UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

PROCOMM INTERNATIONAL PTE. LTD., Plaintiff, v. VERIZON COMMUNICATIONS, INC., CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS, TELEFONAKTIEBOLAGET LM ERICSSON, and ERICSSON INC., Defendants.	Civil Action No. 2:24-cv-00009

PLAINTIFF PROCOMM INTERNATIONAL PTE. LTD.'S
DISCLOSURE OF ASSERTED CLAIMS AND INFRINGEMENT CONTENTIONS

Pursuant to the Court's Order (D.I. 11), Plaintiff Procomm international Pte. Ltd. ("Procomm") provides the following Disclosure of Asserted Claims and Infringement Contentions in accordance with E.D. Texas Local Patent Rule 3-1. Procomm makes these contentions based on the information reasonably available at this time. Discovery has not yet commenced, invalidity contentions have not yet been served, and claim construction has not yet occurred. Procomm reserves the right to supplement and/or amend these contentions to the full extent consistent with the Court's Rules and Orders, including in light of discovery and claim construction.

I. ASSERTED CLAIMS (E.D. TEX. PATENT RULE 3-1(A))

Procomm asserts that Defendants Verizon Communication, Inc. and Cellco Partnership d/b/a Verizon Wireless (collectively, "Verizon," or "the Verizon Defendants"), Telefonaktiebolaget LM Ericsson ("LM Ericsson"), and Ericsson, Inc. ("Ericsson USA")

(collectively, LM Ericsson and Ericsson USA are "Ericsson" or "the Ericsson Defendants," and the Ericsson Defendants together with the Verizon Defendants are "the Defendants") infringe, directly under 35 U.S.C. § 271(a), contributorily under 35 U.S.C. § 271(c), and by inducement under 35 U.S.C. § 271(b), the following claims (collectively, the "Asserted Claims") of the Asserted Patents:

- U.S. Patent No. 8,583,100 – claims 15, 19
- U.S. Patent No. 7,103,377 – claim 1
- U.S. Patent No. 8,497,813 – claims 1, 4
- U.S. Patent No. 7,724,521 – claims 1, 4, 5, 14-16

Procomm asserts the Verizon Defendants infringe, directly under 35 U.S.C. § 271(a), contributorily under 35 U.S.C. § 271(c), and by inducement under 35 U.S.C. § 271(b), the following claims (collectively, the "Asserted Claims") of U.S. Patent No. 7,834,721:

- U.S. Patent No. 7,834,721 – claims 1, 2

Procomm believes that discovery, including inspection of the source code and other technical documents relating to Defendants' products, may reveal that Defendants infringe additional claims of the Asserted Patents. In such case, Procomm reserves the right to amend and/or supplement these contentions.

II. ACCUSED INSTRUMENTALITIES (E.D. TEX. PATENT RULE 3-1(B))

Procomm asserts that the Asserted Claims are infringed by the following products, and products that are reasonably similar to the following (collectively, the "Accused Instrumentalities"):

- Ericsson's Macro products
- Ericsson's Massive MIMO products

- Ericsson's Street Macro products, including but not limited to Ericsson's Street Macro 6701
- Small Cell products used in Verizon's network, including but not limited to Ericsson's small cell products, Samsung small cell products, and Nokia small cell products
- Tunable multicavity filters used by Verizon, including but not limited to Kaelus KA-6008-8433 Interference Filter as well as similar filters used by Verizon and manufactured by Analog Devices, Inc., Dover Corporation, The LGL Group, Inc., Netcom, Inc., Telonic Berkeley Corporation, and Kaelus Inc.
- Defendants' systems and services using the components set forth above.

The above Accused Instrumentalities infringe the Asserted Claims, as set forth in the Appendixes A-E (collectively, the "Claim Charts").

Procomm reserves the right to amend and/or supplement this disclosure based on additional products identified during discovery, or released, developed, or made available by any of the Defendants after the date on which these contentions are served.

III. CLAIM CHARTS (E.D. TEX. PATENT RULE 3-1(C))

Procomm identifies where each element of each Asserted Claim is found within each Accused Instrumentality in the Claim Charts, and accompanying exhibits. Procomm asserts that Defendants directly infringe the Asserted Claims under 35 U.S.C. § 271(a) by making, having made, using, selling, offering for sale, and/or importing systems and methods protected thereby within the United States.

Procomm further asserts that the Ericsson Defendants induce the direct infringement of the Asserted Claims by users of the Accused Instrumentalities pursuant to 35 U.S.C. § 271(b) at least

by one or more of: making, selling, offering to sell, and importing the Accused Instrumentality, and through activities relating to selling, marketing advertising, promotion, support, and distribution of the Accused Instrumentalities. For example, when a user uses the Accused Instrumentalities as designed and intended by Ericsson, each component and/or step of each Asserted Claim is used and/or performed as described in the Claim Charts. As another example, Ericsson indues the direct infringement of the Asserted Claims by providing instructions and directions (in the form of , *e.g.*, manuals and other supporting documentation) regarding use of the Accused Instrumentalities that provide detailed instructions and guidance on how to use the Accused Instrumentalities in manners that directly infringe the Asserted Claims as described in the Claim Charts.

Procomm further asserts that the Ericsson Defendants contribute to the direct infringement of the Asserted Claims by users of the Accused Instrumentalities pursuant to 35 U.S.C. § 271(c) at least by making, selling, offering to sell, and/or importing or exporting one or more components of the Accused Instrumentalities used to practice the Asserted Claims, that constitute a material part of the inventions claimed in the Asserted Claims, and that have no substantial non-infringing use, with knowledge that such components are especially made or adapted for use in infringing the Asserted Claims.

Procomm further asserts that the Verizon Defendants induce the direct infringement of the Asserted Claims by users of the Accused Instrumentalities pursuant to 35 U.S.C. § 271(b) at least by one or more of: making, selling, offering to sell, and importing the Accused Instrumentality, and through activities relating to selling, marketing advertising, promotion, support, and distribution of the Accused Instrumentalities. For example, when a user uses the Accused Instrumentalities as designed and intended by Verizon, each component and/or step of each

Asserted Claim is used and/or performed as described in the Claim Charts. As another example, Verizon indues the direct infringement of the Asserted Claims by providing instructions and directions (in the form of , *e.g.*, manuals and other supporting documentation) regarding use of the Accused Instrumentalities that provide detailed instructions and guidance on how to use the Accused Instrumentalities in manners that directly infringe the Asserted Claims as described in the Claim Charts.

Procomm further asserts that the Verizon Defendants contribute to the direct infringement of the Asserted Claims by users of the Accused Instrumentalities pursuant to 35 U.S.C. § 271(c) at least by making, selling, offering to sell, and/or importing or exporting one or more components of the Accused Instrumentalities used to practice the Asserted Claims, that constitute a material part of the inventions claimed in the Asserted Claims, and that have no substantial non-infringing use, with knowledge that such components are especially made or adapted for use in infringing the Asserted Claims.

The Claim Charts are based on publicly available information that is currently accessible to Procomm. The Asserted Claims include limitations that are performed, in whole or in part, by software. Defendants do not make public the source code or other technical documents concerning the operation of such software. Accordingly, Procomm's current positions on infringement are provided without the benefit of the source code for and other non-public information regarding the Accused Instrumentalities. Additionally, there may be different releases or versions of such software (including at different times) that are not publicly available or accessible. The operation of different versions and releases of the operating system and other controlling software for the Accused Instrumentalities is currently believed to be substantially the same with respect to the functionality described in the Claim Charts. Thus, Procomm reserves the right to amend and/or

supplement these contentions in light of discovery, including a complete production by Defendants of the source code for and other non-public information regarding the Accused Instrumentalities, including information regarding prior versions and releases of any relevant software that controls the operation of the Accused Instrumentalities.

Further, Procomm's positions on infringement of specific claims will depend on the claim constructions adopted by the Court. Because the Court has not yet construed the claim terms, Procomm reserves the right to amend and/or supplement these contentions after claim construction, to the full extent consistent with the Court's Rules and Orders.

IV. LITERAL INFRINGEMENT (E.D. TEX. PATENT RULE 3-1(D))

Each limitation of each Asserted Claim is considered to be literally present in the Accused Instrumentalities. If any limitation of any Asserted Claim is not found to be literally present, any such limitation is considered to be present under the Doctrine of Equivalents. Consistent with E.D. Tex. Patent Rule 3-6, Procomm reserves the right to amend and/or supplement this disclosure, including for any of the reasons set forth above (see supra § III), or as ordered by the Court.

V. PRIORITY DATES (E.D. TEX. PATENT RULE 3-1(E))

For each Asserted Patent that claims priority to an earlier application, Procomm identifies below the priority date to which each asserted claim of that patent is entitled based on its claim of priority to an earlier application:

- U.S. Patent No. 8,583,100 – all asserted claims are entitled to a priority date of Jan. 25, 2007
- U.S. Patent No. 7,103,377 – all asserted claims are entitled to a priority date of Dec. 3, 2002
- U.S. Patent No. 7,834,721 – all asserted claims are entitled to a priority date of June 26, 2007

- U.S. Patent No. 8,497,813 – all asserted claims entitled to a priority date of Jun. 26, 2007
- U.S. Patent No. 7,724,521 – all asserted claims entitled to a priority date of Jun. 11, 2008

VI. IDENTIFICATION OF PLAINTIFF'S INSTRUMENTALITIES PRACTICING THE CLAIMED INVENTIONS (E.D. TEX. PATENT RULE 3-1(F))

Not applicable.

VII. DOCUMENT PRODUCTION (E.D. TEX. PATENT RULE 3-2)

Non-privileged documents evidencing conception, reduction to practice, design, and development of each claimed invention are being concurrently produced bearing Bates numbers PROCOMM-A_00000001 – 0000084. Procomm continues to investigate the conception, reduction to practice, design, and development of the claimed inventions, and reserves the right to supplement its production as it receives possession, custody, or control of any additional responsive, non-privileged documents.

Additionally, copies of the file histories for the Asserted Patents are being concurrently produced bearing Bates numbers PROCOMM-A_ 0000085 – 00001737.

Dated: March 20, 2024
New York, New York

By: */s/Timothy Gilman*

Timothy Gilman
tim.gilman@srz.com
Christopher Gerson
Chris.Gerson@srz.com
Natalie Lieber
natalie.lieber@srz.com

Schulte Roth & Zabel LLP
919 Third Avenue
New York, NY 10022
Telephone: 212.756.2000

Attorneys for Plaintiff

CERTIFICATE OF SERVICE

I hereby certify that on March 20, 2024, I caused a true and correct copy of the foregoing PLAINTIFF PROCOMM INTERNATIONAL PTE. LTD.'S DISCLOSURE OF ASSERTED CLAIMS AND INFRINGEMENT CONTENTIONS to be served on all counsel of record via e-mail service.

By: */s/Natalie Lieber*

Natalie Lieber
natalie.lieber@srz.com

Schulte Roth & Zabel LLP
919 Third Avenue
New York, NY 10022
Telephone: 212.756.2000

Attorney for Plaintiff

Appendix A: Claim Chart for U.S. Patent No. 8,583,100

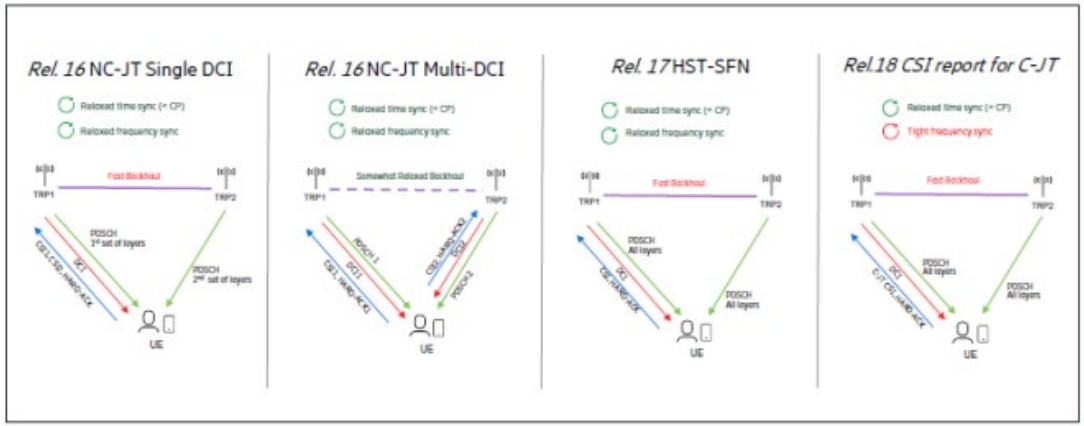
Claim Number	Claim Language	Accused Instrumentalities (Verizon DAS systems, Ericsson's Macro, Massive MIMO, Street Macro and Small Cell Products, including but not limited to Ericsson's Street Macro 6701, and other small cell products used in Verizon's network, including but not limited to Samsung small cell products and Nokia small cell products)[1]
15[a]	A method of transmitting a wireless communication	To the extent that the claim's preamble is determined to be a limitation or otherwise limiting, the Accused Instrumentalities perform a method of transmitting a wireless communication signal, the method comprising the limitations of the claim as discussed below. [2]

[1] Pursuant to E.D. Tex. Patent Rule 3-1(c), this claim chart identifies where each element of the asserted claims of this patent are found within the Accused Instrumentalities or, for method claims, how the Accused Instrumentalities perform the asserted claim. As identified above, the Accused Instrumentalities include Verizon's distributed antenna system (DAS), and products used in Verizon networks, including Ericsson's Macro, Massive MIMO, Street Macro and Small Cell products, Samsung's small cell products, and Nokia's small products. On information and belief, and based on publicly available information, the Accused Instrumentalities infringe for substantially the same reasons, except where indicated otherwise in this chart. For example, this claim chart makes reference to Ericsson's Massive MIMO Handbook, which describes Ericsson's "Massive MIMO solutions" (Massive MIMO, at 2) and Ericsson's "Massive MIMO portfolio." (*Id.* at 5.) The claim chart also refers to certain cellular specifications, which upon information and belief would apply generally to the Accused Instrumentalities. And the claim charts include references to materials describing Verizon's distributed antenna system (DAS) technology. The publicly available materials cited herein do not identify material differences related to infringement across the various accused products, but instead indicate that all accused products operate the same or substantially the same with respect to the DAS System and mTRP infringing technology as described in this chart. Thus, although this claim chart includes exemplary citations and images for certain products, the explanations of how the Accused Instrumentalities meet each limitation of the claims charted herein apply to all of the Accused Instrumentalities unless specifically noted otherwise. To the extent Defendants' source code or other discovery reveals any material differences across products, Plaintiff reserves all rights to amend these contentions accordingly.

[2] In accordance with Local Patent Rule 3-1(c) Procomm identifies where each element of each asserted claim is found within the Accused Instrumentalities by way of exemplary features of the Accused Instrumentalities that illustrate the infringing functionality. Procomm does not contend that the examples set forth herein are the only instance of the infringing feature of the Accused Instrumentalities, and Procomm reserves the right to rely on such other features of the Accused Instrumentalities, and on other facts adduced through discovery, in proving its case at trial.

	signal comprising:	This claim chart provides certain non-limiting examples of the Accused Instrumentalities' infringement. The first relates to Verizon's distributed antenna system technology ("DAS Systems.") The second relates to multi-transmission point and joint transmission technology and other protocols involving the transmission of RF signals from multiple antennas ("mTRP"), which is implemented by the Accused Instrumentalities. Verizon's DAS Systems and the Accused Instrumentalities' implementation of mTRP, as described in more detail below, are capable of performing the claimed method. Both DAS Systems and mTRP transmit wireless communication signals (e.g., to 5G user equipment ("UE")). **DAS Systems:** *See* ettower.com/verizon-uses-small-cells-to-connect-indoor-das/ ("Verizon uses small cells to connect indoor DAS…For Verizon Wireless, using a small cell as a signal source looks like a potential solution to one of the biggest problems in the DAS market") *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("Last year [2020], Walmart and Verizon went into talks about partnering to add 5G technology to the inside of Walmart stores…5G and local mini towners can be introduced…that system may in one area of the facility be a 'pure' 5G deployment while in less sensitive areas of the facility, the 5G can be a signal source for the DAS system in place….It is hard to imagine that the deployment of 5G/DAS hybrid systems will not become very widespread in the next few years.") *See* www.verizon.com/about/news/vzw/2014/04/network-terms-explained ("DAS are networks of cables and antennas that can be installed in high-traffic areas—stadiums, convention or shopping centers, office buildings, train stations, airline terminals, and even dense, outdoor urban areas such as midtown Manhattan.") "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber." *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021 "According to the announcement, Verizon plans to leverage Boingo's experience with 'distributed antenna systems (DAS), small cells and Wi-Fi' to expand its 5G service indoors and to public spaces like airports, stadiums, hotels, and more."

		https://www.theverge.com/2019/8/22/20827985/verizon-5g-indoor-boingo-partnership-problem-solution-phoenix **mTRP:** Release 16 of the 5G specification standardized a multi-Transmission Point (TRP) operation in which a given RF signal was sent by a first unit while sending a network signal (transport signal) to another unit within the same cell which would transmit a duplicative RF signal to constructively boost the signal to the user equipment. Release 17 and Release 18 add in additional "Joint Transmission" protocols, both within cells and between cells. An excerpt from Ericsson's "Massive MIMO Handbook: Technology Primer" (2023), which shows an eCPRI (*i.e.*, network) "backhaul" for the transport signal between two TRPs and the two antennas sending the same RF signal:



In NR, multi-Transmission Point (TRP) operation has been standardized in Rel.16 and onwards.

In **Rel.16**, non-coherent joint transmission (NC-JT) was introduced, where the UE receives from two TRP simultaneously in the same physical resource blocks (PRBs).

In single-DCI NC-JT, a single PDCCH schedules a single PDSCH with multiple MIMO layers. It is transmitted from two TRPs and received by the UE, where the layers are divided into two groups, one per TRP.

In multi-DCI NC-JT, two PDCCH (one per TRP), schedules one PDSCH each (one per TRP). Hence each PDSCH is transmitted from different TRPs and received simultaneously by the UE.

In **Rel.17**, NC-JT was extended to support inter-cell operation, hence the two TRPs can belong to different cells (different physical cell ID).

In addition, a dedicated CSI report for single DCI NC-JT was specified, which takes into account the fact that the UE is receiving from two TRPs simultaneously.

In **Rel.17**, a new multi-TRP scheme was specified, intended for high speed train (HST) scenario using single frequency network (SFN) transmission. This means that the network transmit two identical copies of a PDSCH from two TRPs simultaneously and overlapping in the PRBs. This is different from NC-JT since both TRPs transmit all layers. The SFN transmission is a well know transparent technique to improve the SNR of the PDSCH transmission (i.e. The UE need not know that SFN transmission is taking place) and is used in e.g mobile broadcast transmissions. The new aspect here is that it is not transparent to the UE, instead the UE is given two synchronization signals so it can actually perform sync towards both TRPs simultaneously when receiving the SFN transmitted PDSCH.

In **Rel.18**, the inter-cell multi-DCI NC-JT was further extended to include two time advance receive timing difference between the two DL reference timings (i.e. the two TRPS) and they can be assumed to be larger than cyclic prefix length. Hence, this extends the use of multi-TRP to larger macro cells where the receive timing difference can be large.

In **Rel.18**, CSI reporting for coherent joint transmissions (C-JT) was introduced. In C-JT, similar to HST-SFN, two identical copies of the PDSCH are transmitted from two TRPs simultaneously and on the same PRBs. However, in this case, the transmissions are phase aligned that gives coherent combining (constructive) of the two PDSCH which boosts the SNR in the receiver. This type of transmission requires tight frequency sync among the TRPs and also CSI knowledge on how the network should perform the co-phasing.

		("The Massive MIMO Handbook," *Ericsson,* Second Edition (hereinafter, "Massive MIMO"), at 60.)[3]
15[b]	receiving a first RF signal at an antenna of a first remote wireless communication station;	The Accused Instrumentalities are capable of receiving a first RF signal at an antenna of a first remote wireless communication station. **DAS Systems:** DAS systems, by definition, utilize a plurality of remote antennas to increase the coverage area for cellular systems. In Verizon's DAS systems, a plurality of antenna units are spread throughout the coverage area and connected to *e.g.*, a small cell, via fiber optic cable. *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("[M]any enterprise level facilities use distributed antenna systems (DAS) to support their internal networks. Specifically, they tend to use both active (think power-sourced, fiber connected, dynamic) DAS along with passive (not powered and simpler) to form a hybrid DAS system….[H]ybrid DAS is most in demand.") *See* ettower.com/verizon-uses-small-cells-to-connect-indoor-das/ ("Verizon uses small cells to connect indoor DAS…For Verizon Wireless, using a small cell as a signal source looks like a potential solution to one of the biggest problems in the DAS market"). "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber." *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021 **mTRP:** The antennas in the Accused Instrumentalities are for sending and receiving RF signals. As just one example, Ericsson touts its beamforming technology with its ability "to amplify transmitted/***received signals*** more in some directions than others." (Massive MIMO, at 15.)

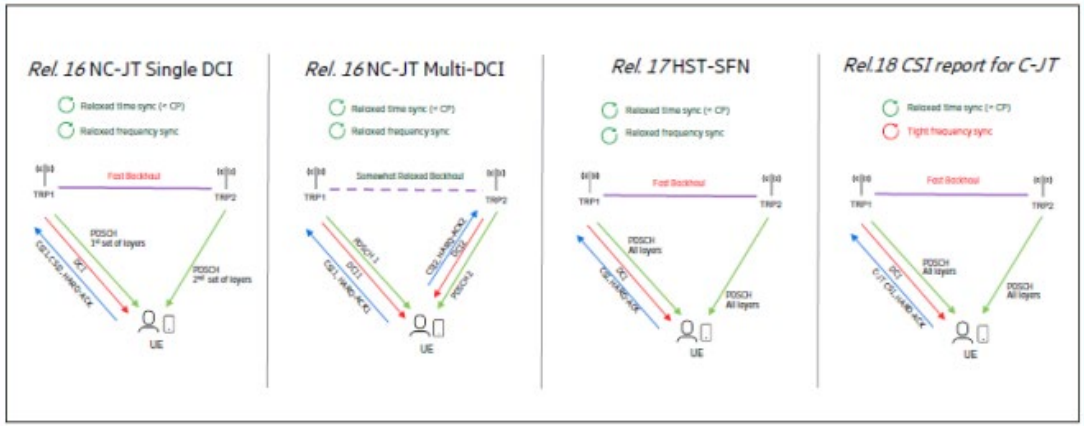
[3] All emphases are added unless indicated otherwise. Citations to a document and highlighting within a document are exemplary only and are not meant to restrict Plaintiff's reliance on the document more generally.

		Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants..[4]
15[c]	processing the first RF signal by a base station at the first remote wireless communication station;	The Accused Instrumentalities are capable of processing the first RF signal by a base station at the first remote wireless communication station. With respect to both DAS Systems and mTRP, antennas are connected to base stations such as small cells or Massive MIMO radio units that implement baseband functionality. **DAS Systems:** "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber." *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021 **mTRP**: Ericsson equipment distributes portions of the base station functionality to MIMO units: "A Massive MIMO radio is a hardware unit that comprises an antenna array, a large number of radio transmitter and receiver chains...and parts of the baseband functionality, all tightly integrated." (Massive MIMO, at 13.) In many solutions, the MIMO radio unit is then connected via an eCPRI link to a Baseband unit. (Massive MIMO, at 45.) Among other things, base stations in networks are for processing RF signals.

[4] A Proposed Discovery Order is due to be filed on April 17, 2024, two weeks after the April 3, 2024 scheduling conference. *See* D.I. 11. This District's Sample Discovery Order for Patent Cases includes an Additional Disclosures modification to the Patent Local Rules, where, "[i]f a party claiming patent infringement asserts that a claim element is a software limitation, the party need not comply with P.R. 3-1 for those claim elements until 30 days after source code for each Accused Instrumentality is produced by the opposing party. Thereafter, the party claiming patent infringement shall identify, on an element-by-element basis for each asserted claim, what source code of each Accused Instrumentality allegedly satisfies the software limitations of the asserted claim elements." Plaintiff reserves all rights to supplement any aspect of these contentions as discovery progresses and as source code is produced, but has made a good-faith effort in these contentions to identify claim elements that are anticipated to be met in whole or in part by software.

		Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants..
15[d]	generating a second RF signal and a first transport signal representing a duplicate of the second RF signal at the first remote wireless communication station;	The Accused Instrumentalities are capable of generating a second RF signal and a first transport signal representing a duplicate of the second RF signal at the first remote wireless communication station. **DAS Systems:** In DAS Systems, the antennas are connected to and distribute signals from a common base station, e.g., a small cell. When the small cell receives a signal from the telephone network for transmission, it generates both an RF signal for transmission by its own antenna as well as a transport signal for sending a data representation of the RF signal to the remote antennas via the fiber network. For example, a given RF transmission may need to be sent from multiple antennas—e.g., to ensure it reaches the full DAS coverage area or for handoffs between antennas. **mTRP:** When the small cell receives a signal from the telephone network for transmission, it generates both an RF signal for transmission by its own antenna as well as a transport signal for sending a data representation of the RF signal to the remote antennas via the fiber network. "Another example…is Coordinated Multi-Point (CoMP), wherein multiple nodes, on the same or different sites, coordinate their transmission/reception in order to mitigate interference or boost the signal energy." (Massive MIMO, at 66.) "This means that the network transmits two identical copies of a PDSCH from two TRPs simultaneously and overlapping in the PRBs." (Massive MIMO Handbook: Technology Primer," *Ericsson* (hereinafter "Massive MIMO Technology Primer,") at 60.) "For C-JT, the same precoding layer(s) are transmitted from the multiple cooperating TRPs with the intention for the transmissions to coherently add up at the receiving UE."

		(Massive MIMO, at 112.) Release 16 of the 5G specification (from 2020) standardized a multi-Transmission Point (TRP) operation in which a given RF signal was sent by a first unit while sending a network signal (transport signal) to another unit within the same cell which would transmit a duplicative RF signal to constructively boost the signal to the user equipment. Release 17 (2022) and Release 18 (pending 2023-24) add in additional "Joint Transmission" protocols, both within cells and between cells. An excerpt from Ericsson's "Massive MIMO Handbook: Technology Primer" (2023), which shows an eCPRI (*i.e.*, network) "backhaul" for the transport signal between two TRPs and the two antennas sending the same RF signal:



In NR, multi-Transmission Point (TRP) operation has been standardized in Rel.16 and onwards.

In **Rel.16**, non-coherent joint transmission (NC-JT) was introduced, where the UE receives from two TRP simultaneously in the same physical resource blocks (PRBs).

In single-DCI NC-JT, a single PDCCH schedules a single PDSCH with multiple MIMO layers. It is transmitted from two TRPs and received by the UE, where the layers are divided into two groups, one per TRP.

In multi-DCI NC-JT, two PDCCH (one per TRP), schedules one PDSCH each (one per TRP). Hence each PDSCH is transmitted from different TRPs and received simultaneously by the UE.

In **Rel.17**, NC-JT was extended to support inter-cell operation, hence the two TRPs can belong to different cells (different physical cell ID).

In addition, a dedicated CSI report for single DCI NC-JT was specified, which takes into account the fact that the UE is receiving from two TRPs simultaneously.

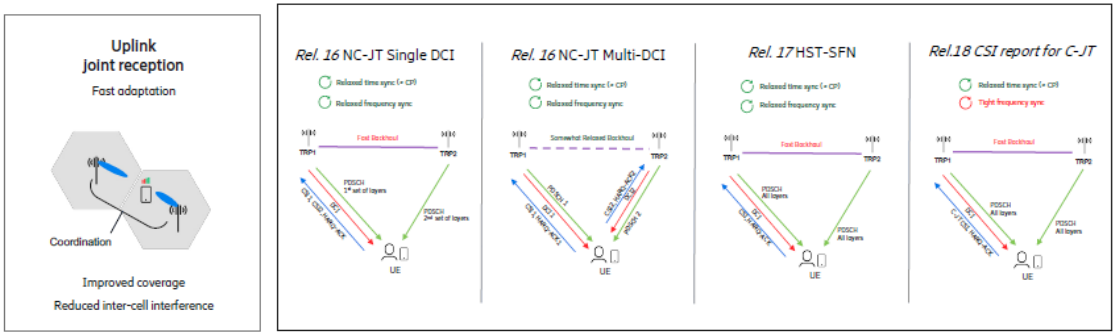
In **Rel.17**, a new multi-TRP scheme was specified, intended for high speed train (HST) scenario using single frequency network (SFN) transmission. This means that the network transmit two identical copies of a PDSCH from two TRPs simultaneously and overlapping in the PRBs. This is different from NC-JT since both TRPs transmit all layers. The SFN transmission is a well know transparent technique to improve the SNR of the PDSCH transmission (i.e. The UE need not know that SFN transmission is taking place) and is used in e.g mobile broadcast transmissions. The new aspect here is that it is not transparent to the UE, instead the UE is given two synchronization signals so it can actually perform sync towards both TRPs simultaneously when receiving the SFN transmitted PDSCH.

In **Rel.18**, the inter-cell multi-DCI NC-JT was further extended to include two time advance receive timing difference between the two DL reference timings (i.e. the two TRPS) and they can be assumed to be larger than cyclic prefix length. Hence, this extends the use of multi-TRP to larger macro cells where the receive timing difference can be large.

In **Rel.18**, CSI reporting for coherent joint transmissions (C-JT) was introduced. In C-JT, similar to HST-SFN, two identical copies of the PDSCH are transmitted from two TRPs simultaneously and on the same PRBs. However, in this case, the transmissions are phase aligned that gives coherent combining (constructive) of the two PDSCH which boosts the SNR in the receiver. This type of transmission requires tight frequency sync among the TRPs and also CSI knowledge on how the network should perform the co-phasing.

		(Massive MIMO, at 60.) In these various 5G joint transmission implementations, a given TRP (which will include some baseband functionality) generates a second RF signal, which it emits (or transmits) from its antenna, and a first transport signal representing a duplicate of the second RF signal at the first remote wireless communication station. The various 5G revisions teach both simple implementations of this such as merely constructively increasing signal to the User Equipment to more sophisticate implementations for beamforming and spatial multiplexing applications (as exemplified above). Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.
15[e]	transmitting the second RF signal from the antenna at the first remote wireless communication station;	The Accused Instrumentalities are capable of transmitting the second RF signal from the antenna at the first remote wireless communication station. As described above with respect to claim limitation 15[d], incorporated herein by reference, the generated second RF signal is emitted (or transmitted) from the first antenna in both DAS Systems and mTRP. E.g., in DAS a given RF ***transmission may need to be sent*** from multiple antennas. E.g.,: in mTRP, the Massive MIMO documentation describes: "Another example…is Coordinated Multi-Point (CoMP), wherein multiple nodes, on the same or different sites, ***coordinate their transmission***/reception in order to mitigate interference or boost the signal energy." (Massive MIMO, at 66.)

		"This means that ***the network transmits two identical copies of a PDSCH*** from two TRPs simultaneously and overlapping in the PRBs." (Massive MIMO Technology Primer, at 60.) "For C-JT, ***the same precoding layer(s) are transmitted from the multiple cooperating TRPs*** with the intention for the transmissions to coherently add up at the receiving UE." (Massive MIMO Technology Primer, at 112.) Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.
15[f]	routing the first transport signal through a network of remote wireless communication stations to a second remote wireless communication station, each remote wireless communication station having a co-located, network layer router;	The Accused Instrumentalities are capable of routing the first transport signal through a network of remote wireless communication stations to a second remote wireless communication station, each remote wireless communication station having a co-located, network layer router. **DAS Systems:** In an active or hybrid DAS network, the remote antenna units are coupled to a network backbone (*e.g.*, fiber) and include routers for receiving and transmitting data that corresponds to RF signals. "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber….[T]he base station radio is a single unit that connects via fiber to the DAS antennas" *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021. *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("[T]hat system may in one area of the facility be a 'pure' 5G deployment while in less sensitive areas of the facility, the 5G can be a signal source for the DAS system in place.") **mTRP:** Similarly with the multi-small cell implementations, a network layer connects the small cells to each other for sending and receiving data that corresponds to the sent/received RF signals for the cellular network.

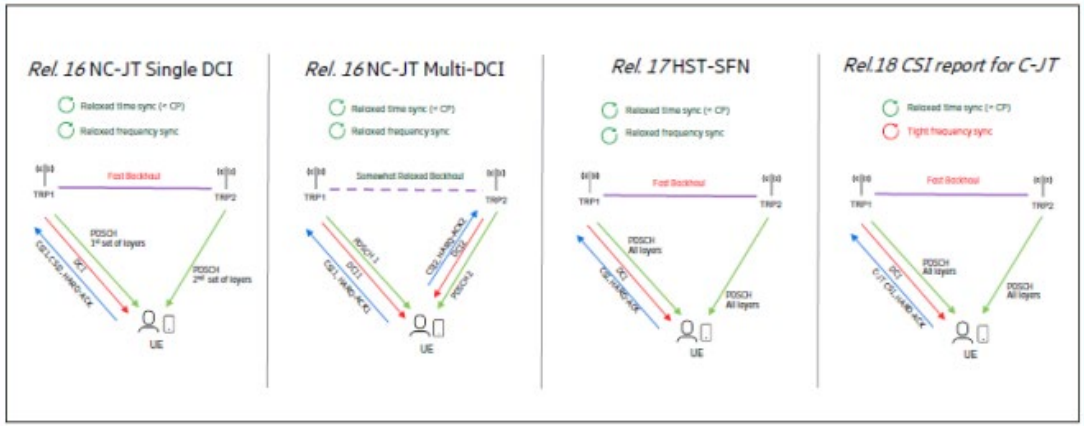
		"eCPRI is an evolution of CPRI that uses the packet-based Ethernet protocol [between units] and enables more flexibility and data compression." (Massive MIMO, at 45.) Using this network layer, remote units exchange both uplink and down link data, *e.g.*, through "Coordinated Multi-Point (CoMP)":  (Massive MIMO, at 97; Massive MIMO Technology Primer, at 60.) "The purpose of creating a new fronthaul interface, eCPRI, was to enable more efficient implementations of Massive MIMO radios with many radio chains, and to introduce Ethernet based transport. An Ethernet based transport enables switched front-haul." (Massive MIMO, at 77.) Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.
15[g]	transmitting a duplicate of the second RF signal	The Accused Instrumentalities are capable of transmitting a duplicate of the second RF signal based on the first transport signal from the antenna of the second remote wireless communication station.

	based on the first transport signal from the antenna of the second remote wireless communication station;	As described above with respect to claim limitation 15[d], incorporated herein by reference, the duplicate of the second RF signal based on the first transport signal is transmitted by the antenna of the second remote wireless communication system. E.g., in DAS a given RF ***transmission may need to be sent*** from ***multiple antennas***. E.g.,: in mTRP, the Massive MIMO documentation describes: "Another example…is Coordinated Multi-Point (CoMP), wherein multiple nodes, on the same or different sites, ***coordinate their transmission***/reception in order to mitigate interference or boost the signal energy." (Massive MIMO, at 66.) "This means that ***the network transmits two identical copies of a PDSCH*** from two TRPs simultaneously and overlapping in the PRBs." (Massive MIMO Technology Primer, at 60.) "For C-JT, ***the same precoding layer(s) are transmitted from the multiple cooperating TRPs*** with the intention for the transmissions to coherently add up at the receiving UE." (Massive MIMO Technology Primer, at 112.) Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.
15[h]	receiving a third RF signal at the first remote wireless communication station; and	The Accused Instrumentalities are capable of receiving a third RF signal at the first remote wireless communication station. *See* Claim element 15[b] above, incorporated by reference herein. An antenna in a e.g., a 5G network is capable of receiving multiple RF signals. Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.

15[i]	sending a second transport signal to a host unit based on the second RF signal.	The Accused Instrumentalities are capable of sending a second transport signal to a host unit based on the second RF signal. As described above with respect to Claim limitation 15[f], the Accused Instrumentalities include a fiber backbone. This also connects to a hardware or cloud-based host unit for sending receiving data that corresponds to the RF signals for the cellular network. The host unit in both DAS Systems and mRTP includes the functional component to connect or interface the base stations / radio access network to the network Core. The host unit may comprise the small cells in some implementations. Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.

Claim Number	Claim Language	
19[a]	A remote wireless communication station for transmitting high speed wireless data comprising:	To the extent that the claim's preamble is determined to be a limitation or otherwise limiting, the Accused Instrumentalities comprise a remote wireless communication station for transmitting high speed wireless data as discussed below. This claim chart provides certain non-limiting examples of the Accused Instrumentalities' infringement. The first relates to Verizon's distributed antenna system technology ("DAS Systems."). The second relates to multi-transmission point and joint transmission technology and other protocols involving the transmission of RF signals from multiple antennas ("mTRP"), with is implemented by the Accused Instrumentalities. Verizon's DAS Systems and the Accused Instrumentalities' implementation of mTRP, as described in more detail below have remote wireless communications stations for transmitting high speed wireless data. Both DAS Systems and mTRP transmit high speed wireless data (e.g., to 5G user equipment ("UE").) **DAS Systems:** *See* ettower.com/verizon-uses-small-cells-to-connect-indoor-das/ ("Verizon uses small cells to connect indoor DAS…For Verizon Wireless, using a small cell as a signal source looks like a potential solution to one of the biggest problems in the DAS market") *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("Last year [2020], Walmart and Verizon went into talks about partnering to add 5G technology to the inside of Walmart stores…5G and local mini towners can be introduced…that system may in one area of the facility be a 'pure' 5G deployment while in less sensitive areas of the facility, the 5G can be a signal source for the DAS system in place….It is hard to imagine that the deployment of 5G/DAS hybrid systems will not become very widespread in the next few years.") *See* www.verizon.com/about/news/vzw/2014/04/network-terms-explained ("DAS are networks of cables and antennas that can be installed in high-traffic areas—stadiums, convention or shopping centers, office buildings, train stations, airline terminals, and even dense, outdoor urban areas such as midtown Manhattan.")

		"Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber." *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021 "According to the announcement, Verizon plans to leverage Boingo's experience with 'distributed antenna systems (DAS), small cells and Wi-Fi' to expand its 5G service indoors and to public spaces like airports, stadiums, hotels, and more." https://www.theverge.com/2019/8/22/20827985/verizon-5g-indoor-boingo-partnership-problem-solution-phoenix **mTRP:** Release 16 of the 5G specification standardized a multi-Transmission Point (TRP) operation in which a given RF signal was sent by a first unit while sending a network signal (transport signal) to another unit within the same cell which would transmit a duplicative RF signal to constructively boost the signal to the user equipment. Release 17 and Release 18 add in additional "Joint Transmission" protocols, both within cells and between cells. An excerpt from Ericsson's "Massive MIMO Handbook: Technology Primer" (2023), which shows an eCPRI (*i.e.*, network) "backhaul" for the transport signal between two TRPs and the two antennas sending the same RF signal:



In NR, multi-Transmission Point (TRP) operation has been standardized in Rel.16 and onwards.

In **Rel.16**, non-coherent joint transmission (NC-JT) was introduced, where the UE receives from two TRP simultaneously in the same physical resource blocks (PRBs).

In single-DCI NC-JT, a single PDCCH schedules a single PDSCH with multiple MIMO layers. It is transmitted from two TRPs and received by the UE, where the layers are divided into two groups, one per TRP.

In multi-DCI NC-JT, two PDCCH (one per TRP), schedules one PDSCH each (one per TRP). Hence each PDSCH is transmitted from different TRPs and received simultaneously by the UE.

In **Rel.17**, NC-JT was extended to support inter-cell operation, hence the two TRPs can belong to different cells (different physical cell ID).

In addition, a dedicated CSI report for single DCI NC-JT was specified, which takes into account the fact that the UE is receiving from two TRPs simultaneously.

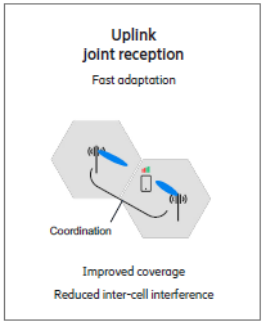
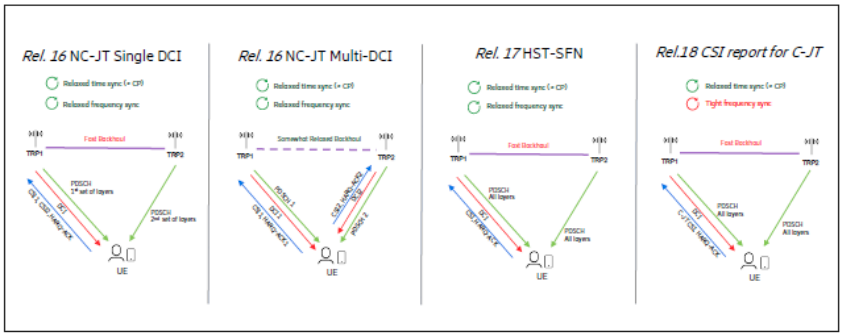
In **Rel.17**, a new multi-TRP scheme was specified, intended for high speed train (HST) scenario using single frequency network (SFN) transmission. This means that the network transmit two identical copies of a PDSCH from two TRPs simultaneously and overlapping in the PRBs. This is different from NC-JT since both TRPs transmit all layers. The SFN transmission is a well know transparent technique to improve the SNR of the PDSCH transmission (i.e. The UE need not know that SFN transmission is taking place) and is used in e.g mobile broadcast transmissions. The new aspect here is that it is not transparent to the UE, instead the UE is given two synchronization signals so it can actually perform sync towards both TRPs simultaneously when receiving the SFN transmitted PDSCH.

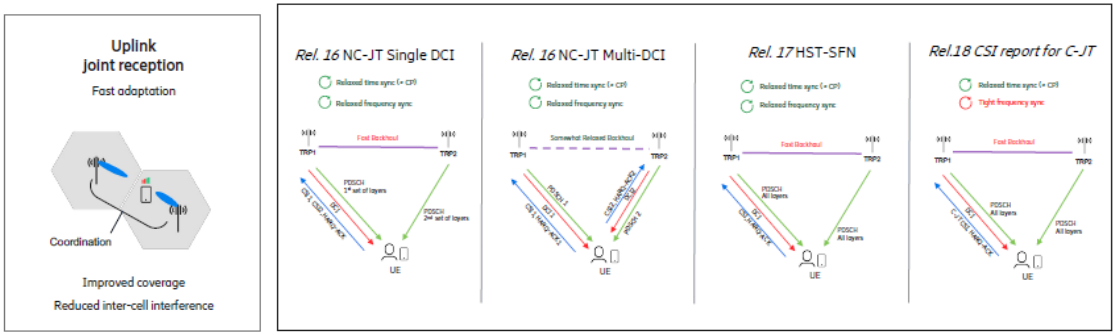
In **Rel.18**, the inter-cell multi-DCI NC-JT was further extended to include two time advance receive timing difference between the two DL reference timings (i.e. the two TRPS) and they can be assumed to be larger than cyclic prefix length. Hence, this extends the use of multi-TRP to larger macro cells where the receive timing difference can be large.

In **Rel.18**, CSI reporting for coherent joint transmissions (C-JT) was introduced. In C-JT, similar to HST-SFN, two identical copies of the PDSCH are transmitted from two TRPs simultaneously and on the same PRBs. However, in this case, the transmissions are phase aligned that gives coherent combining (constructive) of the two PDSCH which boosts the SNR in the receiver. This type of transmission requires tight frequency sync among the TRPs and also CSI knowledge on how the network should perform the co-phasing.

		(Massive MIMO, at 60.)[5]
19[b]	a remote unit;	The Accused Instrumentalities comprise a remote unit. **DAS Systems:** DAS systems, by definition, utilize a plurality of remote antennas to increase the coverage area for cellular systems. In Verizon's DAS systems, a plurality of antenna units are spread throughout the coverage area and connected to, e.g., a small cell through, for example, fiber optic cable. The small cell includes a baseband unit that transmits RF sampled data to the remote antenna units, which then transmit an RF signal based on the RF data to wireless devices in the coverage area. *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("[M]any enterprise level facilities use distributed antenna systems (DAS) to support their internal networks. Specifically, they tend to use both active (think power-sourced, fiber connected, dynamic) DAS along with passive (not powered and simpler) to form a hybrid DAS system….[H]ybrid DAS is most in demand.") *See* ettower.com/verizon-uses-small-cells-to-connect-indoor-das/ ("Verizon uses small cells to connect indoor DAS…For Verizon Wireless, using a small cell as a signal source looks like a potential solution to one of the biggest problems in the DAS market") **mTRP:** The Accused Instrumentalities include remote units. With the multi-small cell implementations, a network layer connects the small cells (*i.e.*, antenna units) to each other for sending and receiving data that corresponds to the sent/received RF signals for the cellular network. "eCPRI is an evolution of CPRI that uses the packet-based Ethernet protocol [between units] and enables more flexibility and data compression." (Massive MIMO, at 45.) Using this network layer, remote units exchange both uplink and down link data, *e.g.*, through "Coordinated Multi-Point (CoMP)":

[5] All emphases are added unless indicated otherwise. Citations to a document and highlighting within a document are exemplary only and are not meant to restrict Plaintiff's reliance on the document more generally.

		  (Massive MIMO, at 97; Massive MIMO Technology Primer, at 60.) "The purpose of creating a new fronthaul interface, eCPRI, was to enable more efficient implementations of Massive MIMO radios with many radio chains, and to introduce Ethernet based transport. An Ethernet based transport enables switched front-haul." (Massive MIMO Technology Primer, at 77.)
19[c]	a router co-located with and coupled to the remote unit;	The Accused Instrumentalities comprise a router co-located with and coupled to the remote unit. **DAS Systems:** In an active or hybrid DAS network, the remote antenna units are coupled to a network backbone (*e.g.*, fiber) and include routers for receiving and transmitting data that corresponds to RF signals. "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber….[T]he base station radio is a single unit that connects via fiber to the DAS antennas" *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021. **mTRP:** A network layer connects the small cells (*i.e.*, antenna units) to each other for sending and receiving data that corresponds to the sent/received RF signals for the cellular network.

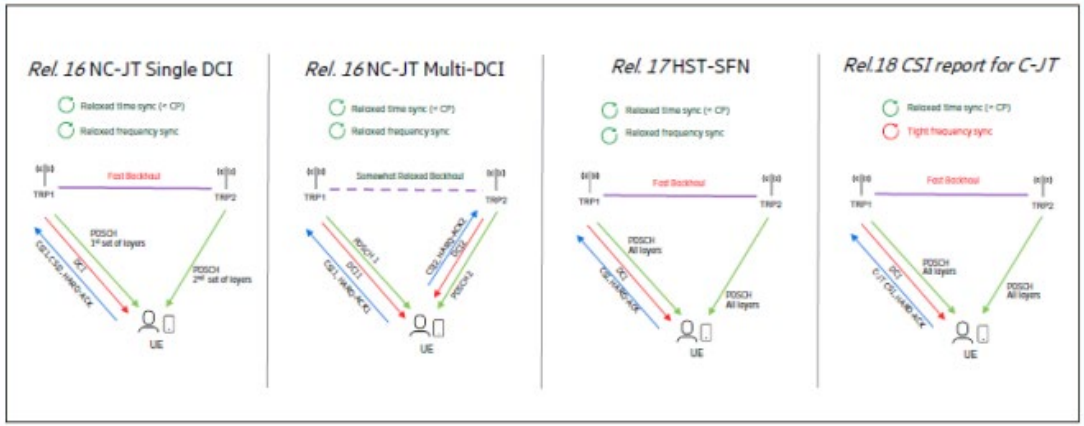
		"eCPRI is an evolution of CPRI that uses the packet-based Ethernet protocol [between units] and enables more flexibility and data compression." (Massive MIMO, at 45.) Using this network layer, remote units exchange both uplink and downlink data, *e.g.*, through "Coordinated Multi-Point (CoMP)":  (Massive MIMO, at 97; Massive MIMO Technology Primer, at 60.) "The purpose of creating a new fronthaul interface, eCPRI, was to enable more efficient implementations of Massive MIMO radios with many radio chains, and to introduce Ethernet based transport. An Ethernet based transport enables switched front-haul." (Massive MIMO Technology Primer, at 77.)
19[d]	a baseband unit co-located with and coupled to the remote unit; and	The Accused Instrumentalities comprise a baseband unit co-located with and coupled to the remote unit. **DAS Systems:** For active and hybrid DAS systems, a network layer connects the remote antenna units to the small cell that includes a base station.

		See www.verizon.com/about/news/vzw/2014/04/network-terms-explained ("Smalls cells are like mini cell towers") "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber." *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021 **mTRP:** Ericsson equipment distributes portions of the base station functionality to MIMO units: "A Massive MIMO radio is a hardware unit that comprises an antenna array, a large number of radio transmitter and receiver chains...and parts of the baseband functionality, all tightly integrated." (Massive MIMO, at 13.) In many solutions, the MIMO radio unit is then connected via an eCPRI link to a Baseband unit. (Massive MIMO, at 45.)
19[e]	an antenna coupled to the remote unit;	The Accused Instrumentalities comprise an antenna coupled to the remote unit. **DAS Systems:** DAS systems, by definition, utilize a plurality of remote antennas to increase the coverage area for cellular systems. In Verizon's DAS systems, a plurality of antenna units are spread throughout the coverage area and connected to the, e.g., a small cell via, for example, fiber optic cable. The small cell includes a baseband unit that transmits RF sampled data to the remote antenna units, which then transmit an RF signal based on the RF data to wireless devices in the coverage area. *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("[M]any enterprise level facilities use distributed antenna systems (DAS) to support their internal networks. Specifically, they tend to use both active (think power-sourced, fiber connected, dynamic) DAS along with passive (not powered and simpler) to form a hybrid DAS system….[H]ybrid DAS is most in demand.") *See* ettower.com/verizon-uses-small-cells-to-connect-indoor-das/ ("Verizon uses small cells to connect indoor DAS…For Verizon Wireless, using a small cell as a signal source looks like a potential solution to one of the biggest problems in the DAS market").

		Similarly, in the reverse direction, RF signals received at the remote antennas are converted to RF data that is sent to the small cell. **mTRP:** The antennas in the Accused Instrumentalities are for sending and receiving RF signals. As just one example, Ericsson touts its beamforming technology with its ability "to amplify transmitted/received signals more in some directions than others." (Massive MIMO, at 15.) *See also id.* at 14 ("Massive MIMO can increase network coverage, capacity, and user throughput using multi-antenna technologies such as beamforming, nullforming and spatial multiplexing (MIMO).")
19[f]	wherein the remote unit is configured to send uplink RF sampled data to a host unit based on RF signals received, and is configured to route data corresponding to RF signals transmitted and/or received over a network of remote units of which the remote unit is a member;	The Accused Instrumentalities meet this limitation—the remote unit is configured to send uplink RF sampled data to a host unit based on RF signals received, and is configured to route data corresponding to RF signals transmitted and/or received over a network of remote units of which the remote unit is a member. **DAS Systems:** DAS systems, by definition, utilize a plurality of remote antennas to increase the coverage area for cellular systems. In Verizon's DAS systems, a plurality of antenna units are spread throughout the coverage area and connected to the small cell *e.g.*, via fiber optic cable. The small cell includes a baseband unit that transmits RF sampled data to the remote antenna units, which then transmit an RF signal based on the RF data to wireless devices in the coverage area. In the reverse direction RF signals received at the remote antennas are converted to RF data that is sent to the small cell. Further, the small cell transmits and receives data based on RF signals with the core over a network of which the small cell is a member. *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("[M]any enterprise level facilities use distributed antenna systems (DAS) to support their internal networks. Specifically, they tend to use both active (think power-sourced, fiber connected, dynamic) DAS along with passive (not powered and simpler) to form a hybrid DAS system….[H]ybrid DAS is most in demand.")

		See ettower.com/verizon-uses-small-cells-to-connect-indoor-das/ ("Verizon uses small cells to connect indoor DAS…For Verizon Wireless, using a small cell as a signal source looks like a potential solution to one of the biggest problems in the DAS market") **mTRP:** As described above in solutions, such as those provided by Ericsson, the MIMO radio unit is connected via an eCPRI link to a baseband unit. Similar to the DAS Systems, the units transmit and receive data based on RF signals with the core over a network of which the unit is a member. (Massive MIMO, p. 45.) The hardware or cloud-based host unit in both DAS Systems and mRTP includes the functional component to connect or interface the base stations / radio access network to the Core. The host unit may comprise the small cells in some implementations. Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.
19[g]	wherein the baseband unit is configured to generate a first RF signal and a transport signal representing a duplicate of the first RF signal,	The Accused Instrumentalities meet this limitation— the baseband unit is configured to generate a first RF signal and a transport signal representing a duplicate of the first RF signal. **DAS Systems:** In DAS Systems, the antennas are connected to and distribute signals from a common base station, e.g., a small cell. When the small cell receives a signal from the telephone network for transmission, it generates both an RF signal for transmission by its own antenna as well as a transport signal for sending a data representation of the RF signal to the remote antennas via the fiber network. For example, a given RF transmission may need to be sent from multiple antennas—e.g., to ensure it reaches the full DAS coverage area or for handoffs between antennas.

		mTRP: When the small cell receives a signal from the telephone network for transmission, it generates both an RF signal for transmission by its own antenna as well as a transport signal for sending a data representation of the RF signal to the remote antennas via the fiber network. "Another example…is Coordinated Multi-Point (CoMP), wherein multiple nodes, on the same or different sites, coordinate their transmission/reception in order to mitigate interference or boost the signal energy." (Massive MIMO, at 66.) "This means that the network transmits two identical copies of a PDSCH from two TRPs simultaneously and overlapping in the PRBs." (Massive MIMO Technology Primer, at 60.) "For C-JT, the same precoding layer(s) are transmitted from the multiple cooperating TRPs with the intention for the transmissions to coherently add up at the receiving UE." (Massive MIMO Technology Primer, at 112.) Release 16 of the 5G specification (from 2020) standardized a multi-Transmission Point (TRP) operation in which a given RF signal was sent by a first unit while sending a network signal (transport signal) to another unit within the same cell which would transmit a duplicative RF signal to constructively boost the signal to the user equipment. Release 17 (2022) and Release 18 (pending 2023-24) add in additional "Joint Transmission" protocols, both within cells and between cells. An excerpt from Ericsson's "Massive MIMO Handbook: Technology Primer" (2023), which shows an eCPRI (*i.e.*, network) "backhaul" for the transport signal between two TRPs and the two antennas sending the same RF signal:



In NR, multi-Transmission Point (TRP) operation has been standardized in Rel.16 and onwards.

In **Rel.16**, non-coherent joint transmission (NC-JT) was introduced, where the UE receives from two TRP simultaneously in the same physical resource blocks (PRBs).

In single-DCI NC-JT, a single PDCCH schedules a single PDSCH with multiple MIMO layers. It is transmitted from two TRPs and received by the UE, where the layers are divided into two groups, one per TRP.

In multi-DCI NC-JT, two PDCCH (one per TRP), schedules one PDSCH each (one per TRP). Hence each PDSCH is transmitted from different TRPs and received simultaneously by the UE.

In **Rel.17**, NC-JT was extended to support inter-cell operation, hence the two TRPs can belong to different cells (different physical cell ID).

In addition, a dedicated CSI report for single DCI NC-JT was specified, which takes into account the fact that the UE is receiving from two TRPs simultaneously.

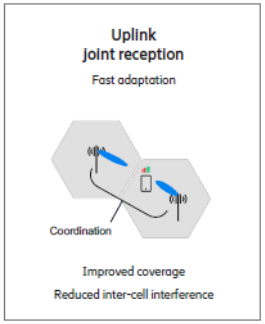
In **Rel.17**, a new multi-TRP scheme was specified, intended for high speed train (HST) scenario using single frequency network (SFN) transmission. This means that the network transmit two identical copies of a PDSCH from two TRPs simultaneously and overlapping in the PRBs. This is different from NC-JT since both TRPs transmit all layers. The SFN transmission is a well know transparent technique to improve the SNR of the PDSCH transmission (i.e. The UE need not know that SFN transmission is taking place) and is used in e.g mobile broadcast transmissions. The new aspect here is that it is not transparent to the UE, instead the UE is given two synchronization signals so it can actually perform sync towards both TRPs simultaneously when receiving the SFN transmitted PDSCH.

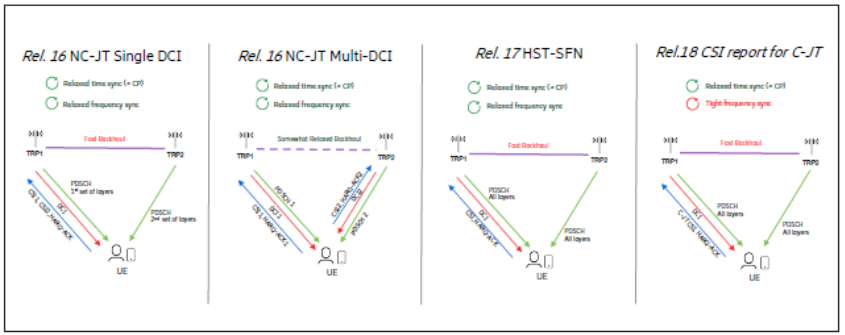
In **Rel.18**, the inter-cell multi-DCI NC-JT was further extended to include two time advance receive timing difference between the two DL reference timings (i.e. the two TRPS) and they can be assumed to be larger than cyclic prefix length. Hence, this extends the use of multi-TRP to larger macro cells where the receive timing difference can be large.

In **Rel.18**, CSI reporting for coherent joint transmissions (C-JT) was introduced. In C-JT, similar to HST-SFN, two identical copies of the PDSCH are transmitted from two TRPs simultaneously and on the same PRBs. However, in this case, the transmissions are phase aligned that gives coherent combining (constructive) of the two PDSCH which boosts the SNR in the receiver. This type of transmission requires tight frequency sync among the TRPs and also CSI knowledge on how the network should perform the co-phasing.

		(Massive MIMO, at 60.) In these various 5G joint transmission implementations, a given TRP (which will include some baseband functionality) generates a second RF signal, which it emits (or transmits) from its antenna, and a first transport signal representing a duplicate of the second RF signal at the first remote wireless communication station. The various 5G revisions teach both simple implementations of this such as merely constructively increasing signal to the User Equipment to more sophisticated implementations for beamforming and spatial multiplexing applications (as exemplified above). Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.
19[h]	wherein the remote unit is configured to: process the first RF signal to be transmitted from the antenna coupled to the remote unit; and	The Accused Instrumentalities comprise—the remote unit is configured to: process the first RF signal to be transmitted from the antenna coupled to the remote unit With respect to both DAS Systems and mTRP, antennas are connected to base stations such as small cells or Massive MIMO radio units that implement baseband functionality. **DAS Systems:** "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber." *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021 **mTRP**: Ericsson equipment distributes portions of the base station functionality to MIMO units: "A Massive MIMO radio is a hardware unit that comprises an antenna array, a large number of radio transmitter and receiver chains...and parts of the baseband functionality, all tightly integrated." (Massive MIMO, at 13.) In many solutions, the MIMO radio unit is then connected via an eCPRI link to a Baseband unit. (Massive MIMO, at 45.)

		Among other things, base stations in, e.g., 5G networks are for processing RF signals. Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a potential software limitation with respect to the "processing" of a first RF signal by a base station.
19[i]	send the transport signal over the network to be routed to a second of the remote units, such that a duplicate of the first RF signal can be transmitted from the second of the remote units.	The Accused Instrumentalities comprise—the remote unit is configured to: send the transport signal over the network to be routed to a second of the remote units, such that a duplicate of the first RF signal can be transmitted from the second of the remote units. **DAS Systems:** In an active or hybrid DAS network, the remote antenna units are coupled to a network backbone (*e.g.*, fiber) and include routers for receiving and transmitting data that corresponds to RF signals. "Distributed antenna systems are a wireless network structured as a number of antennas that are connected to and distribute signals from a common base station, via fiber….[T]he base station radio is a single unit that connects via fiber to the DAS antennas" *What Are Small Cells and Distributed Antenna Systems (DAS)?*, Jan. 19, 2021. *See* broadbandinfrastructure.com/5g-and-das-horizon/ ("[T]hat system may in one area of the facility be a 'pure' 5G deployment while in less sensitive areas of the facility, the 5G can be a signal source for the DAS system in place.") **mTRP:** A network layer connects the small cells to each other for sending and receiving data that corresponds to the sent/received RF signals for the cellular network. "eCPRI is an evolution of CPRI that uses the packet-based Ethernet protocol [between units] and enables more flexibility and data compression." (Massive MIMO, at 45.) Using this network layer, remote units exchange both uplink and downlink data, *e.g.*, through "Coordinated Multi-Point (CoMP)":





(Massive MIMO, at 97; Massive MIMO Technology Primer, at 60.)

"The purpose of creating a new fronthaul interface, eCPRI, was to enable more efficient implementations of Massive MIMO radios with many radio chains, and to introduce Ethernet based transport. An Ethernet based transport enables switched front-haul."
"Massive MIMO Handbook: Technology Primer", Ericsson, p. 77
As described above with respect to claim limitation 15[d], incorporated herein by reference, the duplicate of the second RF signal based on the first transport signal is transmitted by the antenna of the second remote wireless communication system.

E.g., in DAS a given RF ***transmission may need to be sent*** from ***multiple antennas***.

E.g.,: in mTRP, the Massive MIMO documentation describes: "Another example…is Coordinated Multi-Point (CoMP), wherein multiple nodes, on the same or different sites, ***coordinate their transmission***/reception in order to mitigate interference or boost the signal energy."
(Massive MIMO, at 66.)

"This means that ***the network transmits two identical copies of a PDSCH*** from two TRPs simultaneously and overlapping in the PRBs."
(Massive MIMO Technology Primer, at 60.)

"For C-JT, ***the same precoding layer(s) are transmitted from the multiple cooperating TRPs*** with the intention for the transmissions to coherently add up at the receiving UE."

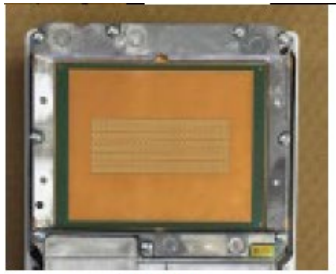
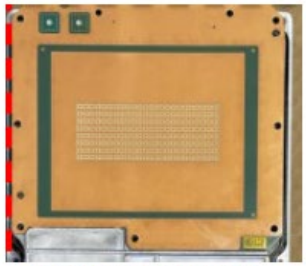
		(Massive MIMO Technology Primer, at 112.) Pursuant to this Court's Sample Discovery Order's Additional Disclosures provisions, Plaintiff identifies this claim element as a software limitation and reserves rights to supplement the contentions after source code is produced by Defendants.

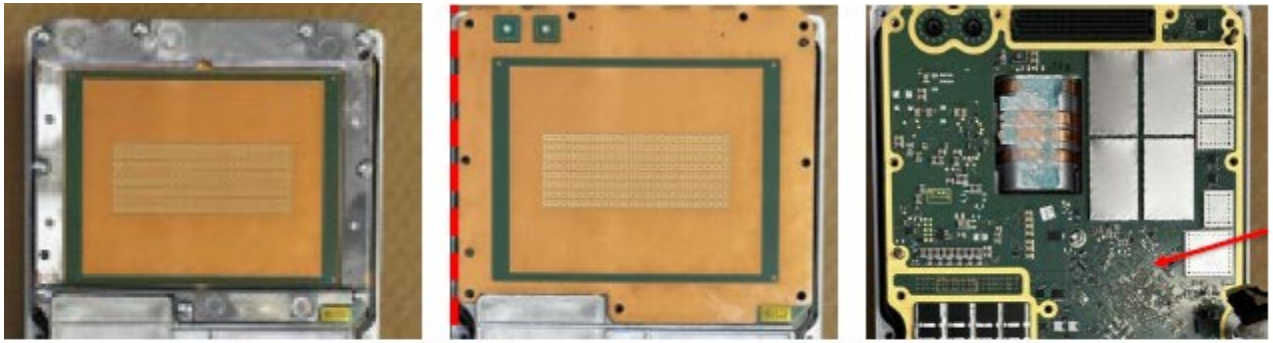
Appendix C: Claim Chart for U.S. Patent No. 8,497,813

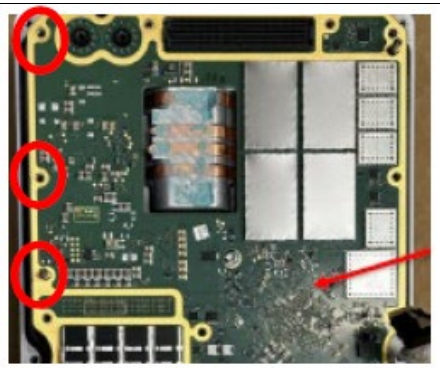
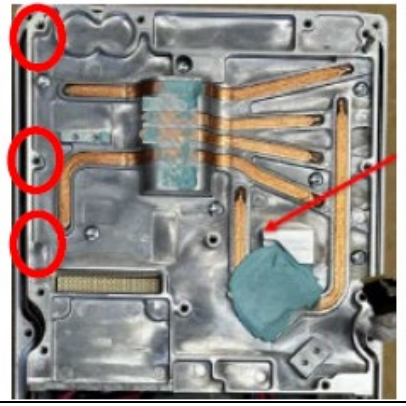
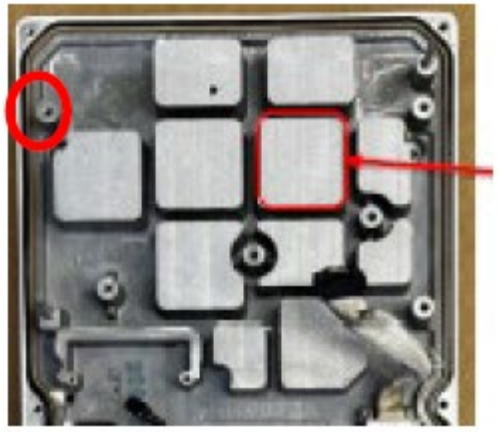
Claim Number	Claim Language	Accused Instrumentalities (Ericsson's Macro, Massive MIMO, Street Macro and Small Cell Products, including but not limited to Ericsson's Street Macro 6701, and other small cell products used in Verizon's network, including but not limited to Samsung small cell products and Nokia small cell products)[1]
1[a]	A panel antenna, comprising:	To the extent that the claim's preamble is determined to be a limitation or otherwise limiting, the Accused Instrumentalities—including but not limited to Ericsson's Macro, Massive MIMO, Street Macro and Small Cell Products, including but not limited to Ericsson's Street Macro 6701, and other small cell products used in Verizon's network, including but not limited to Samsung small cell products and Nokia small cell products—are panel antennas. For example, as shown in the exemplary images below Ericsson's Street Macro 6701 is a panel antenna that includes the antenna array (in the middle of the orange element).

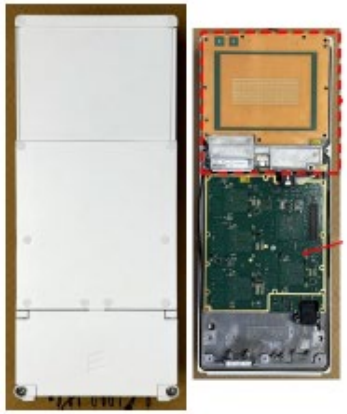
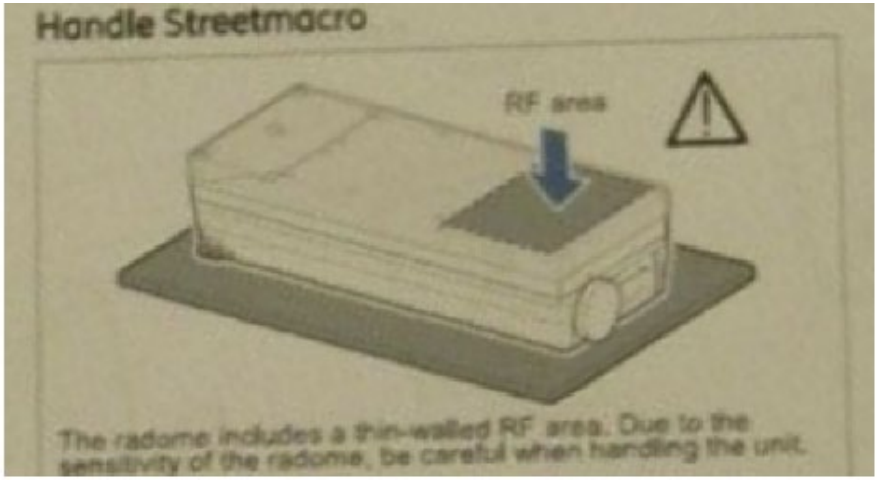
[1] Pursuant to E.D. Tex. Patent Rule 3-1(c), this claim chart identifies where each element of the asserted claims of this patent are found within the Ericsson Street Macro 6701. On information and belief, the physical configuration of the Ericsson Street Macro 6701, Ericsson's Macro, Ericsson's Massive MIMO, Ericssons's Street Macro, Ericssons's Small Cell Products, Samsung's small cell products, and Nokia's small cell products is substantially the same or identical—each includes radio electronics organized into isolated compartments with heat dispersing features. https://www.ericsson.com/en/portfolio/networks/ericsson-cloud-ran/radio-portfolio. Additionally, on information and belief, the operation of these devices with respect to these infringement contentions is substantially the same or identical, at least because each includes radio electronics organized into isolated compartments with heat dispersing features, which govern the functionality of these devices that is relevant to these infringement contentions. Thus, although this claim chart includes exemplary citations and images for the Ericsson Street Macro 6701, the explanations of how the Accused Instrumentalities meet each limitation of the claims charted herein are substantially the same or identical for each of the Accused Instrumentalities.

1[b]	an enclosure, the enclosure including a rear panel, a first side wall, and a second side wall,	The Accused Instrumentalities contain an enclosure, the enclosure including a rear panel, a first side wall, and a second side wall, a top wall and a bottom wall, the rear panel and the walls defining a cavity, the walls further defining an aperture through which the cavity of the enclosure may be accessed.

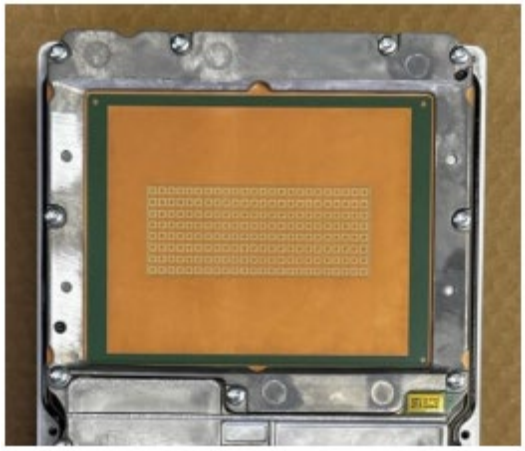
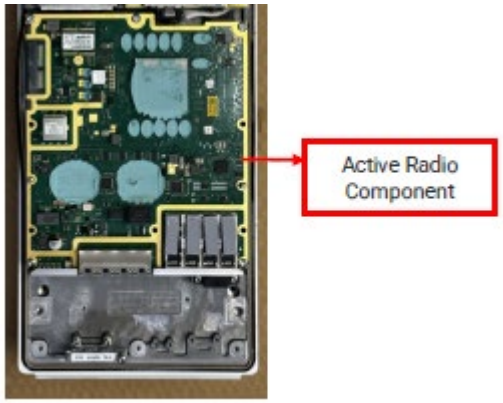
	a top wall and a bottom wall, the rear panel and the walls defining a cavity, the walls further defining an aperture through which the cavity of the enclosure may be accessed,	For example, as shown in the exemplary teardown images of the Ericsson Street Macro 6701 below, the side, top and bottom walls and the back panel (right image) join together to define a cavity (covered by the orange internal cover) in which radio electronics sit. The rear panel (blue) along with side walls (yellow) and top and bottom walls (green) join to help define the cavity in which some of the electronics sit, which can be accessed through the aperture on top when the cover is removed.  (top)  (internal cover) (radio electronics) (rear panel)
1[c]	an internal cover, the internal cover being dimensioned to overlap an area	The Accused Instrumentalities contain an internal cover, the internal cover being dimensioned to overlap an area defined by the aperture of the enclosure and providing an environmental seal and electromagnetic shielding for the cavity, the internal cover having at least one RF radiating module fastened to an exterior surface thereof.

	defined by the aperture of the enclosure and providing an environmental seal and electromagnetic shielding for the cavity, the internal cover having at least one RF radiating module fastened to an exterior surface thereof,	For example, as shown in the exemplary teardown images of the Ericsson Street Macro 6701 below, the internal cover overlaps the aperture, isolating the radiating elements in the middle of the orange cover (on top) from the radio electronics (shown below) underneath. The exterior (top) of the internal cover includes the antenna array, *i.e.*, the RF radiating module.  (top) (internal cover) (radio electronics)
1[d]	at least one micro radio mounted to an internal surface of the first side wall, the micro radio being coupled to the RF radiating module;	The Accused Instrumentalities contain at least at least one micro radio mounted to an internal surface of the first side wall, the micro radio being coupled to the RF radiating module. For example, as shown in the exemplary teardown images of the Ericsson Street Macro 6701 below, the radio electronics, *i.e.*, micro radio (far left) are mounted to the side wall (near left) at the locations indicated in red.

		 
1[e]	a first heat sink, mounted to an external surface of the first side wall, and	The Accused Instrumentalities contain a first heat sink, mounted to an external surface of the first side wall. For example, as shown in the exemplary teardown images of the Ericsson Street Macro 6701 below, a heat sink (near left) is located below the rear panel and is mounted to the external surface of the first side wall (far left). 

1[f]	a radome, the radome mounting to the internal cover and enclosing the RF radiating module;	The Accused Instrumentalities contain a radome, the radome mounting to the internal cover and enclosing the RF radiating module. For example, as shown in the exemplary teardown images of the Ericsson Street Macro 6701 below, a radome is mounted to the internal cover and encloses the RF radiating module.  
1[g]	wherein a flange joins the first and second side walls and the top and bottom wall, and a lip extends from the flange, further defining	The Accused Instrumentalities contain a flange that joins the first and second side walls and the top and bottom wall, and a lip that extends from the flange, further defining the aperture through which the cavity of the enclosure may be accessed, the lip being engaged by the internal cover to provide the environmental seal[2]:

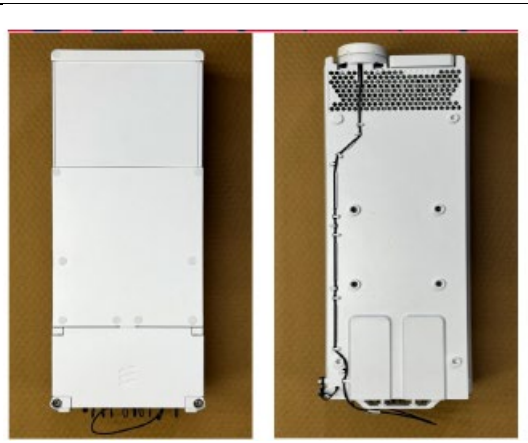
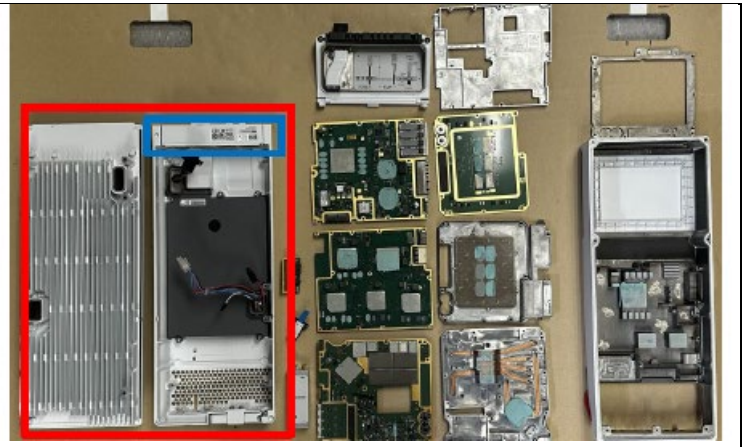
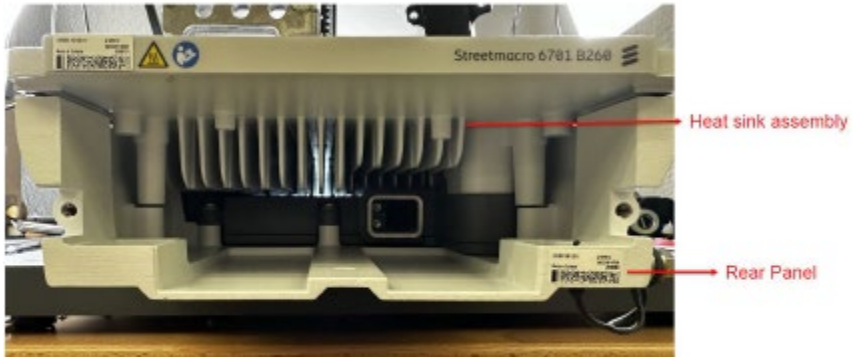
[2] In accordance with Local Patent Rule 3-1(c) Procomm identifies where each element of each asserted claim is found within the Accused Instrumentalities by way of exemplary features of the Accused Instrumentalities that illustrate the infringing functionality. Procomm does not contend that the examples set forth herein are the only instance of the infringing feature of the Accused Instrumentalities, and Procomm reserves the right to rely on such other features of the Accused Instrumentalities, and on other facts adduced through discovery, in proving its case at trial.

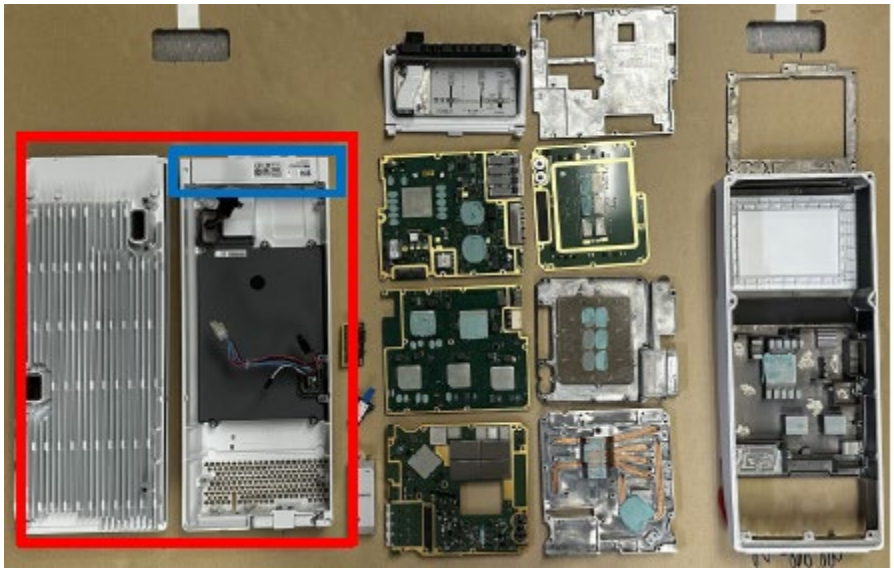
	the aperture through which the cavity of the enclosure may be accessed, the lip being engaged by the internal cover to provide the environmental seal.	
4	The panel antenna of claim 1, further comprising a communications hub coupled to each micro radio.	The Accused Instrumentalities contain a communications hub coupled to each micro radio, as shown in the exemplary images below of the internal communication electronics for the unit. (See claim limitations 1[b] and 1[d]). 

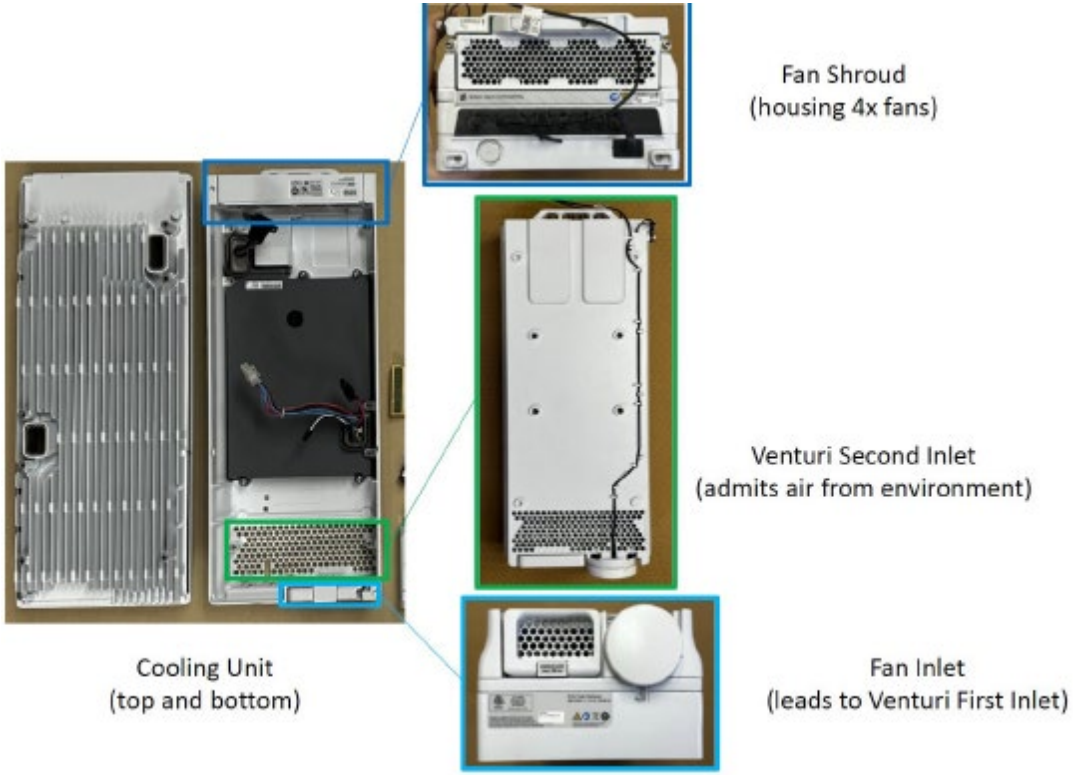
Appendix D: Claim Chart for U.S. Patent No. 7,724,521

Claim Number	Claim Language	Accused Instrumentalities (Ericsson's Macro, Massive MIMO, Street Macro and Small Cell Products, including but not limited to Ericsson's Street Macro 6701, and other small cell products used in Verizon's network, including but not limited to Samsung small cell products and Nokia small cell products)[1]
1[a]	A cooling unit for an enclosure housing electronics, the cooling unit comprising:	To the extent that the claim's preamble is determined to be a limitation or otherwise limiting, the Accused Instrumentalities—including but not limited to Ericsson's Macro, Massive MIMO, Street Macro and Small Cell Products, including but not limited to Ericsson's Street Macro 6701, and other small cell products used in Verizon's network, including but not limited to Samsung small cell products and Nokia small cell products—contain a cooling unit for an enclosure housing electronics. For example, as shown in the exemplary images below, Ericsson's Street Macro 6701 includes an enclosure (left) housing electronics (right) that includes a cooling unit comprising a heat sink and outer casing emphasized in red (right).

[1] Pursuant to E.D. Tex. Patent Rule 3-1(c), this claim chart identifies where each element of the asserted claims of this patent are found within the Ericsson Street Macro 6701. On information and belief, the physical configuration of the Ericsson Street Macro 6701, Ericsson's Macro, Ericsson's Massive MIMO, Ericssons's Street Macro, Ericssons's Small Cell Products, Samsung's small cell products, and Nokia's small products is substantially the same or identical—each includes radio electronics organized into isolated compartments with heat dispersing features. https://www.ericsson.com/en/portfolio/networks/ericsson-cloud-ran/radio-portfolio. Additionally, on information and belief, the operation of these devices with respect to these infringement contentions is substantially the same or identical, at least because each includes radio electronics organized into isolated compartments with heat dispersing features, which govern the functionality of these devices that is relevant to these infringement contentions. Thus, although this claim chart includes exemplary citations and images for the Ericsson Street Macro 6701, the explanations of how the Accused Instrumentalities meet each limitation of the claims charted herein are substantially the same or identical for each of the Accused Instrumentalities.

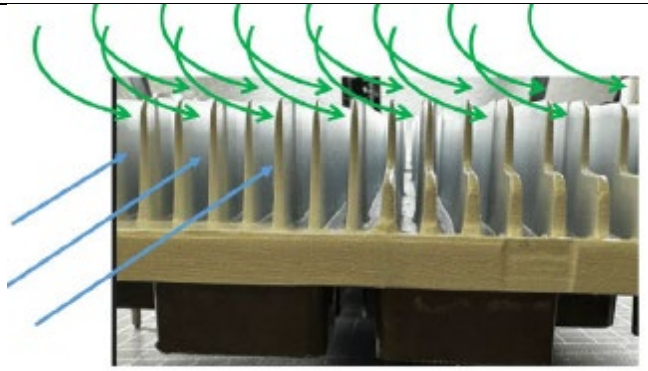
		  The heat sink is shown assembled in the cross section below. 
1[b]	a fan shroud having at least one electrical fan; and	The Accused Instrumentalities contain a fan shroud having at least one electrical fan. For example, as shown in the exemplary images below, Ericsson's Street Macro 6701 contains a fan shroud at one end of the cooling unit, emphasized in blue below and shown head on (top).

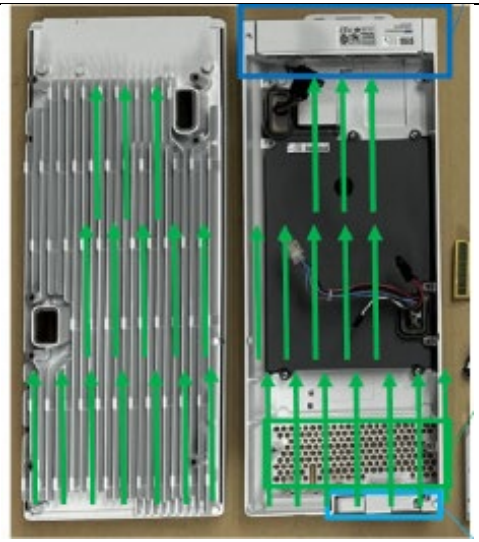
		 
1[c]	a Venturi chamber having a first inlet for receiving a heated airflow from a heatsink, a second inlet for receiving an airflow from a surrounding	The Accused Instrumentalities contain a Venturi chamber having a first inlet for receiving a heated airflow from a heatsink, a second inlet for receiving an airflow from a surrounding environment, and an outlet coupled to the fan shroud, the fan drawing air from the Venturi chamber via the outlet when the fan is on. For example, as shown in the exemplary images below, Ericsson's Street Macro 6701 has a cooling unit that includes two inlets, one at the end of the unit (parallel to and opposite the Fan Shroud) that is a smaller inlet at the beginning of the heat sink, so that the inlet air will be rapidly heated by fins from the heat sink and can flow up into the Venturi flow. The second inlet is on the back cover of

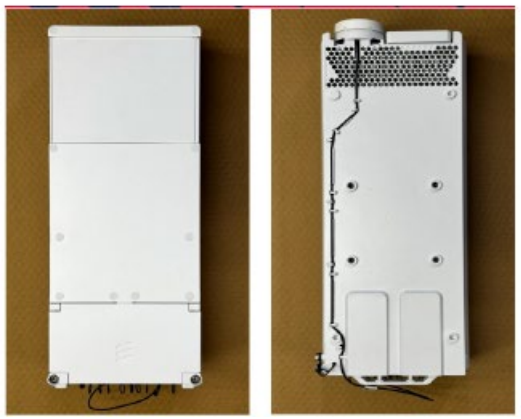
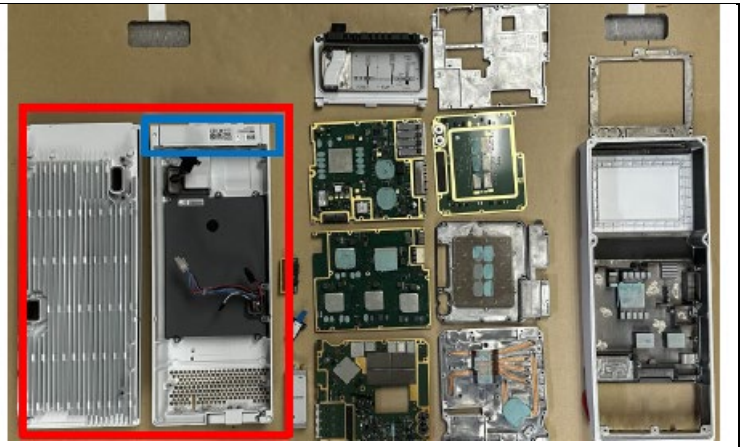
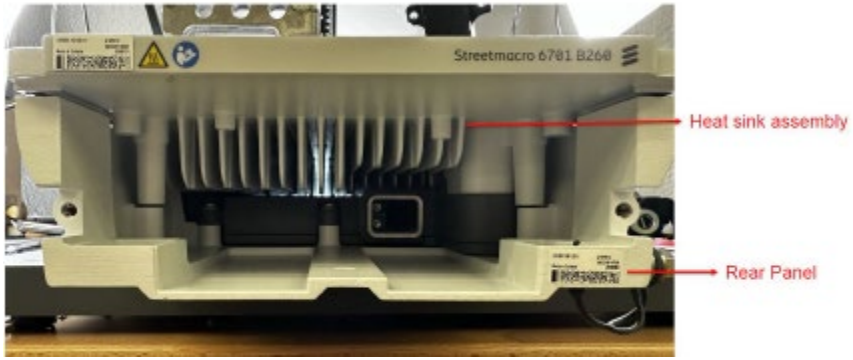
	environment, and an outlet coupled to the fan shroud, the fan drawing air from the Venturi chamber via the outlet when the fan is on;	the chamber, perpendicular to the fan shroud, that is larger and will pull in air form the surrounding environment. The Fan Shroud includes an outlet for expelling the heated air. 
1[d]	wherein the Venturi chamber comprises a wall for directing the airflow air from the surrounding environment in from the second	The Accused Instrumentalities contain a wall for directing the airflow air from the surrounding environment in from the second inlet and across the heated airflow from the heatsink in a manner to as to draw the heated airflow through the heatsink using a Venturi effect, when the fan is on. For example, as shown in the exemplary images below, in Ericsson's Street Macro 6701, the walls of the Venturi chamber create a narrowing path from the Second Inlet to the outlet at the Fan

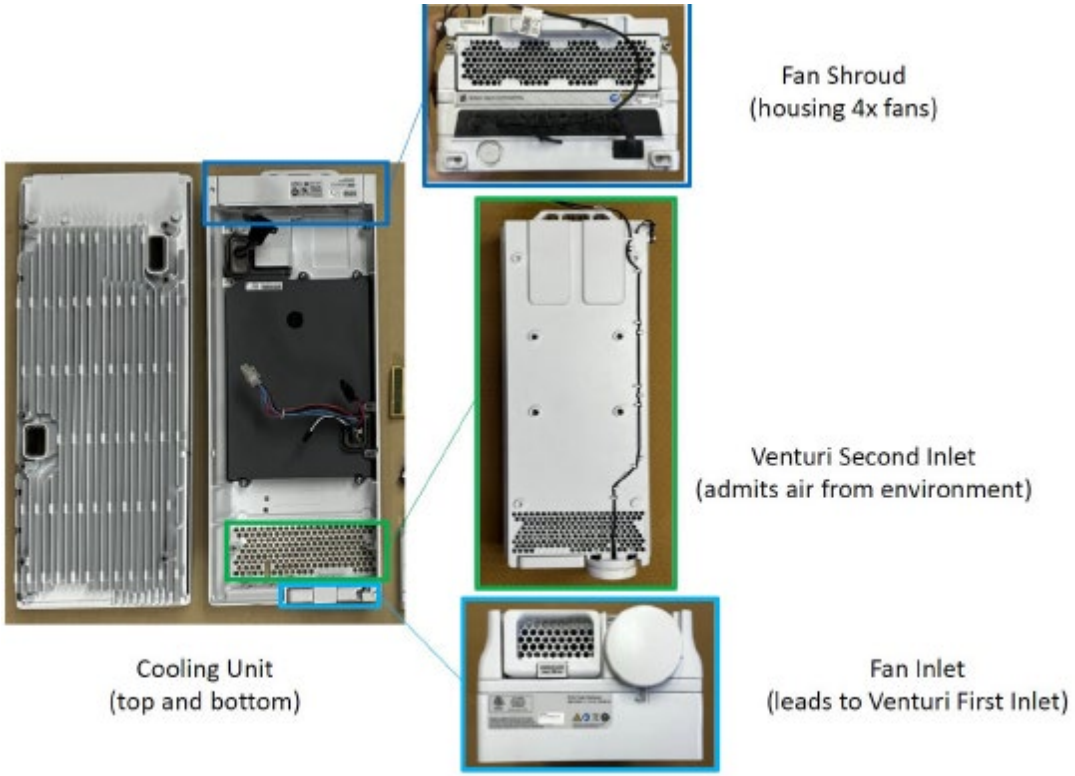
	inlet and across the heated airflow from the heatsink in a manner to as to draw the heated airflow through the heatsink using a Venturi effect, when the fan is on.	Shroud.[2] The airflow from the Second Inlet—by traveling through a narrowing pathway—will create a Venturi effect of lower pressure, drawing up the heated air from the First Inlet as shown below.

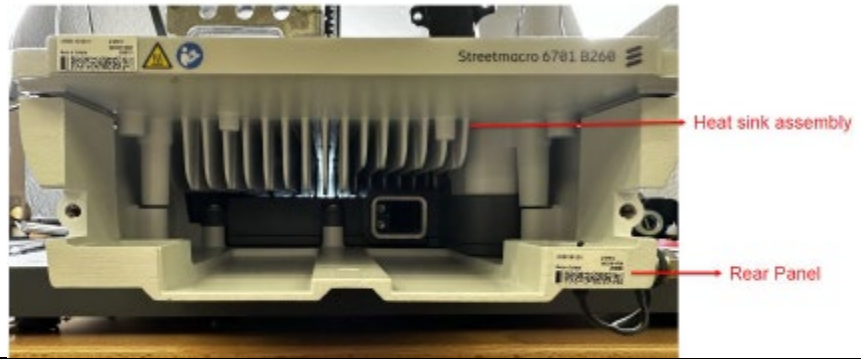
[2] In accordance with Local Patent Rule 3-1(c) Procomm identifies where each element of each asserted claim is found within the Accused Instrumentalities by way of exemplary features of the Accused Instrumentalities that illustrate the infringing functionality. Procomm does not contend that the examples set forth herein are the only instance of the infringing feature of the Accused Instrumentalities, and Procomm reserves the right to rely on such other features of the Accused Instrumentalities, and on other facts adduced through discovery, in proving its case at trial.

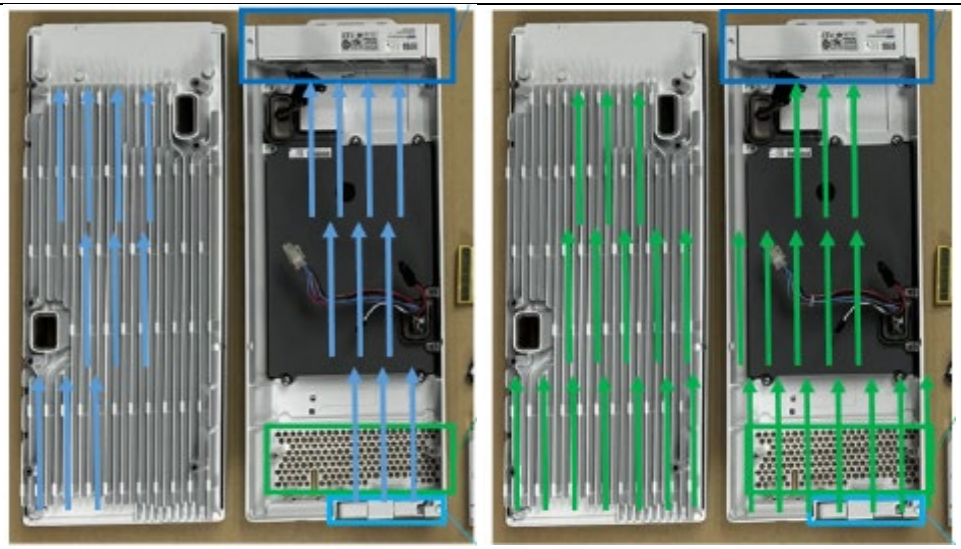
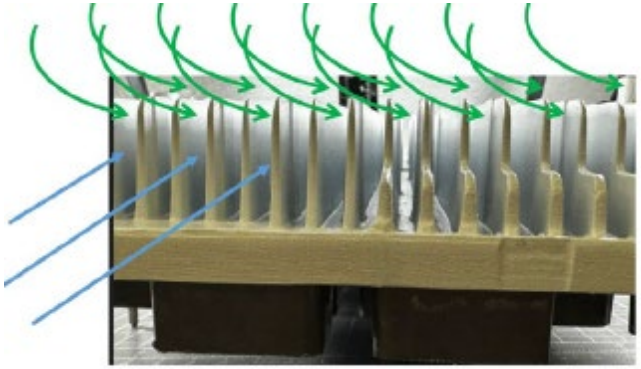
		
4	The cooling unit of claim 1, wherein the Venturi chamber first inlet encircles one or more convective openings of the heatsink.	The Accused Instrumentalities contain a cooling unit wherein the Venturi chamber first inlet encircles one or more convective openings of the heatsink. For example, as shown the exemplary images above, in Ericsson's Street Macro 6701, the air flow from the first inlet surrounds the convective openings of the heatsink.
5	The cooling unit of claim 1, wherein the airflow from the surrounding environment is cooler than the heated airflow.	The Accused Instrumentalities contain a cooling unit, wherein the airflow from the surrounding environment is cooler than the heated airflow. For example, as shown the exemplary images below, in Ericsson's Street Macro 6701, the air flow from the surrounding environment that is pulled in through second inlet is cooler than the heated airflow from the heatsink.

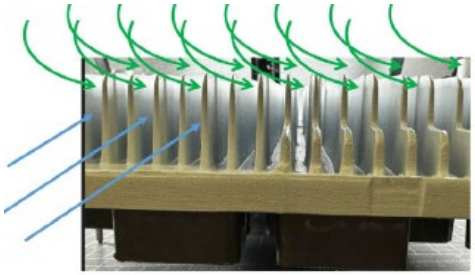
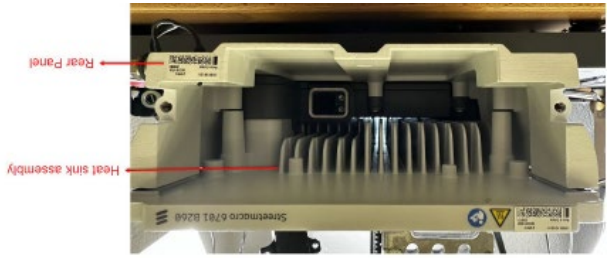
		
14[a]	A method for cooling a sealed environment of an enclosure for housing electronics, the method comprising:	To the extent that the claim's preamble is determined to be a limitation or otherwise limiting, Defendants and Accused Instrumentalities perform the following steps of cooling an enclosure housing electronics. For example, as shown in the exemplary images below, Ericsson's Street Macro 6701 includes an enclosure (left) housing electronics (right) that includes a cooling unit comprising a heat sink and outer casing emphasized in red (right).

		  The heat sink is shown assembled in the cross section below. 
14[b]	directing heat generated by one or more electronic devices housed within a sealed environment of an enclosure to a	The Accused Instrumentalities direct heat generated by one or more electronic devices housed within a sealed environment of an enclosure to a heatsink thermally coupled to an external environment. For example, as shown in the exemplary images below, Ericsson's Street Macro 6701 has a cooling unit that includes two airflows, one drawn through the Venturi inlet by the pull of the fans, and a second flowing from the smaller opening opposite the fan shroud at the base of the heatsink that is

	heatsink thermally coupled to an external environment;	coupled to the electronics outside of the Venturi chamber, so that the inlet air will be rapidly heated by fins from the heat sink and can flow up into the Venturi flow. The Fan Shroud includes an outlet for expelling the heated air. 
14[c]	drawing a first airflow across one or more convective openings of the heatsink, wherein the first airflow	The Accused Instrumentalities draw a first airflow across one or more convective openings of the heatsink, wherein the first airflow does not flow into the one or more convective openings of the heatsink. For example, as shown in the exemplary images below, in Ericsson's Street Macro 6701, the path of the first airflow runs from the large external opening to the fan shroud through the chamber adjacent to the heat sink fins:

	does not flow into the one or more convective openings of the heatsink;	 
14[d]	drawing a second airflow of heated air from the one or more convective openings using a Venturi effect created by	The Accused Instrumentalities draw a second airflow of heated air from the smaller opening opposite the fan shroud, through the convective openings of the heat sink (in blue below) driven in part by the Venturi effect created by the first airflow (in green below).

	drawing the first airflow.	 

15[a]	The method of claim 14 wherein drawing the first airflow further comprises drawing the first airflow into a Venturi chamber;	The Accused Instrumentalities draw the first airflow into a Venturi chamber. For example, as shown in the exemplary images below, in Ericsson's Street Macro 6701, the first airflow will be drawn from the heatsink fins up into the second airflow by the Venturi effect of the second airflow; the airflow from the Second Inlet—by travelling through a narrowing pathway—will create a Venturi effect of lower pressure, drawing in the heated air from the First Inlet, as shown below.  
15[b]	wherein drawing the second airflow further comprises drawing the second airflow into the Venturi chamber;	The Accused Instrumentalities draw the second airflow into the Venturi chamber. For example, as shown in the exemplary images above, in Ericsson's Street Macro 6701, the Venturi effect of the second airflow will draw the first airflow up into the Venturi chamber and then out the fan shroud.
15[c]	the method further comprising operating a fan to pull the first airflow and the second airflow	The Accused Instrumentalities operate a fan to pull the first airflow and the second airflow out of the Venturi chamber. For example, as shown in the exemplary images above, in Ericsson's Street Macro 6701, the operation of the fan will pull both the first and the second airflows out of the Venutri chamber and into the outside environment.

	out of the Venturi chamber.	
16	The method of claim 14, further comprising operating a fan to draw the first airflow and the second airflow	*See* 15[c]