Router with Voice

by Novatel Wireless™

4G LTE BROADBAND ROUTER WITH VOICE (T1114)

- 4G LTE: B4 (1700/2100 MHz) & B13 (700 MHz)
- CDMA 1xRTT: 800/1900 MHz

GPS

- A-GPS for E911

DIMENSIONS AND WEIGHT

- 179.3 x 138.2 x 80.2 mm
- 14.8 Oz

ENVIRONMENTAL

- Operating temperature: -10°C to 55°C

WLAN

- 802.11 a/b/g/n/
- Wi-Fi 2.4 GHz & 5 GHz
- Connect up to 10 Wi-Fi enabled devices

ETHERNET

- 3 Ethernet ports

PHONE PORTS

- 2 RJ-11 ports

LED

- Power, Wi-Fi, LAN, WPS, WWAN

ANTENNA

- Integrated main and diversity antenna for voice and data
- Integrated Wi-Fi/GPS antenna

SYSTEMS SUPPORTED

- Windows® 8, 7, Vista (SP2), XP (SP3)
- Mac OS® X 10.6 or higher
- Linux® Ubuntu 10.4 or higher

BACKUP BATTERY

- 2150 mAh
- Talk Time: 4 Hrs**
- Standby Time: 33 Hrs**

EXTERNAL DISPLAY/INDICATORS

- 1.54" Touch-key navigation OLED display

SECURITY

- Wi-Fi security (WEP/WPA/WPA2)
- Wi-Fi Protected Setup (WPS)
- Wi-Fi privacy separation
- VPN pass-through
- MAC address filtering
- NAT firewall
- Port filtering
- Security hardened web interface
- Password hash
- Anti-CSRF
- Session timeout
- Incorrect password lockout

STANDARDS /APPROVALS /CERTIFICATIONS

- FCC
- RoHS





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FOR MORE INFORMATION: SALES@NVT.COM NASDAQ: NVTL WEBSITE: novatelwireless.com
Specifications are subject to change. Please see your Novatel Wireless contact for more details.
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** Voice and/or data plan required. Coverage subject to network availability. Visit verizonwireless.com for details.
*** Battery life may vary. To maximize phone time, Internet connectivity is not available in backup battery mode.

Novatel Wireless, Inc. - Proprietary and Confidential

The Jetpack MiFi 8800L is a MiFi device that utilizes a 4G LTE network to provide Wi-Fi services to a location. The Jetpack MiFi 8800L includes a first wireless transceiver operable to communicate with a base station. The first wireless transceiver in the Jetpack MiFi 8800L comprises the following components, in combination with support modules, antenna modules, and related circuitry. *See <https://www.waveform.com/a/b/guides/hotspots/jetpack-8800L>:*

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PETITIONER VERIZON
EX. 1016

- An LTE transceiver operating in the following Bands: B4/B5/B7/B13/B14*/B20/B28/B46/B48/B66.
- A UMTS transceiver operating in the following Bands: B1/B2/B5/B8.
- A Qualcomm Snapdragon X20 LTE Modem Chipset.

Verizon Jetpack MiFi 8800L Technical Specifications

Supported 4G LTE bands in the US

- Verizon: B2, B4, B5, B13, B46, B48, B66
- AT&T: B2, B4, B5, B14, B66, ~~B12~~, ~~B17~~, ~~B29~~, ~~B30~~
- T-Mobile: B2, B4, B5, B66, ~~B41~~, ~~B25~~, ~~B26~~, ~~B71~~, ~~B12~~

Cellular Modem

- Model: Qualcomm Snapdragon X20
- MIMO Support: 4X4 w/ internal antennas, 2x2 w/ external antennas
- LTE-A Carrier Aggregation: Yes, including LAA (5x 20 Mhz bands)
- LTE Performance Category: Cat 18
- Max Theoretical Speeds: 1,200Mbps Download, 150Mbps Upload

Wi-Fi

- Technologies: 802.11 b/g/n/a/ac
- Bands: Simultaneous 2.4 GHz and 5.8 GHz

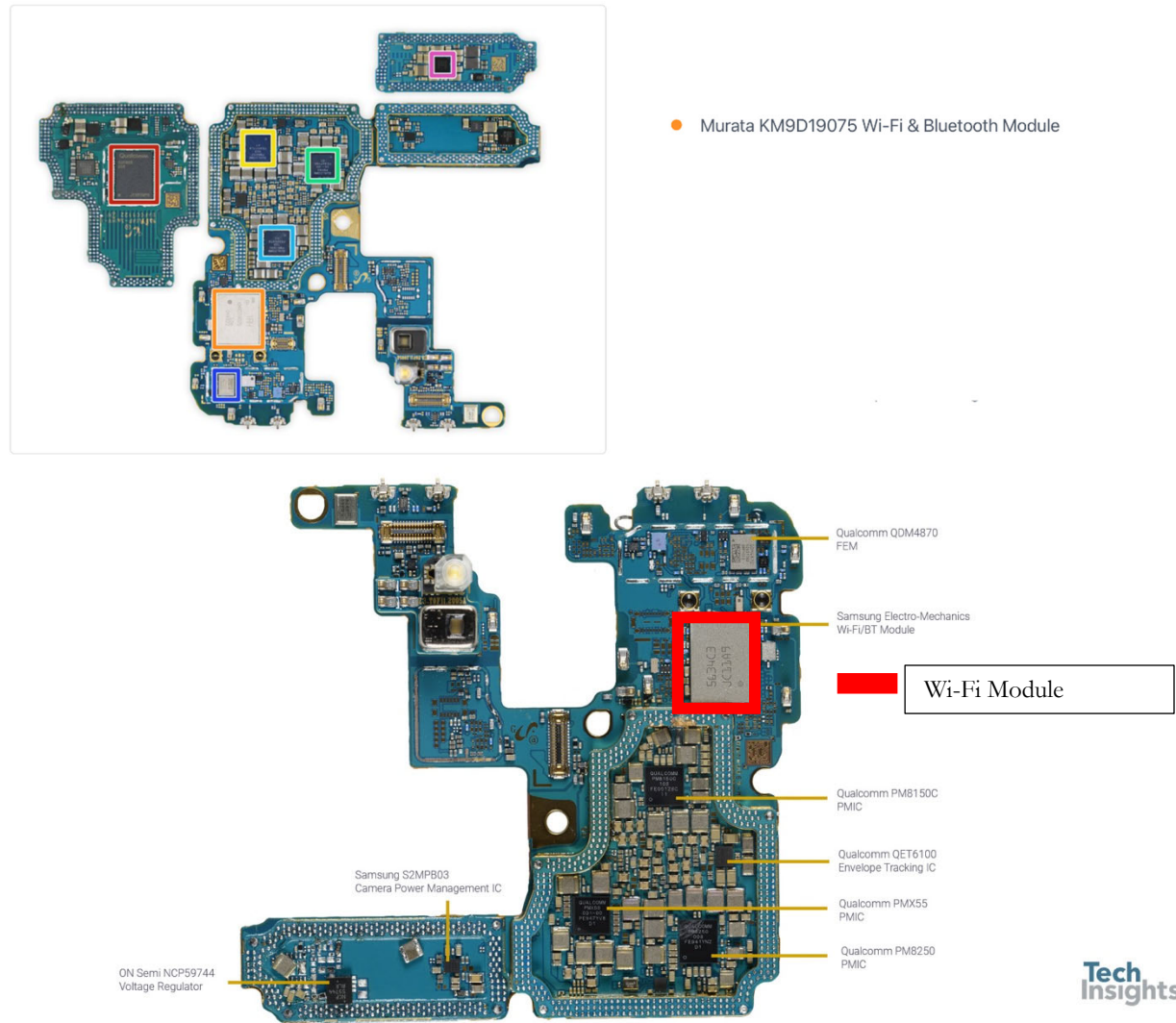
Ports

- Cellular Antenna Ports: Dual TS-9
- Other Ports: USB-C (power)

Other

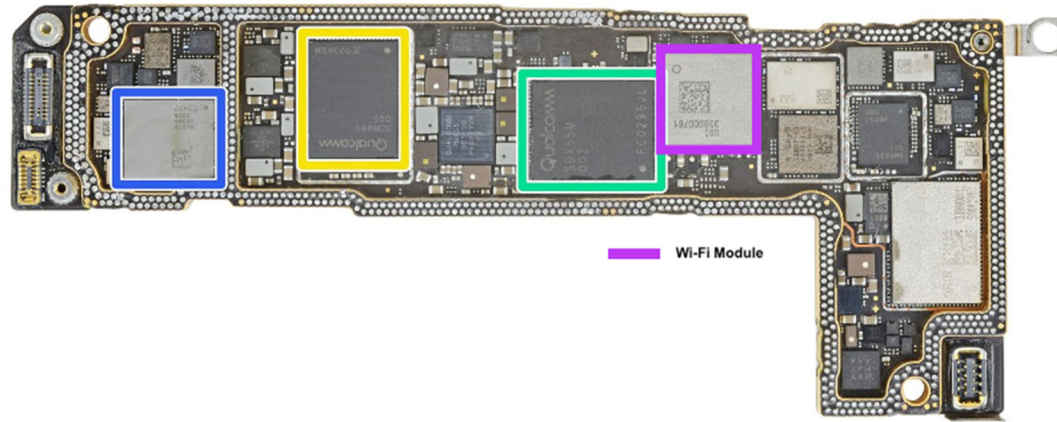
- Claimed battery life: 24 hours
- Can Be Powered Without a Battery: No

1.2	a second wireless transceiver coupled to the first wireless transceiver and operable to directly communicate with a first mobile station and a second mobile station, wherein the second wireless transceiver communicates with the first mobile station and the second mobile station according to a local area wireless communication protocol,	<p>Verizon's Accused Wi-Fi Products include a second wireless transceiver coupled to the first transceiver and operable to directly communicate with a first mobile station and a second mobile station, wherein the second wireless transceiver communicates with the first mobile station and the second mobile station according to a local area wireless communication protocol, as described in Claim 1. Each of Verizon's Accused Wi-Fi Products communicate with mobile stations (e.g., computers, iPads, cellphones, etc.) using a Wi-Fi transceiver. The Wi-Fi transceivers included in Verizon's Accused Wi-Fi Products comprise the "second wireless transceiver" of Claim 1.</p> <p>The Wi-Fi transceivers in Verizon's Accused Wi-Fi Products directly communicate with the first and second mobile stations. For example, a data packet transmitted from the second transceiver to a mobile station will identify the "transmitter" with a MAC address of the second transceiver, and will identify the "receiver" with a MAC address of the mobile station. The second transceiver is a Wi-Fi Access Point (AP) which communicates with one or more mobile stations (Wi-Fi STAs).</p> <p>The exemplar products include the following specific components comprising the "second wireless transceiver" of Claim 1.</p> <p>For example, the Samsung Galaxy S20 Ultra includes a second wireless transceiver coupled to the first wireless transceiver and operable to directly communicate with a first mobile station and a second mobile station according to a local area wireless communication protocol (LAN).</p> <p>The second wireless transceiver in the Samsung Galaxy S20 Ultra comprises the Wi-Fi module, shown in the following figure, in combination with support modules, antenna modules, and related circuitry:</p>
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See <https://www.ifixit.com/Teardown/Samsung+Galaxy+S20+Ultra+Teardown/131607/>.

	<p>The Samsung Electro-Mechanics Wi-Fi/BT module is a wireless transceiver that communicates using a wireless local area communication protocol.</p> <p>In the Samsung Galaxy S20, the second transceiver is coupled to the first transceiver, allowing the sharing of cellular internet connectivity through a Wi-Fi hotspot. <i>See, e.g.,</i> https://www.verizon.com/support/mobile-hotspot-faqs/:</p> <p style="padding-left: 40px;">A Mobile Hotspot lets you share your Verizon network connection with other devices so they can access the internet. Devices connect to your Mobile Hotspot using Wi-Fi. While devices are connected, you're charged for any data they use according to your monthly data plan.</p> <p>The Samsung Galaxy S20 includes a software configuration setting to enable data flow between the first transceiver to the second transceiver. This setting is labeled “Wi-Fi Hotspot” under the “Hotspot and tethering” section of “Settings”. When enabled, information flows between the two coupled transceivers.</p> <p>The Apple iPhone 12 also includes a second wireless transceiver coupled to the first wireless transceiver and operable to directly communicate with a first mobile station and a second mobile station according to a local area wireless communication protocol (LAN). The second wireless transceiver comprises the Wi-Fi module, shown in the following figure, in combination with support modules, antenna modules, and related circuitry:</p>
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Apple specifications for the iPhone 12 include “Wi-Fi 6 (802.11ax) with 2x2 MIMO” (see <https://www.apple.com/ca/iphone-12/specs/>).

The Apple iPhone 12 includes a software configuration setting to enable data flow between the first transceiver to the second transceiver in the form of a user-controlled switch in the phone’s settings. This setting is labeled “Allow Others to Join” under the “Personal Hotspot” section of “Settings”. When enabled, information flows between the two coupled transceivers.

From the Verizon website:

Gone are the days of relying on public Wi-Fi for your laptop or tablet. Today, most smartphones from Verizon include a built-in mobile hotspot function that allows you to work and browse the Internet while you’re on the go.

With a mobile hotspot, you can connect multiple devices on a 5G capable or 4G LTE capable smartphone. After a few quick steps, the phone creates its own secure Wi-Fi network for your devices to join. There’s no need for a USB cable, and multiple users can share your phone’s mobile data plan at once.

See: <https://www.verizon.com/articles/Wi-Fi-hotspot-service-data-plans/how-to-use-your-smartphone-as-a-mobile-hotspot/>. See also <https://support.apple.com/en-us/HT204023> (Apple’s website also explains how to set up Wi-Fi hotspot).

		<p>The NovAtel/Verizon 4G LTE router also includes a second wireless transceiver coupled to the first wireless transceiver and operable to directly communicate with a first mobile station and a second mobile station according to a local area wireless communication protocol (LAN). The second wireless transceiver of the NovAtel/Verizon 4G LTE router comprises a Wi-Fi transceiver with the following capabilities (Wi-Fi Alliance certified, see www.wi-fi.org), in combination with support modules, antenna modules, and related circuitry:</p> <ul style="list-style-type: none">• 802.11 a/b/g/n• Wi-Fi 2.4 GHz & 5 GHZ• Connect up to 10 Wi-Fi enabled devices
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4G LTE Broadband Router with Voice

by Novatel Wireless™

4G LTE BROADBAND ROUTER WITH VOICE (T1114)

- 4G LTE: B4 (1700/2100 MHz) & B13 (700 MHz)
- CDMA 1xRTT: 800/1900 MHz

GPS

- A-GPS for E911

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- 179.3 x 138.2 x 80.2 mm
- 14.8 Oz

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- Operating temperature: -10°C to 55°C

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- 802.11 a/b/g/n/
- Wi-Fi 2.4 GHz & 5 GHz
- Connect up to 10 Wi-Fi enabled devices

ETHERNET

- 3 Ethernet ports

PHONE PORTS

- 2 RJ-11 ports

LED

- Power, Wi-Fi, LAN, WPS, WWAN

ANTENNA

- Integrated main and diversity antenna for voice and data
- Integrated Wi-Fi/GPS antenna

SYSTEMS SUPPORTED

- Windows® 8, 7, Vista (SP2), XP (SP3)
- Mac OS® X 10.6 or higher
- Linux® Ubuntu 10.4 or higher

BACKUP BATTERY

- 2150 mAh
- Talk Time: 4 Hrs**
- Standby Time: 33 Hrs**

EXTERNAL DISPLAY/INDICATORS

- 1.54" Touch-key navigation OLED display

SECURITY

- Wi-Fi security (WEP/WPA/WPA2)
- Wi-Fi Protected Setup (WPS)
- Wi-Fi privacy separation
- VPN pass-through
- MAC address filtering
- NAT firewall
- Port filtering
- Security hardened web interface
- Password hash
- Anti-CSRF
- Session timeout
- Incorrect password lockout

STANDARDS /APPROVALS /CERTIFICATIONS

- FCC
- RoHS





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FOR MORE INFORMATION: SALES@NVT.COM NASDAQ: NVTL WEBSITE: novatelwireless.com

Specifications are subject to change. Please see your Novatel Wireless contact for more details.

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** Voice and/or data plan required. Coverage subject to network availability. Visit verizonwireless.com for details.

*** Battery life may vary. To maximize phone time, Internet connectivity is not available in backup battery mode.

Novatel Wireless, Inc. - Proprietary and Confidential

In the NovAtel/Verizon 4G LTE router, information flows between the two coupled transceivers, thus enabling mobile stations connected via Wi-Fi to receive information from Verizon's LTE network:

		<p>ACCESS LIGHTNING FAST 4G LTE INTERNET ON YOUR DEVICES Need fast Internet, even in remote areas where broadband DSL or cable modem service isn't available? No problem. Wirelessly connect up to 10 Wi-Fi enabled devices including laptops, computers, tablets, eReaders, gaming consoles, smartphones, music players, printers and more. Connect up to 3 wired devices like network storage drives, computers, printers and routers via Ethernet.</p> <p>The Jetpack MiFi 8800L device also includes a second wireless transceiver coupled to the first wireless transceiver and operable to directly communicate with a first mobile station and a second mobile station according to a local area wireless communication protocol (LAN). The second wireless transceiver of the Jetpack MiFi 8800L device comprises a Wi-Fi transceiver with the following capabilities (Wi-Fi Alliance certified, see www.wi-fi.org, Certification ID: WFA100763), in combination with support modules, antenna modules, and related circuitry:</p> <ul style="list-style-type: none"> • 802.11 b/g/a/n/ac • 2.4 GHz/5 GHZ • Connect up to 15 Wi-Fi enabled devices to the Internet at once <p><i>See</i> https://ss7.vzw.com/is/content/VerizonWireless/Devices/Verizon/Jetpack%20MiFi%208800L/Us%20Manual/verizon-jetpack-mifi-8800l-um.pdf:</p>
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Product Specifications

General

Name:	Verizon Jetpack® - MiFi® 8800L
Model:	MIFI8800L
Approvals:	FCC (US)
Weight:	162 g / 5.71 oz
Dimensions:	113 mm x 71 mm x 19.15 mm, 4.45 in x 2.8 in x 0.75 in
Wireless Network	LTE, UMTS
Wireless Network – Wi-Fi Mode	Real simultaneous Dual Band 802.11 b/g/a/n/ac 2.4 GHz/5.0 GHz
Display	2.4 in color touchscreen LCD
Default SSID	MIFI8800L-XXXX
Battery	
• Size	4400 mAh Li-Ion
• Time required for full charge	3 hours (when not in use)
• Usage	Up to 24 hours
Chip Set:	QUALCOMM® SDx20
Interface Type:	Type C USB Port for Quick Charge charging port, Universal charging feature, Internet over USB, content access
Memory:	RAM = 128MB, LPDDR FLASH = 256MB, NAND

Technology/Bands

Technology:	LTE, UMTS
Band Designation:	CAT 18 LTE w/5-Carrier CA
Bands:	LTE Bands: B4/B5/B7/B13/B14*/B20/B28/B46/B48/B66 UMTS Bands: B1/B2/B5/B8 Carrier Aggregation - DL CA: B13+B4, B13+B2, B4+B2, B4+B4, B2+B2, B2+B5, B4+B5, B13+B66, B66+B2, B66+B66, B5+B66, B2+B48, B13+B48, B48+B66, B2+B46, B4+B46, B13+B46, B5+B46, B46+B66, B13+B4+B2, B13+B4+B4, B13+B2+B2, B5+B4+B2, B5+B4+B4, B5+B2+B2, B13+B66+B2, B13+B66+B66, B66+B66+B2, B66+B66+B66, B5+B66+B2, B5+B66+B66 UL CA: B13+B4, B13+B2, B13+B66; LAA sGPS/XTRA capable

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		<div><h2>Overview</h2><p>Congratulations on your purchase of the Verizon Jetpack® MiFi® 8800L.</p><p>With the Jetpack you can access 4G LTE networks for faster apps, uploads and downloads. Connect up to 15 Wi-Fi enabled devices to the Internet at once - laptops, tablets, e-readers, gaming consoles and more* - and experience download speeds up to 10 times faster than with Verizon's 3G*.</p><p>The Jetpack is also backwards compatible to 3G networks, ensuring reliable connectivity when you need it most.</p></div> <p><i>See also https://www.waveform.com/a/b/guides/hotspots/jetpack-8800L:</i></p>
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		<div data-bbox="846 199 1745 277" data-label="Section-Header"> <h3>Verizon Jetpack MiFi 8800L Technical Specifications</h3> </div> <div data-bbox="846 310 1228 342" data-label="Section-Header"> <h4>Supported 4G LTE bands in the US</h4> </div> <div data-bbox="873 362 1344 454" data-label="List-Group"> <ul style="list-style-type: none"> • Verizon: B2, B4, B5, B13, B46, B48, B66 • AT&T: B2, B4, B5, B14, B66, B12, B17, B29, B30 • T-Mobile: B2, B4, B5, B66, B41, B25, B26, B71, B12 </div> <div data-bbox="846 483 1035 513" data-label="Section-Header"> <h4>Cellular Modem</h4> </div> <div data-bbox="873 534 1499 693" data-label="List-Group"> <ul style="list-style-type: none"> • Model: Qualcomm Snapdragon X20 • MIMO Support: 4X4 w/ internal antennas, 2x2 w/ external antennas • LTE-A Carrier Aggregation: Yes, including LAA (5x 20 Mhz bands) • LTE Performance Category: Cat 18 • Max Theoretical Speeds: 1,200Mbps Download, 150Mbps Upload </div> <div data-bbox="846 721 919 750" data-label="Section-Header"> <h4>Wi-Fi</h4> </div> <div data-bbox="873 773 1278 831" data-label="List-Group"> <ul style="list-style-type: none"> • Technologies: 802.11 b/g/n/a/ac • Bands: Simultaneous 2.4 GHz and 5.8 GHz </div> <div data-bbox="846 860 924 889" data-label="Section-Header"> <h4>Ports</h4> </div> <div data-bbox="873 911 1207 972" data-label="List-Group"> <ul style="list-style-type: none"> • Cellular Antenna Ports: Dual TS-9 • Other Ports: USB-C (power) </div> <div data-bbox="846 1000 930 1031" data-label="Section-Header"> <h4>Other</h4> </div> <div data-bbox="873 1052 1260 1114" data-label="List-Group"> <ul style="list-style-type: none"> • Claimed battery life: 24 hours • Can Be Powered Without a Battery: No </div> <div data-bbox="653 1174 1917 1328" data-label="Text"> <p>The second transceivers included in Verizon’s Accused Wi-Fi Products communicates with the first mobile station and the second mobile station according to a local area wireless communication protocol, known as “Wi-Fi”. Verizon’s Accused Wi-Fi Products are designed to the IEEE 802.11 Standard. See https://www.wi-fi.org:</p> </div>
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		<p>Wi-Fi Alliance® is the worldwide network of companies that brings you Wi-Fi®, one of the world's most valued communications technologies. Our vision is to connect everyone and everything, everywhere.</p> <p>Wi-Fi Generations</p> <p>For two decades Wi-Fi has changed the way the world operates and communicates. Wi-Fi technology, based on the Institute of Electrical and Electronics Engineers (IEEE) wireless communication standard 802.11, has continually improved, with each generation bringing faster speeds, lower latency, and better user experiences in a multitude of environments and with a variety of device types.</p> <p>Verizon's web page on cellular hotspots highlights their use of "Wi-Fi" technology. <i>See</i> https://www.verizon.com/articles/how-to-get-wifi-anywhere/:</p> <p>Turn your smartphone into a Wi-Fi hotspot.</p> <p>Most <u>smartphones</u> can be turned into an internet access point that your other devices, such as <u>tablets</u> or other phones, can connect to. These are called Wi-Fi hotspots, and they can be indispensable when you need to access the internet with other devices.</p> <p>The process to <u>set up a personal hotspot</u> depends on the type of phone you have:</p> <ul style="list-style-type: none"> • On iOS devices, go to Settings, then toggle "Personal Hotspot" on. Once you do, you'll be given a Wi-Fi password. Other devices will be able to connect to your phone via Wi-Fi and Bluetooth under the name of the phone, and they'll need this password to access the hotspot. • On Android devices, the process can differ a little depending on your phone's model. Go to Settings, then look for a menu for networks or connections. On Samsung devices, for example, you'll need to navigate to "Connections," then "Mobile Hotspot and Tethering." On Google Pixels, you must go to "Network & Internet," then "Hotspot & Tethering." After turning the hotspot on, you'll be given a Wi-Fi password. Other devices will be able to connect to the hotspot by selecting your device name and entering this password. <p><i>See also</i> https://ss7.vzw.com/is/content/VerizonWireless/Devices/Verizon/Jetpack%20MiFi%208800L/Us%20Manual/verizon-jetpack-mifi-8800l-um.pdf at 3:</p>
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		<p>About Jetpack’s Internet Connection</p> <p>With LTE you can get the speed you require to work efficiently outside the home or office. You can connect to the Internet, access your corporate intranet, check your email and download attachments at speeds that are up to 10 times faster than 3G*.</p> <p><u>4G Mobile Broadband with LTE*</u></p> <ul style="list-style-type: none"> • Download: typical download speeds of 5-12 Mbps. • Upload: typical upload speeds of 2-5 Mbps. <p><u>Wi-Fi 802.11a/b/g/n/ac</u></p> <ul style="list-style-type: none"> • 802.11a uses the 5.0 GHz frequency with speeds up to 12 Mbps. • 802.11b uses the 2.4 GHz frequency with speeds up to 12 Mbps. <p>IEEE 802 defines, among other standards, a standard for “Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks”. The 802.11 Standard, also known as “Part 11”, defines “Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications” which provide standards for a wireless local area network (LAN).</p> <p>The 802.11 standards define Wireless LAN (local area network) requirements for Wi-Fi. The Wi-Fi transceivers included in Verizon’s Accused Wi-Fi Products are based on the IEEE 802.11 standard.</p> <p>The Samsung Galaxy S20 Ultra was certified by the Wi-Fi Alliance as compliant for 2.4 GHz and 5 GHz Wi-Fi including 802.11.b, a, g, n, ac, and Wi-Fi 6 (see https://www.wi-fi.org/product-finder-results?sort_by=name&sort_order=asc&keywords=SM-G988U&companies=239).</p> <p>The Apple iPhone 12 is compatible with 802.11 as indicated on apple.com:</p>
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Wi-Fi specifications for iPhone models

- *802.11 compatibility and frequency band:* 802.11ax (Wi-Fi 6), 802.11ac (Wi-Fi 5), 802.11n (Wi-Fi 4), 802.11a, 802.11b/g, and 2.4GHz or 5GHz.
- *Physical layer (PHY) data rate:* The highest rate at which a client can transmit data over Wi-Fi.
- *Channel bandwidth:* The maximum channel bandwidth that is supported. Starting with 802.11n, channels can be combined to create a wider channel that allows for more data to be transmitted during a single transmission. With 802.11n for 5GHz band, two 20MHz channels can be combined to create a 40MHz channel. With 802.11ac for 5GHz band, four 20MHz channels can be combined to create an 80MHz channel.
- *MCS index:* The Modulation and Coding Scheme (MCS) index defines the maximum transmission rate at which 802.11ac/n devices can communicate. 802.11ac uses Very High Throughput (VHT) and 802.11n uses High Throughput (HT) frames.
- *Spatial streams/SISO/MIMO:* Each radio can send a specific number of independent data streams, called *spatial streams*, at the same time, which can increase overall throughput. Single input single output (SISO) uses a single radio and antenna, and multiple input multiple output (MIMO) uses multiple radios and antennas.

Wi-Fi specifications for iPhone 11 and later models

The table below details the Wi-Fi specifications for the iPhone 11 and later models listed in the above table.

802.11 standard, name, frequency	Maximum PHY data rate	Maximum channel bandwidth	Maximum MCS index	Maximum spatial streams
ax@5GHz	1200Mbps	80MHz	11 (HE)	2/MIMO
ac@5GHz	866Mbps	80MHz	9 (VHT)	2/MIMO
a/n@5GHz	300Mbps	40MHz	7 (HT)	2/MIMO
ax@2.4GHz	195 Mbps	20MHz	9 (HE)	2/MIMO
b/g/n@2.4GHz	144Mbps	20MHz	7 (HT)	2/MIMO

See <https://support.apple.com/en-in/guide/deployment/dep268652e6c/web>.

		<p>The NovAtel/Verizon 4G LTE router was certified by the Wi-Fi Alliance as compliant for 2.4 GHz and 5 GHz Wi-Fi including 802.11.b, a, g, and n (see https://www.wi-fi.org/product-finder-results?sort_by=name&sort_order=asc&keywords=1114&companies=677).</p> <p>The Jetpack MiFi 8800L has been certified by the Wi-Fi alliance as compliant for 2.4 GHz and 5 GHz Wi-Fi including 802.11.b, a, g, n, and ac. See https://www.wi-fi.org/product-finder-results?keywords=8800L.</p>																																																											
1.3	wherein the first wireless transceiver receives from the base station a first downlink signal intended for the first mobile station and provides the first downlink signal to the second wireless transceiver and wherein the second wireless transceiver receives the first downlink signal and re-transmits the first downlink signal to the first mobile station as a second downlink signal according to the local area wireless communication protocol, and	<p>Verizon’s Accused Wi-Fi Products include a first transceiver that receives from the base station a first downlink signal intended for the first mobile station as described in Claim 1.</p> <p>The “first transceiver” in Verizon’s Accused Wi-Fi Products receives information from the internet in the form of IPv4 and/or IPv6 packets. The relevant protocols require that each packet include information identifying the destination for which the data in the packet is intended.</p> <p>For example, IPv4 packets include the following headers:</p> <table><tr><td>0</td><td>4</td><td>8</td><td>16</td><td>19</td><td>24</td><td>31</td></tr><tr><td colspan="2">VERS</td><td colspan="2">HLEN</td><td colspan="2">SERVICE TYPE</td><td colspan="2">TOTAL LENGTH</td></tr><tr><td colspan="4">IDENTIFICATION</td><td colspan="2">FLAGS</td><td colspan="2">FRAGMENT OFFSET</td></tr><tr><td colspan="2">TIME TO LIVE</td><td colspan="2">PROTOCOL</td><td colspan="4">HEADER CHECKSUM</td></tr><tr><td colspan="7">SOURCE IP ADDRESS</td></tr><tr><td colspan="7">DESTINATION IP ADDRESS</td></tr><tr><td colspan="5">IP OPTIONS (IF ANY)</td><td colspan="2">PADDING</td></tr><tr><td colspan="7">PAYLOAD ...</td></tr></table> <p>Figure 7.3 Format of an IPv4 datagram, the basic unit of transfer in a TCP/IP internet.</p> <p>Douglas E. Comer – “Internetworking with TCP_IP Volume One”, Addison-Wesley (2013) p. 123.</p> <p>See also, <i>id.</i> at 123:</p> <p>Fields SOURCE IP ADDRESS and DESTINATION IP ADDRESS contain the 32-bit IP addresses of the datagram’s sender and intended recipient. Although the datagram may be forwarded through many intermediate routers, the source and destination fields never change; they specify the IP addresses of the original source and ultimate destination.</p>	0	4	8	16	19	24	31	VERS		HLEN		SERVICE TYPE		TOTAL LENGTH		IDENTIFICATION				FLAGS		FRAGMENT OFFSET		TIME TO LIVE		PROTOCOL		HEADER CHECKSUM				SOURCE IP ADDRESS							DESTINATION IP ADDRESS							IP OPTIONS (IF ANY)					PADDING		PAYLOAD ...						
0	4	8	16	19	24	31																																																							
VERS		HLEN		SERVICE TYPE		TOTAL LENGTH																																																							
IDENTIFICATION				FLAGS		FRAGMENT OFFSET																																																							
TIME TO LIVE		PROTOCOL		HEADER CHECKSUM																																																									
SOURCE IP ADDRESS																																																													
DESTINATION IP ADDRESS																																																													
IP OPTIONS (IF ANY)					PADDING																																																								
PAYLOAD ...																																																													

As shown above in the standard IPv4 datagram header, the “destination IP address” is used to identify the intended recipient of information transmitted on an IP network. When the first transceiver receives a datagram from a base station, the datagram header contains information identifying the mobile station for which that data is intended.

The “destination IP address” is similarly used to identify the intended recipient of information transmitted on an IP network using IPv6. *See, e.g. the IPv6 datagram header format:*

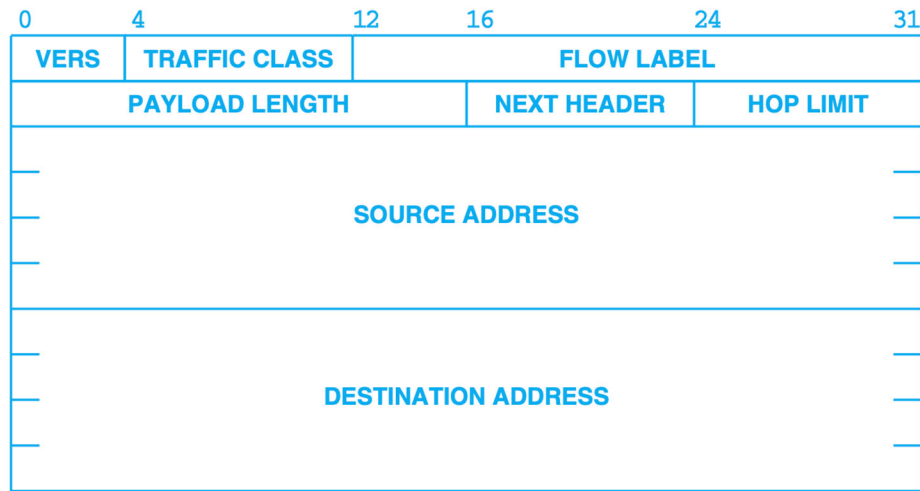


Figure 7.6 The IPv6 base header format; the size is fixed at 40 octets.

Douglas E. Comer – “Internetworking with TCP_IP Volume One”, Addison-Wesley (2013) p. 126:

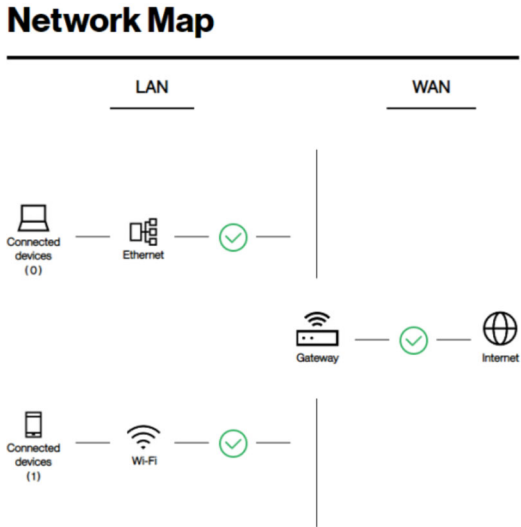
Each IPv6 datagram begins with a 40-octet base header as Figure 7.6 illustrates.
...

Finally, the SOURCE ADDRESS and DESTINATION ADDRESS fields specify the IPv6 addresses of the original sender and ultimate destination.

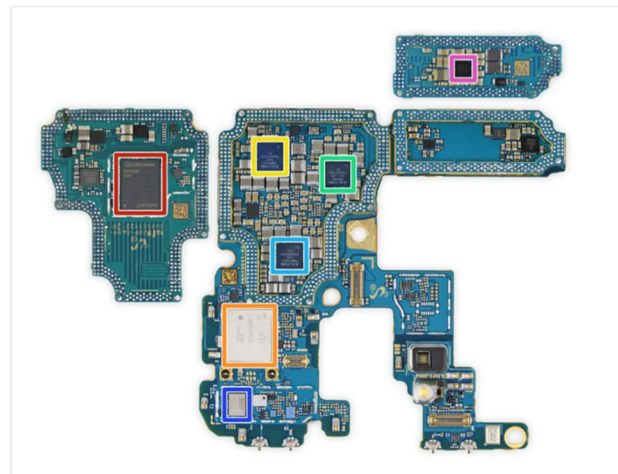
Note that IPv6 datagrams may be used to encapsulate IPv4 datagrams (for backward compatibility), in which case the source and destination addresses are as described for IPv4.

		<p>[A]lthough the IPv6 datagram header differs from the IPv4 header, IPv6 also uses the first four bits for a version number, making it possible for a router or host computer to distinguish between the two versions.</p> <p>Verizon's Accused Wi-Fi Products include a first transceiver that provides the first downlink signal to the second wireless transceiver. As discussed above, the first transceiver receives a downlink signal intended for a mobile station. The first transceiver then provides that signal to the second transceiver. The second transceivers in Verizon's Accused Wi-Fi Products re-transmit the first downlink signal to the first mobile station as a second downlink signal according to the local area wireless communication protocol.</p> <p>Verizon web page on cellular hotspots: https://www.verizon.com/articles/how-to-get-wifi-anywhere/</p> <p>Turn your smartphone into a Wi-Fi hotspot.</p> <p>Most <u>smartphones</u> can be turned into an internet access point that your other devices, such as <u>tablets</u> or other phones, can connect to. These are called Wi-Fi hotspots, and they can be indispensable when you need to access the internet with other devices.</p> <p>The process to <u>set up a personal hotspot</u> depends on the type of phone you have:</p> <ul style="list-style-type: none"> • On iOS devices, go to Settings, then toggle "Personal Hotspot" on. Once you do, you'll be given a Wi-Fi password. Other devices will be able to connect to your phone via Wi-Fi and Bluetooth under the name of the phone, and they'll need this password to access the hotspot. • On Android devices, the process can differ a little depending on your phone's model. Go to Settings, then look for a menu for networks or connections. On Samsung devices, for example, you'll need to navigate to "Connections," then "Mobile Hotspot and Tethering." On Google Pixels, you must go to "Network & Internet," then "Hotspot & Tethering." After turning the hotspot on, you'll be given a Wi-Fi password. Other devices will be able to connect to the hotspot by selecting your device name and entering this password. <p>From the Verizon website https://www.verizon.com/support/mobile-hotspot-faqs/:</p>
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		<div><div><h2>About Mobile Hotspot features and apps</h2><div>Expand All</div><div><div>1. What is a Mobile Hotspot feature or app?</div><div><p>A Mobile Hotspot lets you share your Verizon network connection with other devices so they can access the internet. Devices connect to your Mobile Hotspot using Wi-Fi. While devices are connected, you're charged for any data they use according to your monthly data plan.</p><p>Many smartphones and tablets have a built-in Mobile Hotspot feature that you can access in your device's Settings or the App menu. The feature may have a different name on your device (e.g., Personal Hotspot [iOS], Internet Sharing [Windows®] or Portable Wi-Fi Hotspot [Google™ Nexus devices]), but they do the same thing.</p><p>You can also buy devices that are strictly mobile hotspots. Visit our Mobile hotspot shopping page or go to our Mobile hotspot device FAQs to learn more.</p></div></div></div><div><p>From the Verizon website https://www.verizon.com/support/mobile-hotspot-device-faqs/</p></div><div><div><h2>About mobile hotspot devices</h2><div>Expand All</div><div><div>1. What is a mobile hotspot device?</div><div><p>Unlike the built-in Mobile Hotspot feature or app in your smartphone or tablet, a mobile hotspot device (e.g., Verizon Jetpack, Inseego MiFi, etc.) is a separate device that lets you wirelessly share your Verizon network connection with other Wi-Fi capable devices.</p></div></div></div><div><p>For a graphical depiction, the following excerpt from a Netgear datasheet shows how one of the Verizon Accused Wi-Fi products receives a downlink signal intended for a mobile station (depicted on the left-hand side below), that signal is then provided to the second transceiver, which re-transmits the first downlink signal to the first mobile station as a second downlink signal according to the local area wireless communication protocol (shown on the right below).</p></div></div></div>
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		 <p>https://www.downloads.netgear.com/files/GDC/MBR1515/MBR1515_NA_DS_26Oct12.pdf. See also, https://scache.vzw.com/dam/support/pdf/user_guide/verizon-lte-home-router-user-guide.pdf at 21 (depicting a “gateway device” receives a downlink signal from a base station and then provides that signal to a second transceiver for re-transmission to “connected devices” using a Wi-Fi protocol).</p> <p>Network Map</p> 
1.4	wherein the second transceiver monitors first signal characteristics of the second downlink signal of the first mobile station and monitors second signal	The second transceivers in Verizon’s Accused Wi-Fi Products monitor first signal characteristics of the second downlink signal of the first mobile station and monitor second signal characteristics of the second mobile station, and based on the first signal characteristics and the second characteristics, routes information to the first mobile station and the second mobile station, respectively.

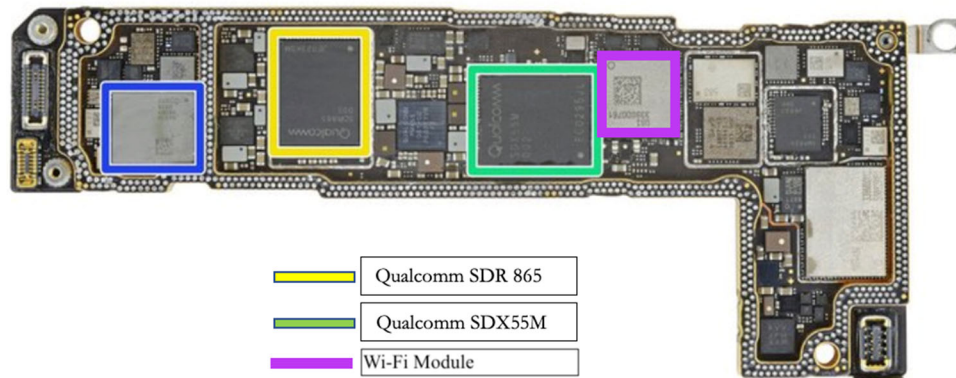
	<p>characteristics of the second mobile station, and based on the first signal characteristics and the second characteristics, routes information to the first mobile station and the second mobile station, respectively.</p>	<p>The second transceiver in Verizon's Accused Wi-Fi products is a Wi-Fi transceiver. The mobile stations can include, for example, computers, smartphones, tablets, e-readers, IOT devices, etc. The second transceivers in Verizon's Accused Wi-Fi products monitor signal characteristics of downlink signals transmitted from the second transceiver to the mobile stations, including the first signal characteristics of the second downlink signal of the first mobile station and the second signal characteristics of the second mobile station.</p> <p>Based on the first signal characteristics and the second characteristics, Wi-Fi transceivers in Verizon's Accused Wi-Fi Products route information to the first mobile station and the second mobile station, respectively.</p> <p>For example, Verizon's Accused Wi-Fi Products monitor the first signal characteristics of the first downlink signal from the second transceiver (previously identified) to the first mobile station (previously identified), and similarly monitors the second signal characteristics of the first downlink signal from the second transceiver to the second mobile station (previously identified), and based on these signal characteristics the second transceiver routes information to the first mobile station and the second mobile station. The active monitoring of the first and second signal characteristics allows the second transceiver to respond to the varying conditions of the network, and the Accused Wi-Fi Products route information in a manner that dynamically responds to these conditions. Verizon's Accused Wi-Fi Products make use of such monitoring of the signal characteristics in the manner described above, and thereby improve their ability to function as a hotspot.</p>
Claim 2	<p>The wireless communication device of claim 1, wherein the second wireless transceiver is coupled to the first wireless transceiver by a wireline connection.</p>	<p>Verizon's Accused Wi-Fi Products include wherein the second wireless transceiver is coupled to the first wireless transceiver by a wireline connection. For example, Verizon's Accused Wi-Fi Products include physical coupling between the second wireless transceiver and the first wireless transceiver. This coupling may comprise a printed circuit board with embedded wire traces connecting integrated circuits, electrical connections between integrated circuits on a printed circuit board, and electrical connections between circuit boards.</p> <p>For example, in the Samsung S20, the first transceiver comprising the Snapdragon 865 5G & LTE processor and the Snapdragon X55 5G modem is mounted on the same printed circuit board and electrically coupled to the second transceiver, comprising the Wi-Fi module, mounted on the underside of the same printed circuit board.</p>



- Qualcomm SDR865 RF Transceiver
- Murata KM9D19075 Wi-Fi & Bluetooth Module

See <https://www.ifixit.com/Teardown/Samsung+Galaxy+S20+Ultra+Teardown/131607/>.

Similarly, in the iPhone 12, the first transceiver comprising the Snapdragon 865 5G & LTE processor and Snapdragon X55M 5G modem is mounted on the same printed circuit board and electrically coupled to the second transceiver, comprising the Wi-Fi module.



- Qualcomm SDR 865
- Qualcomm SDX55M
- Wi-Fi Module

		Verizon's other Accused Wi-Fi Products similarly include a wireline connection coupling the first and second transceivers.
Claim 4	The wireless communication device of claim 1, wherein the first wireless transceiver and second wireless transceiver are disposed in a fixed site subscriber station.	<p>The Verizon Accused Wi-Fi Products that operate as internet routers for a home, office, or other specific location include “wherein the first wireless transceiver and second wireless transceiver are disposed in a fixed site subscriber station” as recited in Claim 4.</p> <p>For example, Verizon 4G LTE Broadband Router with Voice (by Novatel Wireless) is a “4G LTE Broadband Router with Voice Powerful all-in-one solution for fast, easy Internet and phone connectivity.” It is described as “the perfect all-in-one solution for voice or data in your home, office, remote work station and even a vacation destination”:</p> <div data-bbox="737 639 1854 1299" data-label="Image"> <p>NOVATEL WIRELESS™</p> <p>LTE Internet and Home Phone Powerful all-in-one solution for fast, easy Internet and phone connectivity</p> <p>With the Verizon 4G LTE Broadband Router with Voice by Novatel Wireless, you can make calls on your home phone and access high-speed Internet on 10 Wi-Fi and 3 Ethernet devices, simultaneously. There's no need for a separate landline. It's the perfect all-in-one solution for voice and data in your home, small office, remote work station and even a vacation destination*.</p> <p>Leveraging the MiFi® platform's industry leading ease of use, reliability and security, the MiFi Powered 4G LTE Broadband Router with Voice makes it easy to stay connected.</p> </div> <p>See https://files.bbystatic.com/N0T%2FIjqyJ4CfRDHUT8mfmg%3D%3D/4445101_ds.pdf.</p>

		Similarly, the other Verizon Accused Wi-Fi Products that operate as internet routers for a home, office, or other specific location infringe Claim 4.																														
Claim 5	The wireless communication device of claim 1, wherein the first wireless transceiver and the second wireless transceiver are part of an integrated device.	<p>Verizon's Accused Wi-Fi Products all include "wherein the first wireless transceiver and the second wireless transceiver are part of an integrated device." The transceivers in Verizon's Accused Wi-Fi Products are all contained with a single integrated device.</p> <p>For example, the Samsung S20 is a mobile phone with integrated cellular (the first wireless transceiver) and Wi-Fi (the second transceiver) transceivers:</p> <table> <tr> <td>Network/Bearer</td><td>Number of SIM Dual-SIM</td><td>SIM size Nano-SIM (4FF), Embedded-SIM</td></tr> <tr> <td></td><td>SIM Slot Type SIM 1 + Hybrid (SIM or MicroSD)</td><td>Infra 2G GSM, 3G WCDMA, 4G LTE FDD, 4G LTE TDD</td></tr> <tr> <td></td><td>2G GSM GSM850, GSM900, DCS1800, PCS1900</td><td>3G UMTS B1(2100), B2(1900), B4(AWS), B5(850), B8(900)</td></tr> <tr> <td></td><td>4G FDD LTE B1(2100), B2(1900), B3(1800), B4(AWS), B5(850), B7(2600), B8(900), B12(700), B13(700), B17(700), B18(800), B19(800), B20(800), B25(1900), B26(850), B28(700), B32(1500), B66(AWS-3)</td><td>4G TDD LTE B38(2600), B39(1900), B40(2300), B41(2500)</td></tr> <tr> <td>Connectivity</td><td>ANT+ Yes</td><td>USB Interface USB Type-C</td></tr> <tr> <td></td><td>USB Version USB 3.2 Gen 1</td><td>Location Technology GPS, Glonass, Beidou, Galileo</td></tr> <tr> <td></td><td>Earjack USB Type-C</td><td>MHL No</td></tr> <tr> <td></td><td>Wi-Fi 802.11 a/b/g/n/ac/ax 2.4G+5GHz, HE80, MIMO, 1024-QAM</td><td>Wi-Fi Direct Yes</td></tr> <tr> <td></td><td>Bluetooth Version Bluetooth v5.0</td><td>NFC Yes</td></tr> <tr> <td></td><td>PC Sync. Smart Switch (PC version)</td><td></td></tr> </table> <p>See https://www.samsung.com/levant/smartphones/galaxy-s20/specs/.</p> <p>The Apple iPhone 12 is also a mobile phone with integrated cellular and Wi-Fi transceivers:</p>	Network/Bearer	Number of SIM Dual-SIM	SIM size Nano-SIM (4FF), Embedded-SIM		SIM Slot Type SIM 1 + Hybrid (SIM or MicroSD)	Infra 2G GSM, 3G WCDMA, 4G LTE FDD, 4G LTE TDD		2G GSM GSM850, GSM900, DCS1800, PCS1900	3G UMTS B1(2100), B2(1900), B4(AWS), B5(850), B8(900)		4G FDD LTE B1(2100), B2(1900), B3(1800), B4(AWS), B5(850), B7(2600), B8(900), B12(700), B13(700), B17(700), B18(800), B19(800), B20(800), B25(1900), B26(850), B28(700), B32(1500), B66(AWS-3)	4G TDD LTE B38(2600), B39(1900), B40(2300), B41(2500)	Connectivity	ANT+ Yes	USB Interface USB Type-C		USB Version USB 3.2 Gen 1	Location Technology GPS, Glonass, Beidou, Galileo		Earjack USB Type-C	MHL No		Wi-Fi 802.11 a/b/g/n/ac/ax 2.4G+5GHz, HE80, MIMO, 1024-QAM	Wi-Fi Direct Yes		Bluetooth Version Bluetooth v5.0	NFC Yes		PC Sync. Smart Switch (PC version)	
Network/Bearer	Number of SIM Dual-SIM	SIM size Nano-SIM (4FF), Embedded-SIM																														
	SIM Slot Type SIM 1 + Hybrid (SIM or MicroSD)	Infra 2G GSM, 3G WCDMA, 4G LTE FDD, 4G LTE TDD																														
	2G GSM GSM850, GSM900, DCS1800, PCS1900	3G UMTS B1(2100), B2(1900), B4(AWS), B5(850), B8(900)																														
	4G FDD LTE B1(2100), B2(1900), B3(1800), B4(AWS), B5(850), B7(2600), B8(900), B12(700), B13(700), B17(700), B18(800), B19(800), B20(800), B25(1900), B26(850), B28(700), B32(1500), B66(AWS-3)	4G TDD LTE B38(2600), B39(1900), B40(2300), B41(2500)																														
Connectivity	ANT+ Yes	USB Interface USB Type-C																														
	USB Version USB 3.2 Gen 1	Location Technology GPS, Glonass, Beidou, Galileo																														
	Earjack USB Type-C	MHL No																														
	Wi-Fi 802.11 a/b/g/n/ac/ax 2.4G+5GHz, HE80, MIMO, 1024-QAM	Wi-Fi Direct Yes																														
	Bluetooth Version Bluetooth v5.0	NFC Yes																														
	PC Sync. Smart Switch (PC version)																															

		<p>Cellular and Wireless</p> <p>Model A2402*</p> <p>5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)</p> <p>FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)</p> <p>TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)</p> <p>UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)</p> <p>GSM/EDGE (850, 900, 1800, 1900 MHz)</p> <p>All models</p> <p>5G (sub-6 GHz and mmWave) with 4x4 MIMO⁴</p> <p>Gigabit LTE with 4x4 MIMO and LAA⁴</p> <p>Wi-Fi 6 (802.11ax) with 2x2 MIMO</p> <p>Bluetooth 5.0</p> <p>Ultra Wideband chip for spatial awareness⁵</p> <p>NFC with reader mode</p> <p>Express Cards with power reserve</p> <p>See https://www.apple.com/ca/iphone-12/specs/.</p> <p>The Verizon 4G LTE Broadband Router with Voice is a fixed home internet device with integrated 4G LTE and Wi-Fi transceivers:</p>
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		<div data-bbox="930 177 1680 298"> <h2>LTE Internet and Home Phone</h2> <h3>by Novatel Wireless™</h3> </div> <div data-bbox="930 357 1644 386"> <h4>4G LTE BROADBAND ROUTER WITH VOICE (T1114)</h4> </div> <div data-bbox="930 393 1619 459"> <ul style="list-style-type: none"> • 4G LTE: B4 (1700/2100 MHz) & B13 (700 MHz) • CDMA 1xRTT: 800/1900 MHz </div> <div data-bbox="930 492 989 518"> <h4>GPS</h4> </div> <div data-bbox="930 524 1165 553"> <ul style="list-style-type: none"> • A-GPS for E911 </div> <div data-bbox="930 586 1312 612"> <h4>DIMENSIONS AND WEIGHT</h4> </div> <div data-bbox="930 618 1295 683"> <ul style="list-style-type: none"> • 179.3 x 138.2 x 80.2 mm • 14.8 Oz </div> <div data-bbox="930 716 1182 742"> <h4>ENVIRONMENTAL</h4> </div> <div data-bbox="930 748 1495 777"> <ul style="list-style-type: none"> • Operating temperature: -10°C to 55°C </div> <div data-bbox="930 810 1022 841"> <h4>WLAN</h4> </div> <div data-bbox="930 847 1520 951"> <ul style="list-style-type: none"> • 802.11 a/b/g/n/ • Wi-Fi 2.4 GHz & 5 GHz • Connect up to 10 Wi-Fi enabled devices </div> <div data-bbox="667 997 1827 1027"> <p>See https://files.bbystatic.com/N0T%2FIjgyJ4CfRDHUT8mfmg%3D%3D/4445101_ds.pdf.</p> </div> <div data-bbox="667 1070 1827 1099"> <p>Similarly, the Jetpack MiFi 8800L is a MiFi device with integrated LTE and Wi-Fi transceivers:</p> </div> <div data-bbox="762 1141 1919 1279"> <p>“With the Jetpack you can access 4G LTE networks for faster apps, uploads and downloads. Connect up to 15 Wi-Fi enabled devices to the Internet at once - laptops, tablets, e-readers, gaming consoles and more* - and experience download speeds up to 10 times faster than with Verizon’s 3G*.”</p> </div> <div data-bbox="667 1320 1919 1422"> <p>See https://ss7.vzw.com/is/content/VerizonWireless/Devices/Verizon/Jetpack%20MiFi%208800L/Us%20Manual/verizon-jetpack-mifi-8800l-um.pdf.</p> </div>
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		<p>See also https://web.archive.org/web/20211027205838/https://www.verizon.com/internet-devices/verizon-jetpack-mifi-8800l/:</p> <table><tr><td colspan="2">Network</td></tr><tr><td colspan="2"><hr/></td></tr><tr><td>Wi-Fi</td><td>802.11 a/b/g/n/ac Wi-Fi 2.4 GHz & 5 GHz / RSDB Wi-Fi Multiple SSID/Guest Wi-Fi Support Connect up to 15 Wi-Fi Enabled Devices</td></tr><tr><td colspan="2"><hr/></td></tr><tr><td>SAR</td><td>1.58 W/kg</td></tr><tr><td colspan="2"><hr/></td></tr><tr><td>Network</td><td>LTE Category: 18 (DL) / 13 (UL) LTE Bands: B2/B3/B4/B5/B7/B13/B14*/B20/B28/B46/B48*/B66 UMTS Bands: B1/B2/B5/B8</td></tr><tr><td colspan="2"><hr/></td></tr><tr><td>World Device</td><td>Works in over 200 countries depending on your plan.</td></tr><tr><td colspan="2"><hr/></td></tr></table>	Network		<hr/>		Wi-Fi	802.11 a/b/g/n/ac Wi-Fi 2.4 GHz & 5 GHz / RSDB Wi-Fi Multiple SSID/Guest Wi-Fi Support Connect up to 15 Wi-Fi Enabled Devices	<hr/>		SAR	1.58 W/kg	<hr/>		Network	LTE Category: 18 (DL) / 13 (UL) LTE Bands: B2/B3/B4/B5/B7/B13/B14*/B20/B28/B46/B48*/B66 UMTS Bands: B1/B2/B5/B8	<hr/>		World Device	Works in over 200 countries depending on your plan.	<hr/>	
Network																						
<hr/>																						
Wi-Fi	802.11 a/b/g/n/ac Wi-Fi 2.4 GHz & 5 GHz / RSDB Wi-Fi Multiple SSID/Guest Wi-Fi Support Connect up to 15 Wi-Fi Enabled Devices																					
<hr/>																						
SAR	1.58 W/kg																					
<hr/>																						
Network	LTE Category: 18 (DL) / 13 (UL) LTE Bands: B2/B3/B4/B5/B7/B13/B14*/B20/B28/B46/B48*/B66 UMTS Bands: B1/B2/B5/B8																					
<hr/>																						
World Device	Works in over 200 countries depending on your plan.																					
<hr/>																						
Claim 6 Preamble	A method for communicating with a wireless communication device, comprising:	The preamble is non-limiting. To the extent the preamble is limiting, Verizon’s Accused Wi-Fi Products are wireless communication devices. As discussed below, Verizon’s Accused Wi-Fi Products include the remaining limitations of Claim 6.																				
6.1	a first wireless transceiver operable to communicate with a base station, wherein the base station communicates with the first wireless transceiver and a plurality of other wireless communication devices according to a wide area wireless communication protocol; and	See analysis of element 1.1, above.																				

6.2	a second wireless transceiver coupled to the first wireless transceiver and operable to directly communicate with a first mobile station and a second mobile station, wherein the second wireless transceiver communicates with the first mobile station and the second mobile station according to a local area wireless communication protocol, the method comprising:	See analysis of element 1.2, above.
6.3	receiving, using the first wireless transceiver from the base station, a first downlink signal intended for the first mobile station;	See analysis of elements 1.3 and 1.4, above.
6.4	providing, using the first wireless transceiver, the first downlink signal to the second wireless transceiver;	See analysis of elements 1.3 and 1.4, above.
6.5	receiving, using the second wireless transceiver, the first downlink signal and re-transmitting the first downlink signal to the first mobile station as a second downlink signal according	See analysis of elements 1.3 and 1.4, above.

	to the local area wireless communication protocol;	
6.6	monitoring, using the second transceiver, first signal characteristics of the second downlink signal of the first mobile station;	See analysis of elements 1.3 and 1.4, above.
6.7	monitoring, using the second transceiver, second signal characteristics of the second mobile station; and based on the first signal characteristics and the second characteristics, routing, using the second transceiver, information to the first mobile station and the second mobile station, respectively.	See analysis of elements 1.3 and 1.4, above.

EXHIBIT C

Verizon's Accused Wi-Fi Products include all Mobile phones, MiFi devices, Home Internet devices, Tablets, Laptops, and other Devices capable of communicating with a 4G and/or 5G network and of routing information to mobile stations using Wi-Fi (as described in Exhibit B) that were made, used, imported, offered or sale, or sold by Verizon between October 10, 2016, and June 23, 2021. This includes, but is not limited to, every version of the products listed below.

Arris
Arris NVG558
Asus
Asus Zenfone V, ZenPad™ Z8s, ZenPad™ Z8, ZenPad Z10, ZenFone™ V Live
Askey
Verizon Internet Gateway (ASK-NCQ1338FA), Verizon Internet Gateway (ASK-NCQ1338)
Alcatel
Avalon, Avalon V, Alcatel GO FLIP V
Apple
The following iPhone models: 6, 6S, 6S Plus, SE, 7, 7 Plus, 8, 8 Plus, X, XR, XS, XS Max, 11, 11 Pro, 11 Pro Max, SE (2020), SE (2nd), 12, 12 Mini, 12 Pro, 12 Pro Max, 13, 13 Mini, 13 Pro, 13 Pro Max, SE (3rd), 14, 14 Plus, 14 Pro, 14 Pro Max
The following iPad models: iPad (10th gen), iPad pro 12.9 inch 6th gen, iPad pro 11 inch 4th gen, iPad pro 12.9 inch 3rd gen, iPad pro 12.9 inch, iPad 6th gen 9.7 inch, iPad air (5th gen), iPad pro 12.9 inch (2021), iPad 9.7 inch, iPad pro (1st gen), iPad pro (10.5 inch), iPad pro (11 inch), iPad pro 11 inch, iPad mini, iPad pro 11 inch, iPad (9th gen), iPad air (4th gen), iPad (8th gen), iPad (1st Gen), iPad with Wi-Fi and MiFi 2200 Hotspot, iPad Air 2, iPad (7th gen), iPad mini (7.9 inch), iPad mini 4, iPad (9.7 inch), iPad Air (3rd Gen), iPad (3rd Gen) with WiFi + Cellular, iPad mini 3, iPad Pro (9.7 inch)
Google
Pixel 6 Pro, Pixel 3 XL, Pixel 2 XL, Pixel, Pixel 2, Pixel 4a, Pixel 4, Pixel 3a, Pixel 6, Pixel 6a, Pixel 5, Pixel 3, Pixel XL, Pixel 4 XL, Pixel 3a XL, Pixel 4a 5G, Pixel 7, Pixel 7 Pro
Kazuna
eTalk
Kyocera
DuraForce Ultra 5G UW, Duraforce Pro 2, DuraForce Pro , DuraSport 5G UW, Dura XV LTE, Cadence LTE, DuraXV Extreme, DuraForce Pro with Sapphire Shield, Dura XV Extreme+

Laptops and Chromebooks
All Laptops and Chromebooks capable of communicating with a 4G and/or 5G network and with Wi-Fi hotspot capabilities that were made, used, imported, offered or sale, or sold by Verizon between October 10, 2016, and June 23, 2021.
LG
G Pad 10.1, G Pad 5 10.1 FHD, G Pad 7.0, G Pad 8.3, G4, G5, G6, G7 ThinQ, G8 ThinQ, K20 V, K51, K8 V, Q 70, Stylo 2 V, Stylo 5, Stylo 6, V20, V30, V40 ThinQ, V50 ThinQ, V60 ThinQ™ 5G, Velvet™ 5G UW, WING™ 5G, ZONE 4, V50 ThinQ 5G, G Pad 10.1 LTE, G Pad 8.3 LTE, G Pad 7.0 LTE, G Pad X8.3, Lancet for Android, K4 LTE
Lenovo
Tab 4 8 Plus
Motorola
One 5G UW ace, Moto g7 Power, razr, moto Z3, Droid Turbo 2, G Power (2022), edge+, Edge+ 5G UW, Moto e6, Z Force Droid Edition, moto g7, Droid turbo, g stylus 5G, Moto z2 force edition, Moto e5 play, Moto z4, One 5G UW, moto g7 play, Moto Z PLay Droid Edition, Moto Z Droid Edition, Moto z2 play, Moto g6 play, Droid Maxx 2, Moto e4, Moto e5 go, Moto e4 gold, moto g play, Moto g power, Moto g play (2021), Moto g power (2021), Edge (2022), Moto G Pure, Moto 5G, Moto g6, Edge 5G UW, moto e4 plus, moto g stylus
Nokia
2 V, 3 V, 2 V Tella, 8 V 5G UW
OnePlus
8 5G UW
Orbic
Maui, Wonder, Myra 5g, Orbic Speed 5G UW, Journey V
Samsung
Tab S2, A3 (2016), A5 (2016), A7 (2016), A9 (2016), S7, S7 Active, S7 Edge, A8 (2016), A3 (2017), A5 (2017), A7 (2017), Tab S3, S8, S8 Ultra, S8+, A6 (2018), A6+ (2018), A6s (2018), A7 (2018), A8 (2018), A8 Star (2018), A8+ (2018), A8s (2018), A9 (2018), S9, S9+, Tab S4, A10 (2019), A10e (2019), A2 Core (2019), A20 (2019), A20e (2019), A20s (2019), A30 (2019), A30s (2019), A40 (2019), A50 (2019), A50s (2019), A60 (2019), A70 (2019), A70s (2019), A80 (2019), A80s (2019), Tab S5e, S10, S10 5G, S10+, S10e, A01 (2020), A01 Core (2020), A11 (2020), A21 (2020), A21s (2020), A31 (2020), A41 (2020), A51 (2020), A51 5G (2020), A51 5G UW (2020), A71 (2020), A71 5G (2020), A71 5G UW (2020), Tab S6, Z Fold, S20, S20 FE, S20 Ultra 5G, S20+, Z Flip, Tab S6 Lite, Tab S7, Tab S7+, Z Fold 2, S21, S21 Ultra, S21+, Tab S7 FE, A02 (2021), A02s (2021), A03 (2022), A03 Core (2022), A03s (2022), A12 (2021), A13 5G (2022), A13(LTE) (2022), A22 (2021), A22 5G (2021), A23 (LTE) (2022), A23 5G (2022), A32 (2021), A32 5G (2021), A33 5G (2022), A52 (LTE) (2021), A52 5G (2021), A52s 5G (2021), A72 (2021), A73 5G (2022), Z Flip 3, Z Fold 3, S21 FE, S22, S22 Ultra, S22+, Tab S8, Tab S8 Ultra 5G, Tab S8+, A04 (2023), A04s (2023), Z Flip 4, Z Fold 4 , note8, note10, note20 5G, note Edge, Note20 Ultra 5G, Note 10+, Note9, Note10+ 5G, note4, Note5, Note10.1, Tab A (10.5), J7 V (2nd Gen.), J7/J7 V, Tab A (8.0), J3 V, Tab A7 Lite, J3 (3rd Gen), J3 Mission, J3 Eclipse, J3 (2016), J3 V (3rd Gen), J7 (2nd Gen.), Core Prime, S 5, S 6, S 6 edge, S 6 edge+, Tab S, Tab A (8.4 inch), Tab E, Tab E (8.0), Tab 2 (7.0), Tab 4 (8.0), Tab 4 (10.1), A42 5G, A53 5G
Sharp
Rouvo V
Sonim
XP8, XP5s, XP5

TCL
Alcatel TCL, SIGNA, TCL 30 LE, TCL TAB Pro 5g, TCL TAB 8-inch, TCL TAB Family edition, TCL TAB Disney Edition, 10 5G UW, TCL 30 V 5G, TCL LINKZONE 5G UW, TCL Flip Pro
Inseego
Inseego MiFi X PRO 5G UW, Inseego MiFi M2100 5G UW
Verizon-branded
Verizon GizmoTab XLTE (Quanta Sun 2), Verizon Ellipsis 8 HD XLTE (Quanta Sun 1G), Verizon Ellipsis 10 XLTE, Verizon Ellipsis 7, Verizon Ellipsis 8 , Verizon Ellipsis 8 HD, Verizon Ellipsis 10, Verizon Ellipsis 10 HD, Verizon GizmoTab, Verizon GizmoTablet, Verizon Ellipsis Jetpack MHS800L, Verizon Ellipsis Jetpack MHS815L, Verizon Jetpack 4G LTE Mobile Hotspot AC791L, Verizon Jetpack 4G LTE Mobile Hotspot MiFi 4620L, Verizon Jetpack 4G LTE Mobile Hotspot MiFi 4620LE, Verizon Jetpack 4G LTE Mobile Hotspot MiFi 5510L, Verizon Jetpack MiFi 6620L, Verizon Jetpack MiFi 7730L, Verizon Jetpack MiFi 8800L, Verizon Orbic Speed Mobile Hotspot, Verizon Airspeed Mobile Hotspot, Verizon LTE Internet and Home Phone, Verizon Router (CR1000A), Verizon 5G Home Router, Verizon Internet Gateway (ARC-XCI55AX), Verizon Internet Gateway (ASK-NCQ1338) , Verizon Internet Gateway (ASK-NCQ1338FA), Verizon SmartHub with Voice, Verizon 4G LTE Broadband Router, Verizon 4G LTE Broadband Router with Voice, Verizon Receiver (LV65), Verizon 5G Home Internet, MiFi device, Verizon 5G MiFi M1000, Verizon 5G Internet Gateway, Verizon LTE Home Internet, Hum+, Hum x
ZTE
Blade Vantage 2 prepaid, Blade Vantage prepaid

EXHIBIT D

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EXHIBIT E

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