

Filed: April 17, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS
PETITIONER

v.

GENERAL ACCESS SOLUTIONS, LTD.
PATENT OWNER

Case No. IPR2023-00978
U.S. Patent No. 7,230,931

**PATENT OWNER'S RESPONSE
UNDER 37 C.F.R. § 42.120**

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I. INTRODUCTION

The Board has previously held, and the Federal Circuit has affirmed, that Vornefeld does not disclose “using different beams *in the same TDD frame* (i.e., second downlink data traffic, transmitted in ‘said downlink portion of said TDD frame’) to transmit to devices within a different sector,” as claims 28 and 29 of the ’931 patent require (EX1009, 22–24; EX1010, 3)¹, so Petitioner now tries to fill that gap in Vornefeld with Atsuta or Goldberg. However, neither Atsuta nor Goldberg *even discloses transmitting in Time Division Duplexing (“TDD”) frames*. Specifically, for this aspect of claims 28 and 29, Petitioner relies on Atsuta (Grounds 1, 3, and 4), which discloses only Time Division Multiple Access (“TDMA”) and Frequency Division Duplexing (“FDD”), and Goldberg (Grounds 2 and 5), which discloses only FDD.

But the claimed TDD frames (which provide a means for bidirectional communication) are not the same as Atsuta’s TDMA (which provides a means for multiplexing). TDD allocates time between downlink and uplink transmissions to support bidirectional communications using the same frequency. TDMA, by contrast, has nothing to do with separating the uplink and downlink transmissions, and instead is directed to the allocation of specific uplink time slots to different users or devices so that multiple devices can communicate with the base station.

¹ All emphases added unless otherwise indicated.

Even worse, FDD is mutually exclusive with TDD, such that Goldberg's use of FDD prohibits it from disclosing TDD.

In addition to allocating slots among multiple devices through TDMA rather than between uplink and downlink through TDD as claimed, Atsuta discusses only the allocation of uplink timeslots, and does not apply to the downlink transmissions that claims 28 and 29 require.

Petitioner's Ground 3 replacement of Vornefeld with Youssefmir also fails, as Youssefmir teaches no more than Vornefeld with respect to the challenged claims 28 and 29. Therefore, combining Atsuta with Youssefmir fails for the same reason that combining Atsuta with Vornefeld fails. Additionally, Petitioner's Grounds 4-5 addition of Tangemann to its Grounds 1-2 combinations does nothing to cure its Grounds 1-2 failures, and so fails for the same reasons as Grounds 1-2.

Not only would a POSA understand that the art in the Petition's Grounds does not disclose the elements recited in claims 28 and 29, a POSA also would not combine the art making up the Petition's Grounds in the first place. For example, the objective of both Vornefeld (Grounds 1-2, 4-5) and Youssefmir (Ground 3) is to allow for multiple downlink data transmissions at the same time through beamformed signals to different wireless devices. But Atsuta, which the Grounds attempt to combine with Vornefeld and Youssefmir, does not teach or use beamforming at all. In fact, Atsuta *teaches away* from the objective of Vornefeld

and Youssefmir, instead teaching that transmissions must be made sequentially so they never overlap in time. Thus, a POSA would not turn to Atsuta to assist in coordinating the beamformed downlink transmissions of either Vornefeld or Youssefmir.

For these reasons, as well as others discussed herein, the patentability of claims 28 and 29 should be confirmed.

II. BACKGROUND

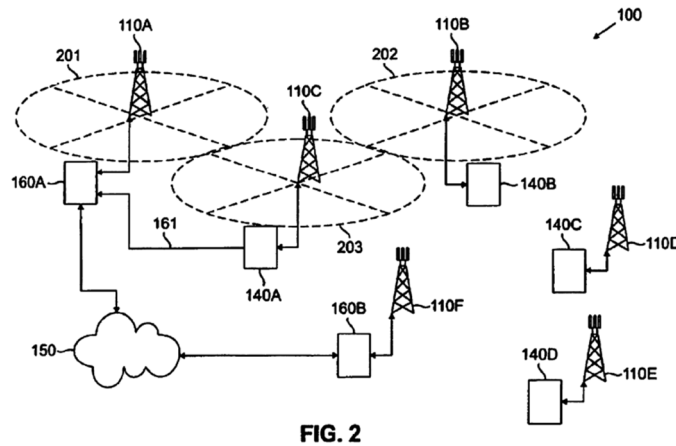
A. The '931 Patent

The '931 patent is entitled “Wireless Access System Using Selectively Adaptable Beam Forming in TDD Frames and Method of Operation.” As explained more fully below, the '931 patent is directed to the coordination of downlink transmissions from a base station to wireless devices in a cellular wireless network using beamforming and Time Division Duplexing (“TDD”). Claims 28 and 29 (the “Challenged Claims”) require that a base station of a cellular wireless network transmit multiple beamformed signals, each of which carries different downlink data to wireless devices in separate geographic sectors of the cell, and that those separate beamformed signals be transmitted in the same downlink portion of the same TDD frame.

1. Cellular Base Stations

Cellular wireless networks are generally constructed using a web of base stations, each covering a “cell” of the network. (EX2028, ¶36.) In modern cellular

wireless networks, each base station is equipped with multiple antennas, with different antennas covering different “sectors” of the cell. (*Id.*) In such an arrangement, each antenna transmits to, and receives transmissions from, wireless devices in its sector of the cell. (*Id.*) Figure 2 of the ’931 patent provides an illustration of a set of base stations, each equipped with four antennas covering a 90° sector of the cell serviced by the base station. (*Id.*)



2. Smartphones Drive Demand for Downlink Data Transmissions

When mobile phones became prevalent in the 1990s, they were used to make voice calls away from traditional “landlines.” (EX2028, ¶37.) But with the widespread adoption of “smartphones,” beginning with Apple’s iPhone in 2007, the transmission of data took on increased importance. (*Id.*) People didn’t want to just talk; they wanted to shop, use social media, download music and video, and do the many other things smartphones make possible. (*Id.*) With this shift in how consumers used their mobile phones, the demand for data on wireless cellular

networks grew exponentially. (*Id.*) In the five-year period from 2016-2021, for example, mobile data traffic increased 17-fold. (EX2018, Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017-2022.) To keep pace with the increased demand for data, wireless carriers required new technologies better suited to transmitting large quantities of data. (*Id.*)

3. Time Division Duplexing

Cellular wireless networks must be able to communicate bi-directionally with wireless devices. (EX2028, ¶38.) Specifically, base stations must be able to transmit “downlink” signals to wireless devices, and wireless devices must be able to communicate “uplink” signals to base stations. (*Id.*) However, downlink and uplink transmissions can interfere with one another, requiring the use of a duplexing protocol. (*Id.*) There are two main approaches to manage bi-directional communications in cellular wireless networks: FDD and TDD. (EX2028, ¶38; EX1001, 5:62-64.) As explained in a treatise expressly incorporated by reference into the ’931 patent, (EX1001, 6:23-31), TDMA systems use “*either* FDD or TDD”—but not both—which are “called TDMA/FDD or TDMA/TDD access systems.” (EX2022, 397; EX2028, ¶¶ 44, 145.)

In the late 1990s and early 2000s, FDD was the dominant approach employed in the marketplace. (EX2028, ¶39; EX2031, 2 (stating, in 2012, that “in the US FDD-LTE has so far been the mode of choice”).) In FDD, downlink and

uplink transmissions are each made using separate, dedicated frequencies or “channels.” (EX2028, ¶40; EX1001, 5:64-66.) Interference between the downlink and uplink transmissions is avoided by spacing the downlink and uplink frequencies. (EX2028, ¶40; EX1001, 5:66-6:2) FDD is well-suited to voice communication where the amount of information being transmitted in downlink and uplink channels is roughly equal. However, FDD is far less efficient in modern cellular networks, which are focused on data transmission. Most smartphone users demand far more downlink data transmissions than uplink. (EX2028, ¶40; EX1001, 13:66-14:1.) For example, a person who seeks to download a movie sends a relatively tiny uplink request for the download, which triggers the streaming of massive quantities of downlink data. (EX2028, ¶40.) In FDD, such a request can leave the channel dedicated to uplink transmissions largely unused. (*Id.*)

In TDD, by contrast, a single band of frequency is used for both downlink and uplink transmissions by allocating separate time intervals or “slots” to each. (EX2028, ¶41; EX1001, 6:2-5, 14:7-10.) TDD is more efficient for data transmissions than FDD, because bandwidth can be dynamically shifted either to downlink or uplink transmissions by allocating larger time slots to downlink or uplink transmissions. (EX2028, ¶41; EX1001, 14:10-14.)

In TDD, downlink and uplink transmissions are organized into “TDD frames.” (EX1001, 14:10-16:3; EX2028, ¶42.) The portion of the ’931 patent’s Figure 3 below provides an exemplary illustration of a TDD frame, showing a downlink portion followed by an uplink portion.

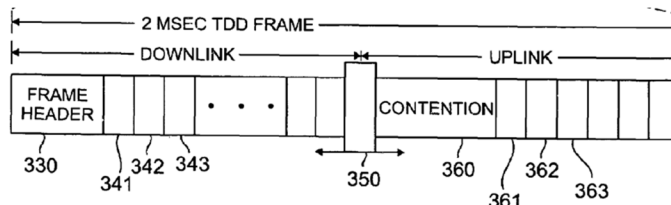


FIG. 3

4. Beamforming

(EX1001, Figure 3.)

Paul Struhsaker, the inventor of the ’931 patent, understood that for cellular wireless networks to be able to accommodate future demands for data they would need to make use of two critical technologies: Time Division Duplexing and “beamforming.” Prior to Mr. Struhsaker’s invention of the ’931 patent, conventional antennas used in cellular wireless networks broadcasted signals to the entire sector covered by the antenna. In the ’931 patent, however, Mr. Struhsaker disclosed critical technology allowing beamforming to be implemented efficiently in cellular wireless networks. Prior to the filing of the ’931 patent, beamforming (which was originally developed for advanced radar systems) had never previously been employed in a commercial cellular wireless network. After the conception of

the '931 patent, Mr. Struhsaker and his colleagues at Raze Technologies worked with antenna manufacturers to develop the advanced antenna arrays necessary to deploy beamforming in cellular wireless networks.

To create beamformed signals, antenna arrays with multiple antenna elements arranged in a line or rectangular grid are used. (EX1001, 26:10-16; EX2028, ¶46.) By delay- or phase- weighting the transmissions from each antenna element, a combined wavefront of radio frequency energy can be directed or “steered” in a specific direction. (EX1001, 26:19-63.) By focusing the radio frequency energy transmitted by the antenna in a desired direction, a beamforming antenna array can increase the quality and range of the signal sent to the desired area while simultaneously interference with transmissions to other wireless devices. (*Id.*, 25:29-37.) Importantly, beamforming can also allow for multiple spatially-separated beams to be sent simultaneously, each carrying different downlink data to wireless devices in different areas using the same frequency, thereby increasing the throughput of the wireless network without requiring the use of additional, scarce spectrum. (*Id.*, 25:32-34, 25:63-26:2.) Beamforming can also increase a network’s coverage. (*Id.*, 5:16-34.) Figure 9 of the '931 patent (below), and its associated text, explain techniques that can be used to create beamformed signals.

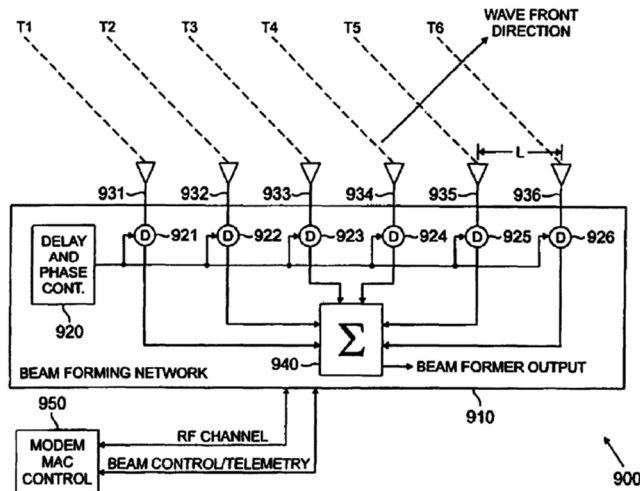


FIG. 9

5. The Teachings of the '931 Patent

The use of beamforming with TDD in a cellular wireless network presented a number of novel challenges. As discussed above, the use of TDD requires precise scheduling of uplink and downlink transmissions so they do not interfere with one another. (EX2028, ¶47; EX1001, 16:4-8.) The complexity of doing so increases dramatically as cells are divided into numerous sectors and multiple beamformed transmissions are sent to multiple wireless devices in different areas of the cell and between cells. (EX1001, 16:4-8, 16:20-34, 25:63-26:2.)

As stated in the '931 patent, “[a] key aspect of the present invention is that the timing of the downlink and uplink positions of each TDD frame must be precisely aligned in order to avoid interference between sectors within the same cell and/or to avoid interference between cells.” (*Id.*, 16:4-8; EX2028, ¶48.) The patent further explains that this interference problem extends across adjacent

sectors and even between adjacent cells of the network. (EX1001, 16:4-8, 16:20-23.)

As explained in the '931 patent, “antennas for different sectors in the same cell site are mounted on the same tower and are located only a few feet apart.” (*Id.*, 16:13-15; EX2028, ¶49.) As a result, if one antenna is “transmitting in the downlink” while another is “receiving in the uplink,” “the power of the downlink transmission will overwhelm” the uplink transmission in the adjacent sector.²

² Downlink transmissions from base station antennas are typically at least an order of magnitude more powerful than the uplink transmissions from wireless devices such as smartphones. Cell phones are generally limited to no more than 3 watts of antenna power while outdoor base station antennas may transmit at over 100 watts. *See, e.g.*, 47 C.F.R. § 27.50 (noting that handheld mobile devices “are limited to 3 watts”); *RF Safety FAQ*, FCC.gov (last visited September 18, 2023), <https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety> (noting that it is possible for base stations to radiate “at very high power levels,” but that “the maximum power radiated in any direction usually does not exceed 500 watts”). As a result, even downlink transmissions directed to other areas of a cell can drown out uplink transmissions.

(EX1001, 16:15-19.) The patent goes on to explain that it is therefore critical that all downlink transmissions—including in adjacent sectors and cells—be completed before any uplink transmissions begin. (*Id.*, 16:20-34.) The patent teaches accomplishing this by “determin[ing] the length of the longest downlink transmission among two or more cell sites and ensures that none of the base station receivers in any of the cells begins to receive in the uplink until after the longest downlink transmission is completed.” (*Id.*, 16:34-38.)

Beamforming can significantly improve the quality of signals received by wireless devices, but also introduces new challenges not experienced by systems that transmit omnidirectionally. (EX2028, ¶50.) For example, “[b]eam forming and advanced antennas change the basic paradigm that all subscribers have the capability of simultaneously receiving broadcast information from the base station.” (EX1001, 25:51-54.) Instead of all wireless devices in the cell receiving all the transmissions all the time, “[t]ransmit and receive beams are formed to optimize communications with a given subscriber.” (*Id.*, 25:54-55.) The patent also explains that “[a]n important issue when using a spatial/beam component in wireless access network 100 is subscriber acquisition and maintaining system synchronization.” (*Id.*, 28:24-26.) Previously-existing “round robin polling” methods would not work because “[t]he revisit time to any specific beam may result in subscribers falling out of synchronization.” (*Id.*, 28:28-33.)

To address these and other issues, the '931 patent disclosed a novel, highly coordinated communications protocol for cellular wireless networks in which the claimed transmit path circuitry, at the start of the claimed TDD frame, transmits a broadcast beam signal to multiple sectors of the cell, and then subsequently transmits, in the same downlink portion of the claimed TDD frame, downlink traffic using directed scanning beams to users located in more than one sector. (EX2028, ¶51; EX1001, 30:44-52, 32:24-34.) The process starts with a “broadcast beam signal” transmitted at the start of a TDD frame. (*Id.*, 30:44-45, 32:24-25.) The broadcast beam signal may also optionally transmit a variety of additional control information to enable the wireless devices to acquire the appropriate beamformed signal and decode subsequent downlink transmissions from the base station. (EX2028, ¶51.) After the broadcast beam signal is transmitted, directed scanning beams are used to transmit downlink data to wireless devices located in two or more sectors of the cell site. (EX1001, 25:61-26:2, 33:1-34:6.)

Figure 14 of the '931 patent illustrates an example of a TDD frame in accordance with the teachings of the patent. (EX2028, ¶¶52-53.) As shown in Figure 14, a broadcast beam is transmitted at the start of each TDD frame (labeled “SOF1” and “SOF2”). After the broadcast beam is transmitted, downlink data is transmitted on narrower scanning beams (labeled “SCAN BEAM A” and “SCAN

BEAM B”) to smaller 10-degree portions of the area covered by the broadcast beam.

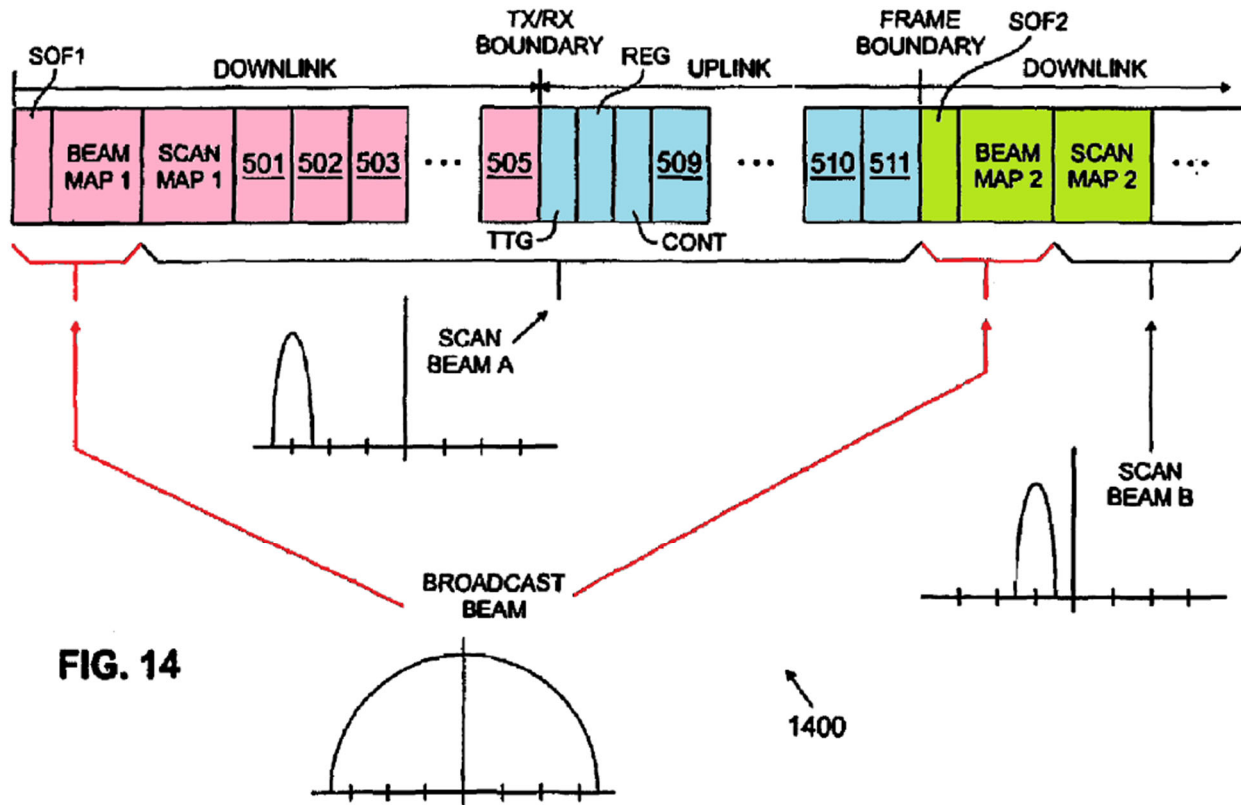


FIG. 14

(EX2027, 3.)

This elegant, highly coordinated approach to beamforming in conjunction with TDD allows for efficient beamformed downlink transmissions to multiple wireless devices in different areas of the cell, including different sectors. (EX2028, ¶54.) As explained in the specification: “These simple sequential cases can be expanded to advanced beam forming techniques to provide simultaneous multiple access to spatially independent users. A beam-forming network can create two or

more independent beams with low self-interference that allow simultaneous communications using the same frequency.” (EX1001, 25:63-26:2.)

6. Challenged Claims 28 and 29

Independent claims 1 and 19 (from which Challenged Claims 28 and 29 depend) address embodiments of the invention involving only a single beamformed downlink transmission in a TDD frame. (EX2028, ¶57.) Claims 1 and 19 require that the base station transmit a “broadcast beam signal” to wireless devices “within more than one” sector of the cell at the start of the TDD frame. Claims 1 and 19 further require that the base stations subsequently transmit downlink data traffic using a “directed scanning beam signal” sent to “substantially only” wireless devices within “one of said sectors.” (EX1001, 30:44-52, 32:24-34.) The “directed scanning beam signals” are focused transmissions made using beamforming techniques. (*Id.*, 9:23-34)

Unlike claims 1 and 19, which were surrendered in a prior IPR,³ the Challenged Claims add a requirement that the base station also transmit (in addition to the first directed scanning beam signal required by Claims 1 and 19)

³ Patent Owner does not concede that all of the elements of Claims 1 and 19 are disclosed in the prior art. The prior IPR was conducted under the former “broadest reasonable construction” standard, which is no longer applicable.

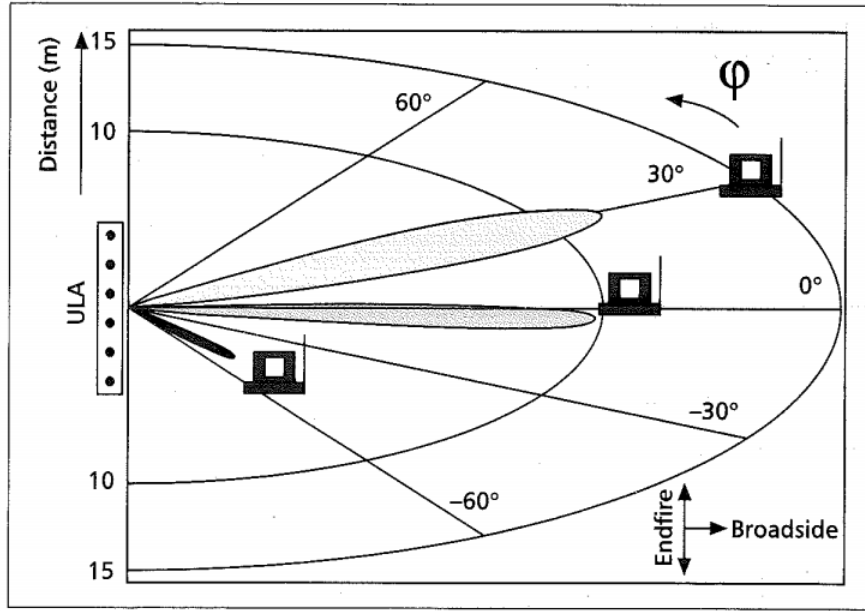
“second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals,” and critically, that the second transmission be “*in said downlink portion of said TDD frame.*” (*Id.*, 33:4-9.) Petitioner has conceded in related litigation that the correct meaning of this language is “*in the same downlink portion of the same TDD frame.*” (EX2019, Ex. A at 4.)

In sum, the Challenged Claims require the use of a single, common TDD frame to coordinate multiple beamformed downlink transmissions to wireless devices in multiple sectors of the cell. Further, these Claims require that the transmissions be made in “the *same downlink portion* of the same TDD frame.” (*Id.*; *see also* EX1009, 23 (“Claim 28 requires the transmit circuitry to transmit second downlink data traffic in the same (said) downlink portion of the same (said) TDD frame recited in claim 1.”).)

B. The Asserted Prior Art

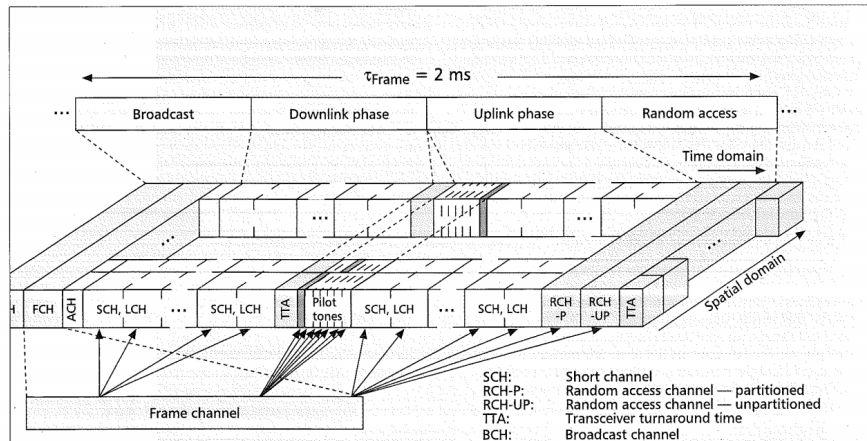
1. Vornefeld

Vornefeld describes the use of space-division multiple access (SDMA) and beamforming within a single sector. (EX1004, 52, Fig. 2.) Vornefeld is substantially described by its Figures 2 and 3 (below):



■ **Figure 2.** *Simultaneous transmission using directive beams.*

(*Id.*, Figure 2.)



■ **Figure 3.** *The basic frame structure of the spatially extended MAC protocol.*

(*Id.*, Figure 3.) In Vornfeld's Figure 2, a uniform linear array (ULA) antenna is used to transmit multiple antenna beams (e.g., the three shown) that can be directed to specific mobile terminal (MT) locations. (*Id.*, 52 ("The Spatial Dimension" section).) Doing so leads to an increase in capacity and reduces signal interference. (*Id.*) Vornfeld's Figure 3 represents the space-time transmissions

described above, wherein each directed (or “directive”) antenna beam in Figure 2 represents a different “Spatial domain” in Figure 3.

Vornefeld does not use the word “sectors” at all. It only once even implies the possible existence of more than one sector, stating that a single uniform linear array (ULA) antenna can only cover up to 180 degrees, so a given cellular architecture may use three ULAs to cover the 360 degrees around a whole radio cell. (EX2028, ¶71; EX1004, 52 (“Due to the single-element antenna characteristic, the covered area of the ULA is restricted to values below 180°; a triangular configuration of three ULAs might be used to cover the whole radio cell. This also takes into account that the individual beam becomes broader when steered from broadside to endfire of the array (Fig. 2).”). Unlike the ’931 patent, Vornefeld provides no teaching of any need to coordinate the timing of downlink and uplink transmissions in such an arrangement disclosure. (Cf. EX1001, 16:13-19.) Nor does it disclose how to organize beamformed transmissions to multiple sectors of the cell. (EX2028, ¶72.)

As discussed in more detail in Section III., the district court construed “sectors,” as “areas defined by an arc around the cell site, each covered by its own antenna.” (EX2027, 18.) In Vornefeld, each ULA is an antenna. (EX2028, ¶73.) Because all the elements of each ULA in Vornefeld are used to transmit to users in the area it covers, the entirety of the area served by one ULA is only one “sector.”

(*Id.*) Stated differently, under the district court’s construction of “sector,” all three beamformed transmissions depicted in Vornefeld Figure 2 are transmitted to the same sector (not separate sectors, as required by Claims 28 and 29 of the ’931 patent). (*Id.*) Figure 3 then also represents one sector, wherein that sector encompasses a broadcast beam covering the whole sector, plus a set of directed beams in the spatial domain. (*Id.*)

Vornefeld does not disclose any needs regarding radio operation or interference at sector boundaries because Vornefeld only discusses beamforming within a single sector. (EX2028, ¶74; EX1004, 52-57.) This is emphasized by Vornefeld’s performance analysis, which uses a single ULA (i.e., sector). (EX1004, 56–57 (“Performance Analysis”); EX2028, ¶74.) Vornefeld also provides its own solution to any potential interference. (EX2028, ¶74.) Specifically, Vornefeld teaches to use beamforming using 120-degree ULAs instead of 180-degree ULAs so that the transmitted RF beams can remain narrow enough to avoid interference at sector boundaries. (EX1004, 52; EX2028, ¶74.)

In the prior IPR, the Board ruled that “Petitioner does not establish Vornefeld discloses using different beams in the same TDD frame (i.e., second downlink data traffic, transmitted in ‘said downlink portion of said TDD frame’) to transmit to devices within a different sector,” and the Federal Circuit affirmed the Board’s determination of the validity of Claims 28 and 29 over Vornefeld.

(EX1009, 22-24; EX1010, 3). Verizon does not challenge that determination here, and the Board has made clear that that determination is taken as conclusive in this proceeding. (ID, 10, 33.)

2. Atsuta

In Ground 1, Petitioner asserts Atsuta in combination with Vornefeld, and suggests that Atsuta supplies the elements of Claims 28 and 29 that the Board previously found not to be disclosed in Vornefeld—specifically that multiple beamformed downlink transmissions be made to wireless devices in different sectors in the same downlink portion of the same TDD frame.

Entitled “TDMA Communicating Method and TDMA Receiving Apparatus,” Atsuta discloses a basic, conventional *TDMA* method for organizing *non-beamformed uplink communications* from wireless devices to base stations in cellular wireless networks. (EX2028, ¶77.) Atsuta teaches that *uplink signals* from each wireless device to the base station must be put in a separate portion of a *TDMA* frame, so they are each transmitted *in a separate time slot so they “do not overlap.”* (EX2028, ¶78; EX1005, 3:67-4:1, 5:36-39, 5:62.)

Atsuta’s abstract states:

A TDMA receiving apparatus for use with a base station including a plurality of receiving antennas, a plurality of outdoor units for converting received signals into first intermediate frequency

signals, a plurality of unit connecting cables for sending the intermediate frequency signals, and an indoor unit for obtaining demodulated signals from the intermediate frequency signals. The indoor unit has a plurality of second frequency converters for converting the first intermediate frequency signals into second intermediate frequency signals with the same frequency and a power combining unit for combining the second intermediate frequency signals. The combined intermediate frequency signal is demodulated by a common demodulating circuit.

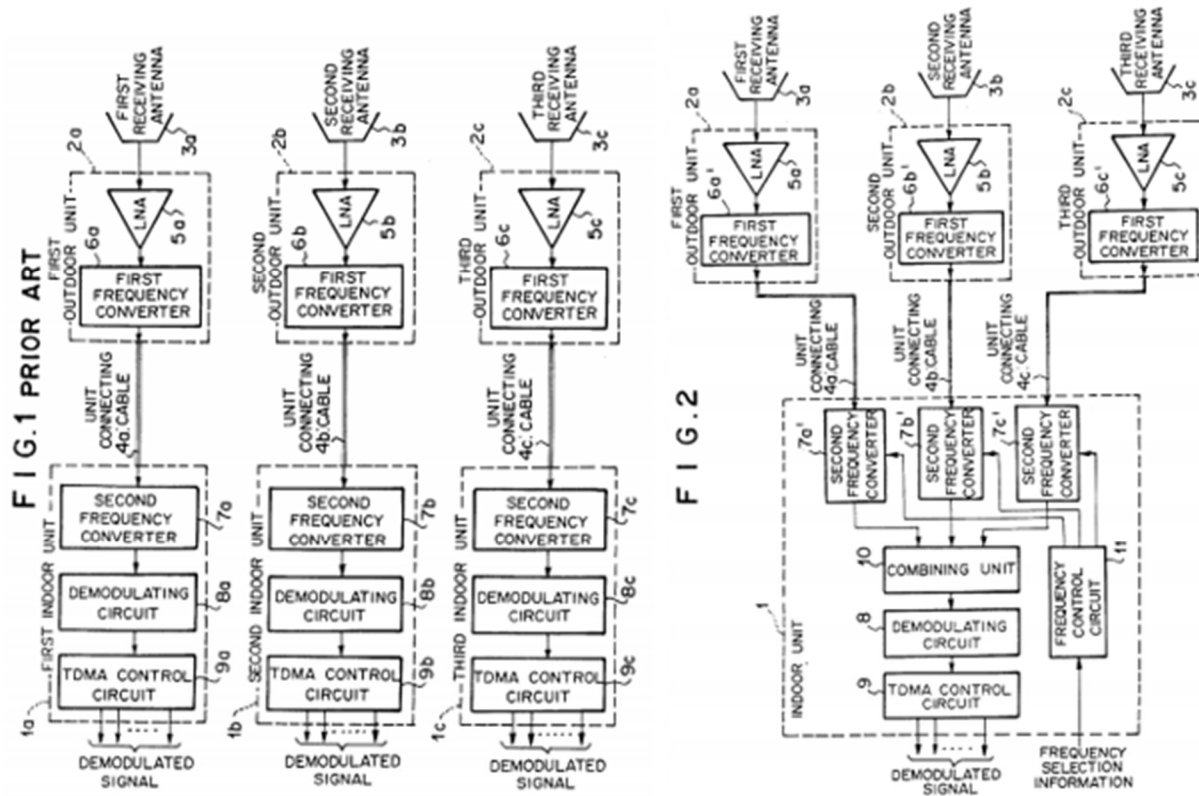
(EX1005, Abstract.) As described in this Abstract, Atsuta's invention is about a receive apparatus that combines and shares a "common demodulator circuit" that would otherwise be replicated for each sector. (*Id.*; (EX2028, ¶77))

As discussed below, Atsuta does not teach or suggest TDD anywhere. (EX2028, ¶79.) Notably, TDD (which provides a means for bidirectional communication) is not the same as TDMA (which provides a means for multiplexing). (*See* Section II.A.3; EX2028, ¶43.) Specifically, TDD allocates slots between downlink and uplink transmissions, while TDMA allocates slots between different users or devices. (EX2028, ¶43, 89, 94.)

Atsuta also discloses no concept of beamforming or of different mobile stations within a sector utilizing antenna arrays to create different space-division

transmission paths (i.e., it has no “directed beam patterns” or “beam scanning” as in the '931 patent). (EX2028, ¶80.) Atsuta also does not teach or suggest solutions for addressing interference between sectors, within sectors, or at sector boundaries, or address the subject of scheduling beamformed downlink transmissions in the same TDD frame at all as the Challenged Claims recite. (*Id.*)

Atsuta’s invention is most easily seen by comparing Atsuta’s Figure 2 versus Atsuta Figure 1 (below):



(EX1005, Figures 1, 2; EX2028, ¶81.) In Figure 1, “Prior art,” Atsuta shows three distinct “indoor unit” receivers that support three distinct “sector zones,” each with a different operating radio frequency. (EX2028, ¶81.) A POSA would presume that

three sectors collectively provide 360 degrees of coverage around a base station site. (*Id.*) The three sector zones are serviced by the three indoor units, three outdoor units, and three antennas. (*Id.*) All mobile stations in one sector zone transmit to the base station receive antenna for that sector zone, i.e., antenna 3a, 3b or 3c in Figure 1 (above). (*Id.*) There is no teaching of the antennas having multiple antenna elements to support beamforming capability. (*Id.*) Nor is there any teaching directed to the coordination of beamformed transmissions, either within a single sector, or across multiple sectors. (*Id.*)

Comparing Figure 2 to Figure 1, Atsuta's invention is to time share one "Demodulating Circuit" (8) and one "TDMA control circuit" (9) among the three previously independent transceivers a, b, and c. (EX2028, ¶83.) Thus, in Atsuta's invention, Atsuta teaches that every mobile station in a sector communicates with the one base station receive antenna for that sector. (EX2028, ¶96.) Atsuta has no concept of an antenna array, beamforming, or spatial division multiplexing of a plurality of phones within a single sector. (EX2028, ¶¶82, 96.)

To the extent Atsuta is relevant at all, it teaches away from the Challenged Claims. (EX2028, ¶125.) This is because, even if Atsuta's general concept were to be applied to the downlink, it is clear from Atsuta's Figure 3 and its specification that there is no transmission to more than one mobile station at a time, let alone in more than one sector. (EX2028, ¶85.) This fact teaches away from a significant

benefit of beamforming and SDMA: the ability to support simultaneous transmission of multiple downlink data signals. (EX2028, ¶85.) As explained below, the approach taught in Atsuta would thwart the very purpose of Claims 28 and 29. (EX2028, ¶86.)

3. Goldberg

In Ground 2, Petitioner asserts Goldberg in combination with Vornefeld, and suggests that Goldberg also supplies the additional elements of the Challenged Claims that the Board previously found were not disclosed in Vornefeld. But as explained below, Goldberg fares no better than Atsuta.

Goldberg is directed to beamforming within a single sector, and teaches methods by which advanced antenna arrays with multiple antenna elements can “achieve a near omnidirectional pattern throughout its area of coverage.” (EX1006, 1:11-13; 6:6-7; EX2028, ¶136.) Goldberg’s abstract states:

This invention relates to a method and apparatus for transmitting one or more downlink signals simultaneously over the same conventional channel from a communication station to one or more subscriber units to achieve a desired overall radiation pattern (e.g., a near omnidirectional pattern) over a desired sector, the communication station including an array of antenna elements...

(EX1006, Abstract.) Goldberg’s disclosure of beamforming within a sector is similar to that of Vornefeld. (EX2028, ¶136.) However, Goldberg is primarily directed at a specific aspect of beamforming: how to perform array-element signal processing such that the antenna array has a non-beam-directed radiation pattern for the signal portions that are intended to be broadcast uniformly over a sector. (*Id.*) This is stated in the abstract (“e.g., a near omnidirectional pattern”) and in the “Field of Invention”:

This invention relates to the field of wireless communication systems, and more specifically, to the efficient broadcast of common downlink communication channel signals in a wireless communications system by a communication station that uses a multiple element transmitting antenna array in order to achieve a near omnidirectional pattern throughout its area of coverage.

(EX1006 at 1:6–14; *see also id.* at 1:39–47, 6:5–13 (“Summary”).) Goldberg recognizes that in a sectorized system, “near omnidirectional” means covering a single sector. (EX2028, ¶136.) Specifically, Goldberg states:

Sectorized systems using antenna arrays are known in the art. In a sectorized system, rather than true omnidirectional broadcasting (360° of azimuth coverage) there is a need in the art for broadcasting efficiently in the intended coverage region (i.e., the sector) of the

antenna array and associated electronics. Thus, in this document, the term “omnidirectional” will be taken in the following sense: 1) “omnidirectional” means approximately, nearly omnidirectional (“NOR”); 2) in an unsectorized cellular system, omnidirectional will mean NOR for 360° of azimuth coverage, and 3) in a sectorized system, omnidirectional will mean nearly omnidirectional in the intended sector width (e.g., 120° of azimuth coverage for 120° sectors).

(See EX1006, 4:6–18.)

Like Vornefeld, Goldberg does not disclose any needs regarding radio operation or interference at sector boundaries. (EX2028, ¶137.)

Goldberg also does not in any way address how transmissions should be organized in a TDD network. (EX2028, ¶138.) No TDD frames or even basic TDD frame structures are shown. (*Id.*) The terms “TDD” and “time division duplexing” are not even used in the reference. (*Id.*) Indeed, Goldberg only discusses FDD, and all embodiments of the invention disclosed in Goldberg use the GSM standard (which is an FDD technology). (EX1006, 9:66–10:9; EX2028, ¶138.)

Critically, Goldberg contains no disclosure of what is required by Claims 28 and 29—the transmission of multiple beamformed signals carrying different downlink data to wireless devices in different sectors of the cell, with the separate

beamformed signals being transmitted in the same portion of the same TDD frame.
(EX2028, ¶146.)

4. Youssefmir

In Ground 3, Petitioner asserts Atsuta in combination with Youssefmir as the primary reference instead of Vornefeld. Youssefmir describes that a first base station “listens” for uplink transmissions from a second user terminal located in a second base station’s service area—presumably near their common cell edge—and chooses a beamforming pattern for its own downlink transmission to its own first user terminal in a way that tries to minimize power in the direction of the second user terminal (which the second user terminal receives as interference). (EX2028, ¶154; EX1007, Abstract.) Youssefmir then generalizes this to more than one second user terminal by stating, “including mitigating interference to the first and one or more other remote communication devices from which the first base station received a first or other uplink response signal.”⁴ (EX2028, ¶154; EX1007, Abstract.)

The configuration Youssefmir envisions is shown in its Figure 1 (below).

⁴ Note that the “second user terminal” is the “first... other remote communication device[.]”

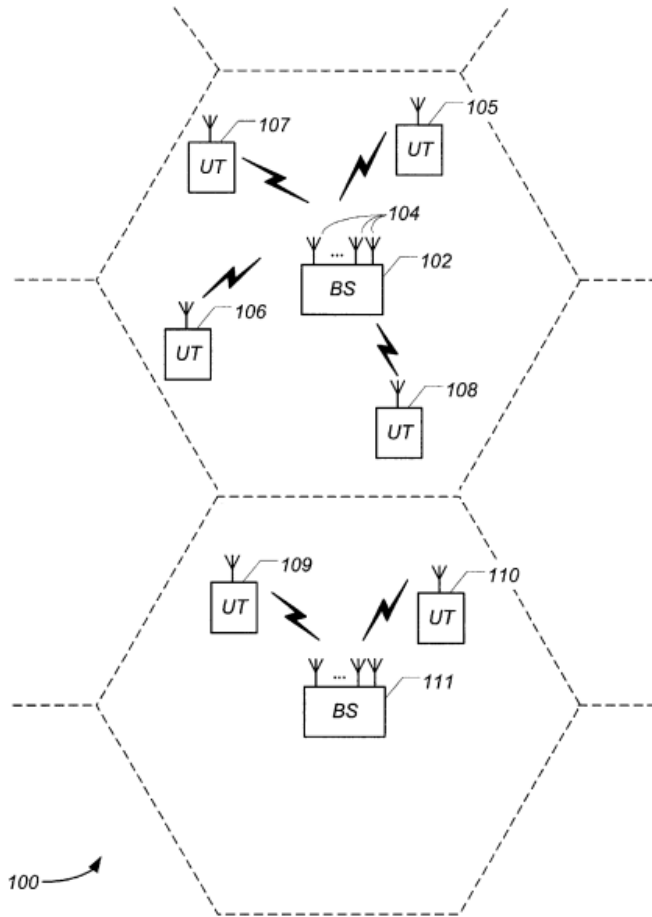


FIG. 1

(EX2028, ¶155; EX1007, Figure 1; *see also id.*, 4:33–47 (noting that BS 102 is the first base station and UTs 105, 106, 107 and 108 are in its service area; BS 111 is the second base station and UTs 109 and 110 are in its service area; UTs 109 and 110 are remote user terminals from the standpoint of the first base station).)

Youssefmir’s patent provides further details about beamforming hardware, beamforming algorithms, and different signals that may be used by beamforming algorithms (e.g., paging signals, acknowledgement signals). (*Id.*, 4:54–18:12, Figures. 2A, 2B; EX2028, ¶156.) Youssefmir’s patent also discloses frame

structures that insert polling, paging and acknowledgement messages between data transmissions to support the operation described in the Abstract. (EX1007, 18:15–27:42, Figures. 3–5; EX2028, ¶156.)

Youssefmir acknowledges that a base station’s coverage area (e.g., one of the hexagons in Figure 1 (above) can be sectorized, but only to clarify that the definition of “non-directional” and “omnidirectional” would then be limited to mean non-directional or omnidirectional “within the sector.” (EX2028, ¶157; EX1007, 9:13–15 (“Non-directional manner, as used herein, refers to not intentionally directing energy towards any particular user or users. In a sectorized system, this means non-directional within the sector.”), 14:13–15 (“In a sectorized system, omnidirectional means substantial omnidirectional within the sector.”).) However, Youssefmir has no other discussion about sectors, how sectors may affect its invention, how its invention might incorporate sectors, or about coordination between sectors. (EX2028, ¶157.)

Just like the other art asserted by Petitioner, Youssefmir contains no disclosure of the critical elements added by the Challenged Claims. (EX2028, ¶¶159, 165, 170.)

5. Tangemann

Tangemann discloses SDMA and beamforming, and is primarily concerned with capacity increases they may provide. (EX1008, 745 (“Abstract”).) For the

purpose of analyzing capacity increases, Tangemann divides a cell coverage area into narrow “minisectors” and provides an example in which a minisector spans 3.6 degrees. (*Id.*, 746 (§ 2.2, “[t]his is achieved by dividing the cell into small minisectors”), 748 (§ 3.1, “where the cell has been divided into $I = 100$ minisectors of 3.6° .”) Tangemann’s minisectors are not “sectors” of the Challenged Claims under the construction Petitioner successfully obtained in the related district court proceeding, as shown below. (EX2028, ¶176.)

III. CLAIM CONSTRUCTION

In related district court litigation, on January 12, 2024, Judge Gilstrap of the United States District Court for the Eastern District of Texas construed several terms of the ’931 patent. Those constructions are listed below:

Term	Court’s Construction
“wireless access network”	Plain and ordinary meaning. Specifically, there is no requirement that the wireless access network be fixed or externally mounted.
“wireless access devices”	Plain and ordinary meaning. Specifically, there is no requirement that the wireless access devices be fixed or externally mounted.
“subscriber premises”	“buildings, places in buildings, or the like, of a subscriber” As a further clarification, subscriber premises do not include just “any location,” e.g., a piece of vacant or undeveloped land.

Term	Court's Construction
“sector[s]”	Sectors are “areas defined by an arc around the cell site, each covered by its own antenna.”
“start of frame field”	“a field used to indicate the start of a frame.”
“in said downlink portion of said TDD frame”	“in the same downlink portion of the same TDD frame”

Particularly relevant to Petitioner’s Grounds is the district court’s construction of “sector[s]” as “areas defined by an arc around the cell site, each covered by its own antenna,” which “cannot be the area covered by any one directed scanning beam.” (EX2027, 11-12, 18-20.) In so ruling, the district court noted:

[T]he patent explains “each sector of a cell site is served by an individual RF modem,” and “[e]ach RF modem uses an individual antenna to transmit and to receive its assigned sector.” ’931 Patent at 16:8-13. “The antennas *for different sectors* in the same cell site are mounted on the same tower and are located only a few feet apart.” *Id.* at 16:13-15 (emphasis added). With this approach, the patent aims “to prevent interference between antennas in different sectors of the same cell site.” *Id.* at 16:20-21. Like the evidence discussed *supra*, these excerpts associate a “sector” of a cell site to something physical—either an RF modem, one or more antennas, or both.

(EX2027, 16.)

In addition, Patent Owner notes that in its Institution Decision, the Board asked Patent Owner to further explain its “implied claim construction” limiting “the challenged claims to the simultaneous transmission of signals, i.e., overlapping signals in the same timeslot.” (*Id.*, 32.) Although in Section IV.B.2.a., Patent Owner discusses simultaneity as a goal of Vornefeld and not Atsuta with respect to a POSA’s lack of a motivation to combine the two references, in this Response, Patent Owner does not address a construction limiting the Challenged Claims “to the simultaneous transmission of signals” because none of Patent Owner’s arguments in this Response turn on whether the Challenged Claims require “simultaneous” transmissions. Furthermore, although the plain language of the claims does not require “simultaneity,” in practice the coordination of the TDD frames is typically and often simultaneous. Patent Owner emphasized that point in its Preliminary Response, in particular, to highlight how Petitioner’s prior art differed.

IV. ARGUMENT

A. Grounds 1-2, 4-5: Vornefeld Does Not Disclose the Challenged Claims.

Both the Patent Trial and Appeal Board *and* the U.S. Court of Appeals for the Federal Circuit have ruled that Vornefeld does not disclose the Challenged Claims. (EX1009, 22–24; EX1010, 3.) Specifically, the PTAB ruled that

“Petitioner does not establish Vornefeld discloses using different beams in the same TDD frame (i.e., second downlink data traffic, transmitted in ‘said downlink portion of said TDD frame’) to transmit to devices within a different sector,” and the Federal Circuit affirmed. *Id.*

For this reason, in all Grounds including Vornefeld (Grounds 1-2 and 4-5), Petitioner relies on references other than Vornefeld for claim 28’s recitation that “said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals.” (See Petition, 30-38, 43-47, 62-72.) Similarly, Petitioner relies on references other than Vornefeld for claim 29’s recitation of “transmitting, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices in a second of said sectors using a second directed scanning beam signal.” (See *id.*).

B. Ground 1 Fails (Vornefeld + Atsuta) Because Atsuta Does Not Supply the Missing Elements of Claims 28 and 29.

1. Atsuta Does Not Disclose Transmitting in a TDD Frame or in the Downlink Portion of that TDD Frame.

Despite the fact that Vornefeld does not disclose transmitting “in said *downlink portion* of said *TDD frame*, second downlink data” to devices “in a second of said sectors using a second directed scanning beam signal” as the

Challenged Claims recite, Petitioner relies on Atsuta for this claim element, even though Atsuta does not teach (1) using **TDD** or (2) implementing its invention in the **downlink** direction.

a. Atsuta Discloses Transmitting in a TDMA/FDD Frame, not a TDD Frame as the Challenged Claims Recite.

With respect to the TDD claim element, although the Challenged Claims are specifically directed to transmitting “in said downlink portion of said **TDD frame**,” Petitioner claims that Atsuta discloses this claim element, despite admitting that “Atsuta is directed to **TDMA frame**-based communication between a base station and subscribers.” (Petition, 24.) But a POSA would understand that TDD is a different concept than TDMA, such that Atsuta’s use of TDMA does not disclose transmitting “in said downlink portion of said **TDD frame**,” as the Challenged Claims recite. (EX2028, ¶¶43, 91.)

The title of the ’931 patent is “Wireless Access System Using Selectively Adaptable Beam Forming in **TDD** Frames and Method of Operation.” The abstract, specification, and claims of the ’931 patent all address **TDD**. (EX2028, ¶88.) The Challenged Claims specifically address the coordination of multiple beamformed signals in a **TDD** wireless network, in which each beamformed signal carries different downlink data to wireless devices in a different sector of the cell. The Challenged Claims also require that wireless devices located in different sectors of

the cell be sent different downlink data, on different beamformed signals, transmitted in the same downlink portion of the same TDD frame.

As explained further in Section II.A.3., in TDD, a single band of frequency is used for both downlink and uplink transmissions by allocating separate time intervals or “slots” to each. (EX2028, ¶¶41, 89; EX1001, 6:2–5 (“In TDD, a single channel is used for transmission and reception and specific periods of time (i.e., slots) are allocated for transmission and other specific periods of time are allocated for reception.”), 14:7–10.) Downlink and uplink transmissions are then organized into “TDD frames.” (*Id.*, 14:10–16:3; EX2028, ¶¶42, 89.) The portion of the ’931 patent’s Figure 3 below provides an exemplary illustration of a TDD frame, showing a downlink portion followed by an uplink portion. (EX2028, ¶89.)

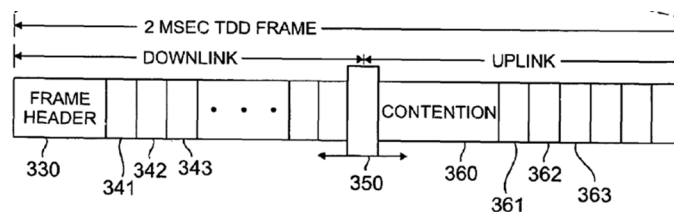


FIG. 3

Atsuta does not mention or describe “TDD,” any frequency reuse between uplink and downlink (i.e. “single channel”), or time division of uplink and downlink. (EX2028, ¶90.) Indeed, when describing how to allocate time slots, Atsuta only describes allocation between subscribers or uplink transmission requests as in TDMA, and never between uplink and *downlink transmission* as

required for TDD, as well as by the Challenged Claims. (EX2028, ¶92; EX1005, 6:13-21 (“In the above-described embodiment, the predetermined number of *time slots of the TDMA synchronous frame are equally assigned to each fan-shaped divided zone*. However, when the *number of time slots assigned to each fan-shaped divided zone is varied corresponding to the density of subscribers* in the pre-assignment method or corresponding to the *number of transmission requests* in the demand-assignment method, the transmission capacity can be assigned corresponding to the communication traffic.”). When discussing the benefits of its invention, Atsuta once again makes clear that it is focused on uplink (i.e., the data *received* by the base station), and not downlink (i.e., the data *transmitted* by the base station). (EX1005, 4:6-12 (“As a second result of the present invention, the *total transmission capacity receivable by the base station can be assigned* to each divided zone corresponding to the communication traffic amount thereof. Thus, the *difference of the density of subscribers and transmission requests for each divided zone* can be properly handled. Consequently, the performance of the base station can be fully realized.”).) For these reason, a POSA would understand that Atsuta does not teach or suggest TDD. (EX2028, ¶¶89-93.)

In a TDMA system like Atsuta’s, subscribers share a frequency channel but allocate spans of time to different users. (EX1005 5:39–43; EX2028, ¶94.) In short,

TDD allocates slots between downlink and uplink transmissions, while TDMA allocates slots between different users. (EX2028, ¶94.)

A POSA would know that TDMA does not imply TDD. (EX2028, ¶95.) For example, a system that employs TDMA may employ FDD to the exclusion of TDD. (EX2028, ¶95; *see* EX2022, 398 (showing TDMA/FDD used in the following wireless communication systems: Global System for Mobile (GSM), U.S. Digital Cellular (USDC), and Japanese Digital Cellular (JDC); EX2022, 397 (TDMA systems use “*either* FDD or TDD,” which are “called TDMA/FDD or TDMA/TDD access systems”); EX2030, 9-10 (showing that in the LTE standard, either FDD or TDD can be chosen as the frame type, to the exclusion of the other).) Further, TDD also does not imply TDMA, since a TDD system could be designed to connect only one user on one end of a particular channel with another user on the other end of the channel (i.e., no “multiple access”). (EX2028, ¶95.)

Indeed, a POSA would understand that Atsuta actually describes FDD, which is mutually exclusive with TDD. (EX2028, ¶¶44, 95, 103.) Petitioner’s expert opines that Atsuta teaches TDD frames, stating “[t]hese frames are TDD frames because Atsuta describes transmitting data ‘in the up link direction’ in the context of ‘sharing a TDMA synchronous frame’ and because Atsuta describes ‘asymmetrical communications’ in the downlink and uplink directions.” (EX1002, ¶105 (citing EX1005, 5:65-6:12).) But this does not imply TDD. Indeed, the cited

portion of Atsuta references only FDD, which is mutually exclusive with TDD.
(EX2028, ¶103.)

Specifically, Atsuta describes a use case where “asymmetrical communications are required. Consequently, since the transmission capacity and the frequency band of data sent in the up link direction are small, the increases of the transmission capacity and the frequency band of the communicating method of sharing a TDMA synchronous frame may not become a problem in many situations.” (EX1005, 6:6–12.) Atsuta describes that the uplink frequency band is “small,” which a POSA recognizes to mean “small” relative to the larger downlink frequency band, because of the asymmetric data rates. (EX2028, ¶104.) A POSA would understand that having an uplink frequency band that is smaller than the downlink frequency band necessarily means that the system is not using the same frequency band (or “channel”) in both directions. (EX2028, ¶104.) Therefore, a POSA would recognize that Atsuta’s described system is FDD and not TDD, since TDD uses the same frequency band (or “channel”) in both directions. (*Id.*; see EX1001, 5:62–6:5.)

b. Petitioner’s Allegations That Atsuta’s TDMA Frames (1) Are Actually TDD Frames (2) Transmitting Downlink Signals Are Wrong on Both Counts.

To fit Atsuta’s TDMA disclosure into the language of the Challenged Claims, Petitioner claims that a POSA would have understood that Atsuta’s

TDMA frames are actually TDD frames. (*See* Petition, 31-32.) Specifically, Petitioner cites to an example implementing Atsuta’s Figures 3(a) and 3(b), and alleges that a “POSA would have understood that the frames described by Atsuta are *TDD frames* inasmuch as Atsuta refers to transmitting data in both the *downlink* and uplink direction in the context of ‘sharing a TDMA synchronous frame’ because “Atsuta describes a ‘single synchronous frame,’ within which there are *sequential downlink signals* transmitted from the base station to subscriber stations in different zones.” (*Id* (citing EX1005, 5:65-6:12).) Petitioner’s assertions are false. (EX2028, ¶99.)

First, while Petitioner asserts that “Atsuta describes a ‘single synchronous frame,’” the term in quotes in both the Petition and Petitioner’s expert declaration—“single synchronous frame”—appears nowhere in Atsuta. (EX2028, ¶100.) When asked at deposition, Petitioner’s expert testified that just because he uses quotation marks followed by a citation does not mean that he is actually quoting language from the reference. (EX2029, 72:7-74:3.)

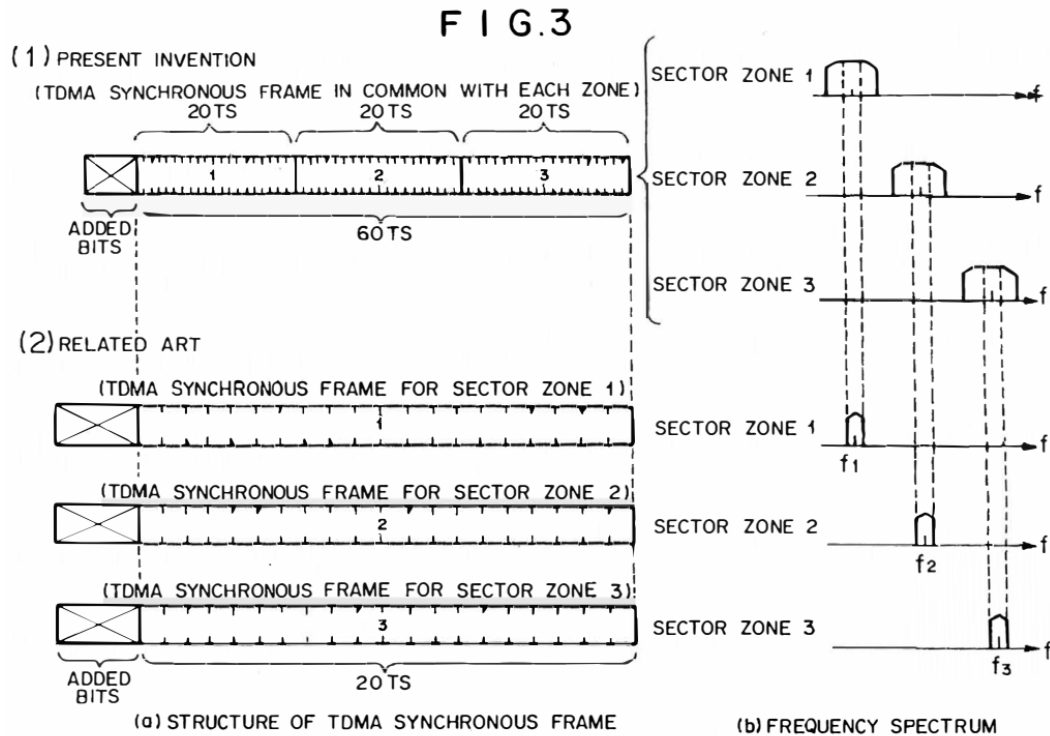
Second, Atsuta never describes sequential downlink signals being transmitted to different subscriber stations in different zones. Atsuta uses the word “downlink (or rather, ‘down link’)” only one time in the portion of Atsuta cited by the Petition, and indeed in its entire 11-page disclosure. (EX1005, 6:3.) This singular mention of downlink transmissions—rather than describing “sequential

downlink signals transmitted from the base station to subscriber stations in different zones” as Petitioner alleges—actually describes a scenario in which “asymmetrical communications are required” between the uplink and downlink. The uplink is the smaller of the two, so “the frequency band and transmission capacity can be increased without a problem” as required for Atsuta’s uplink-focused invention. (EX1005, 5:65-6:12.)

Indeed, even if Atsuta did teach a “single synchronous frame” as Petitioner erroneously alleges, the POSA would interpret this frame to be for *either* the uplink *or* the downlink; there is *nothing* in Atsuta to suggest that the downlink and uplink would time share a frame. (EX2028, ¶101.) Atsuta provides only a cursory overview of downlink hardware, and this overview does not disclose any format or detail of a synchronous frame, let alone a “single synchronous frame” shared with the uplink. (*Id.*; see EX1005, Figure 4, 6:24–57.)

Specifically, in Atsuta’s invention, as shown in Figures 3(a) and 3(b) (below), “20 TS [time slots] of each fan-shaped divided zone are assigned to each fan-shaped divided zone” so that “the resultant TDMA synchronous frame has 60 TS corresponding to the subscriber station in all the fan-shaped divided zones.” Because “the data capacity of the TDMA synchronous frame according to the present invention is three times larger than that of the conventional TDMA synchronous frame, the frequency band is tripled.” (EX1005, 5:46-49; EX2028,

¶102.) For this reason, to implement Atsuta's invention, Atsuta explains that “a receiving apparatus that has a larger transmission capacity than that is actually used and a wider frequency band than that of the conventional frame are required.” (EX1005, 5:51-54; EX2028, ¶102.)



It is in this context that Atsuta explains that “an example in which the frequency band and transmission capacity can be increased without a problem,” is a “picture providing service” where “the transmission capacity of picture data sent from the base station to the subscriber stations in the down link direction is much larger than the transmission capacity of control data such as request data sent from the subscriber stations to the base station in the up link direction.” (EX1005, 5:67-6:6; EX2028, ¶¶103-104.) Atsuta goes on to explain that “since the transmission

capacity and frequency band of data sent in the uplink direction are small, the increases of the transmission capacity and the frequency band of the communicating method of sharing a TDMA synchronous frame may not become a problem in many situations.” (EX1005, 6:7-12; EX2028, ¶104.)

Atsuta’s invention is implemented in the uplink direction *only*, and therefore substantially different than the ’931 patent in its implementation. Namely, Atsuta explicitly states that it is only “since the transmission capacity and the frequency band of data sent in the ***up link direction*** are small, [that] the increases of the transmission capacity and the frequency band of the communicating method of sharing a TDMA synchronous frame may not become a problem” in implementing Atsuta’s invention in this disclosed example. (EX1005, 6:7-12; EX2028, ¶105.)

Atsuta does not disclose or seem to contemplate applicability to a scenario in which the downlink transmission capacity is so small that it “has a larger transmission capacity than that is actually used” as Atsuta’s invention requires. (EX2028, ¶105.). In other words, a POSA would recognize that Atsuta’s disclosed scenario where “the transmission capacity of picture data sent from the base station to the subscriber stations in the down link direction is much larger than the transmission capacity of control data such as request data sent from the subscriber stations to the base station in the up link direction,” is not one in which the

downlink direction “has a larger transmission capacity than that is actually used” as Atsuta’s invention explicitly requires. (*Id.*).

Third, Atsuta never describes “transmitting data in both the **downlink** and the uplink direction in the context of ‘sharing a TDMA synchronous frame’” as Petitioner alleges. (Petition, 32; EX2028, ¶106; *see* EX1005, *passim.*) Instead, Atsuta is directed to the organization only of **uplink** transmissions from multiple wireless devices to the base station (using conventional non-beamformed signals). (EX2028, ¶106.) As detailed above, Atsuta explains its invention *exclusively* in the uplink context, with no disclosure regarding the structure or format of the downlink transmission, let alone any requirement that downlink transmissions occur at different times than uplink, as required for TDD. (*Id.*) As a further example, Atsuta’s abstract describes its invention as relating entirely to uplink, that is **receiving** data at a base station. “A **TDMA receiving apparatus** for use with a base station including a plurality of **receiving antennas**, a plurality of outdoor units for converting **received signals** into first intermediate frequency signals, a plurality of unit connecting cables for sending the intermediate frequency signals, and an indoor unit for obtaining demodulated signals from the intermediate frequency signals.”) (EX2028, ¶107; *see, e.g.*, EX1001, Abstract, 1:7-11 (“The present invention relates to a TDMA Communicating Method and a **TDMA receiving apparatus**, in particular, to a TDMA communicating method of a base station that

communicates with a plurality of zones that use different radio frequencies and a *TDMA receiving apparatus thereof.*”), 3:20-21 (“The TDMA receiving apparatus for use with the base station according to the present invention”), 3:31 (“The TDMA receiving apparatus of the present invention”), 3:46-54 (“The indoor unit has a frequency control circuit that supplies a control signal for controlling the frequencies of the second frequency converters so as to externally vary radio frequencies that can be received and demodulated. The frequency converters of the TDMA receiving apparatus according to the present invention convert TDMA signals with different radio frequencies sent with the same TDMA synchronous frame into intermediate frequency signals with the same frequency.”).)

In contrast to Atsuta, the Challenged Claims are expressly directed to the coordination of downlink transmissions from the base station to wireless devices on the network, which present unique interference problems—even in different sectors—due to the power generated by the base station antenna. (EX2028, ¶108; *see, e.g.*, EX1001, 16:20-23 (“Thus, to prevent interference between antennas in different sectors of the same cell site, the present invention uses a highly accurate

distributed timing architecture to align the start points of the *downlink* transmissions.”).⁵

Finally, Petitioner alleges that, “[a]t the very least, because the frames in Atsuta are comprised of different timeslots reserved for downlink transmission, a POSA would understand that they are compatible with a TDD frame.” (Petition, 21 (citation omitted).) But as discussed above, Atsuta contemplates its invention as one directed to *uplink* transmissions, and thus Atsuta’s direction to “[a] TDMA receiving apparatus for use with a base station including a plurality of receiving antennas”. (EX1005, Abstract; EX2028, ¶109.) Because Atsuta provides little explanation as to how its invention could be modified to apply to downlink transmissions at all, let alone in addition to uplink, a POSA would not have applied Atsuta’s invention to downlink transmissions in a TDD frame as Petitioner alleges without support. (EX2028, ¶109.)

Because Atsuta does not disclose transmitting “in said *downlink* portion of said *TDD frame*, second downlink data traffic to substantially only wireless access

⁵ The Challenged Claims do not speak specifically to the organization of the uplink transmissions, and the specification teaches that unlike downlink transmissions, uplink transmissions “may be limited to a single scanning beam per frame.” (EX1001, 28:66-67; EX2028, ¶108, n.5.)

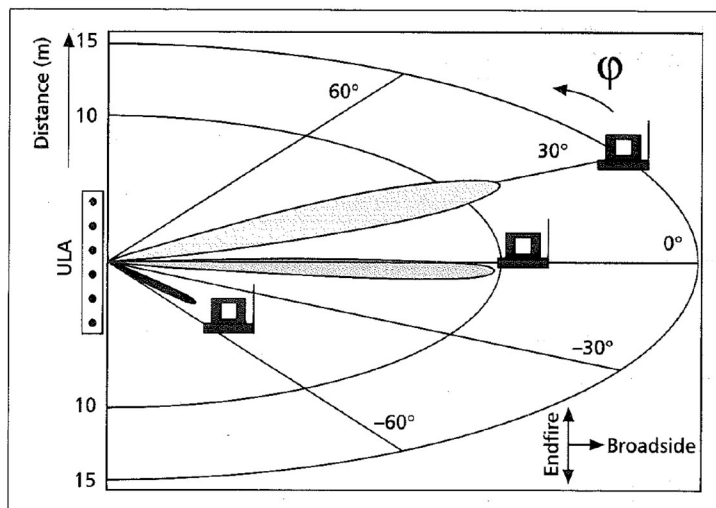
devices in a second of said sectors using a second directed scanning beam signal” as the Challenged Claims recite, Petitioner’s Ground 1 challenge relying on Atsuta for this claim element must fail. (EX2028, ¶¶110-111.)

2. A POSA Would Not Combine Atsuta with Vornefeld.

a. A POSA Would Not Combine Atsuta with Vornefeld Because it Would Thwart the Intended Purpose of Vornefeld.

A POSA would not seek to combine Atsuta with Vornefeld because such a combination would thwart the very purpose of Vornefeld. (EX2028, ¶130.) The system disclosed in Vornefeld was intended to allow for the simultaneous

transmission of beamformed signals to different wireless devices. (*Id.*; EX1004, 53 (“Depending on the number of antenna elements and the applied algorithm, array antennas are able to *simultaneously* direct several



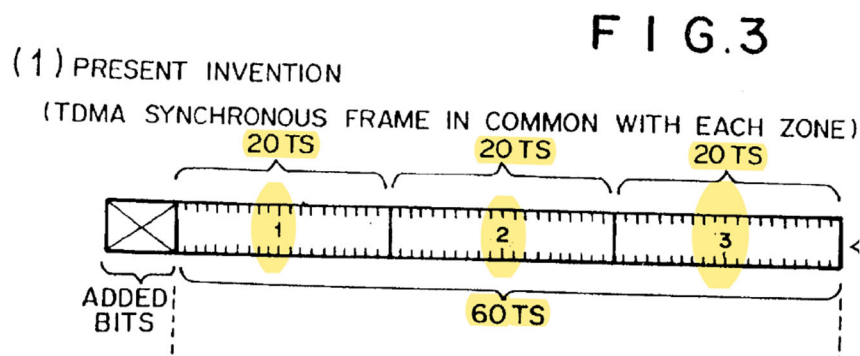
■ Figure 2. Simultaneous transmission using directive beams.

beams to different positions conveying individual user signals.”).) Indeed, Figure 2 of Vornefeld shows that its system uses “simultaneous transmission using directive beams.” (EX2028, ¶130.) As discussed above, the Board previously determined (and Petitioner does not dispute in this proceeding) that Vornefeld teaches the use

of separate TDD frames for each beamformed signal rather than organizing all of the beamformed downlink data transmissions in the same portion of the same TDD frame, while seeking to allow for simultaneous transmission of multiple beamformed signals. (EX2028, ¶131.)

Atsuta, by contrast, repeatedly and consistently teaches that each subscriber within a sector must be allocated a separate portion of the frame so that the transmissions from each subscriber station “do not overlap.” (EX2028, ¶132; *see, e.g.*, EX1005, 3:1-5 (“A subscriber station is adapted for transmitting TDMA signals with time slots of a common TDMA synchronous frame in such a manner that the TDMA signals of the subscriber stations do not overlap.”); 3:67-4:1 (“time slots are assigned to the divided zones so that the time slots do not overlap”); 5:36-39 (according to the present invention, 20 TS . . . are assigned to each fan shaped zone in such a manner that time slots of individual fan-shaped divided zones do not overlap”); 5:62 (“time slots do not overlap”); 7:46-50 (“transmitting, from the subscriber stations, TDMA signals with time slots of a common TDMA synchronous frame by each of the subscriber stations in the outdoor units in such a manner that the TDMA signals of the subscriber stations do not overlap”); 8:20-21 (Claim 3, requiring that the signals be organized “so as not to overlap”); 8:60-61 (Claim 5, requiring that the signals be organized “so as not to overlap”).)

Figure 3 of Atsuta illustrates how uplink transmissions from wireless devices in different sectors are separated into different 20 millisecond portions of the 60-millisecond frame. (EX2028, ¶132.) As shown below, transmissions from wireless devices in each “zone” are assigned a separate and distinct portion of the frame labeled 1, 2 and 3. (*Id.*)



Indeed, Petitioner concedes that Atsuta “assigns different timeslots within a single [uplink] frame to subscribers in different sectors.”⁶ (Petition, 26.) Thus, there can be no dispute that Atsuta does not disclose or event permit multiple simultaneous transmissions. (EX2028, ¶132.)

A POSA seeking to develop a TDD communications protocol allowing for the *simultaneous* transmission of multiple downlink beamformed signals would not turn to Atsuta’s patent teaching the *sequential* transmission of signals so they

⁶ Petitioner erroneously refers to these as “downlink” timeslots. But Atsuta is actually directed to uplink transmissions (and the receipt of uplink transmissions by the base station). (EX2028, ¶132, n.7.)

never overlap in time. (*Id.*) See *Plas-Pak Indus., Inc. v. Sulzer Mixpac AG*, 600 F. App'x 755, 758 (Fed. Cir. 2015) (affirming the Board's finding that an invention was nonobvious where a person of ordinary skill would not have been motivated to pursue the combination because it would "change the basic principles under which the prior art was designed to operate, or...render the prior art inoperable for its intended purpose.") (citations and quotations omitted); see also *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984).

Because Atsuta never describes transmission to more than one mobile station at a time, let alone in more than one sector, a POSA would understand that Atsuta is not compatible with one of the principal objectives of beamforming and SDMA—which is taught by Vornefeld—i.e., that of supporting simultaneous transmission. (EX2028, ¶133; see EX1004, 52.) For this reason, a POSA would not seek to combine Atsuta with Vornefeld's beamforming device. (EX2028, ¶133.)

b. Atsuta Does Not Address Beamforming or Downlink Transmissions, and So Cannot Assist a POSA in Coordinating Vornefeld's Beamformed Downlink Transmissions.

Even if Atsuta disclosed the limitations of Claims 28 and 29 that are missing from Vornefeld (it does not), Petitioner has not—and cannot—show that a POSA would combine Vornefeld and Atsuta. Indeed, Petitioner makes only conclusory statements to the effect that a POSA would be motivated to combine Atsuta with Vornefeld. (Petition, 26, 28.) But Petitioner fails to address the fact that Atsuta

addresses different issues in a different context. (EX2028, ¶113.) Specifically, Petitioner fails to provide any reason why a POSA would look to a patent that deals with *conventional uplink* transmissions to figure out how to coordinate *downlink beamformed* transmissions. (*Id.*) The two references, Vornefeld and Atsuta, are fundamentally different and not something the POSA would even look to combine at a threshold level. (EX2028, ¶¶113-133.)

As described in Section IV.B.1., Atsuta deals only with uplink transmissions, not with downlink transmissions addressed by Vornefeld and the Challenged Claims of the '931 patent. (EX2028, ¶118.) Additionally, Atsuta does not teach or describe any concept of beamforming or of different mobile stations within a sector utilizing antenna arrays to create different space-division transmission paths (i.e., it has no “directed beam patterns” or “beam scanning” as in the '931 patent). (*Id.*)

Beamforming and organization of the downlink transmissions are at the heart of the '931 patent. (EX2028, ¶119.) The title of the '931 patent is “Wireless Access System Using Selectively Adaptable *Beam Forming* in TDD Frames and Method of Operation.” (EX1001, Cover.) The abstract, specification, and claims of the '931 patent all address beamforming. (*See* EX1001, *passim.*) The Challenged Claims specifically address the coordination of multiple beamformed signals in a

TDD wireless network, in which beamformed signals carry different downlink data to wireless devices in a different sector of the cell. (EX2028, ¶119.)

Atsuta, by contrast, does not address beamforming in any way. (EX2028, ¶120.) It does not even address the use of an antenna array capable of beamforming. (*Id.*) Nor does it speak to how multiple beamformed signals carrying downlink data should be organized or coordinated. (*Id.*)

The word “beam” appears only once in Atsuta in its discussion of “conventional” base stations utilizing “a fan-shaped beam antenna for sectoring a service area.” (EX1005, 1:13-18; EX2028, ¶121.) Of course, conventional base station antennas at the time did not use beamforming. (*Id.*) Atsuta does not address antennas capable of beamforming (e.g., including multiple elements with means for controlling their weights and/or phases). (*Id.*) In context, Atsuta’s “fan-shaped beam antenna” is just a conventional antenna designed to transmit a typical fan-shaped beam. (*Id.*; *see generally* EX2021 (defining “fan beam” and depicting conventional antennas capable of transmitting a fan-shaped beam).)

Atsuta’s hardware modification is most easily seen by comparing Atsuta’s Figure 2 versus Figure 1 (below):

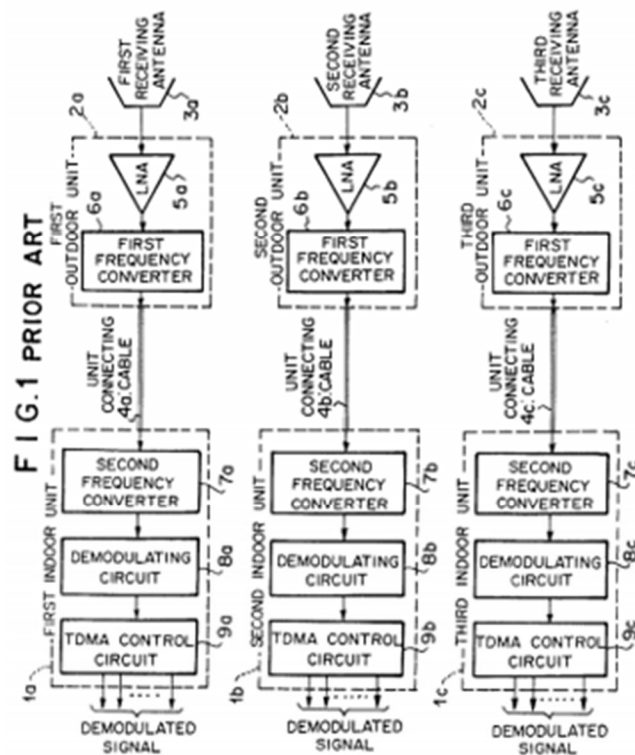
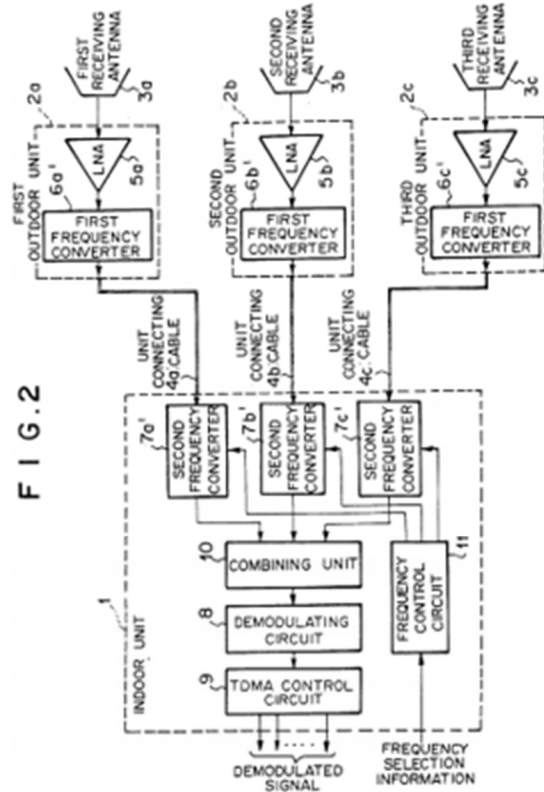


FIG. 2



(EX1005, Figures 1, 2; EX2028, ¶122.) In Figure 1, “Prior art,” Atsuta starts with three distinct “indoor unit” receivers that support three distinct sectors, each with a different operating radio frequency. (EX1005, Figure 1; EX2028, ¶122.) A POSA would presume that the three sectors together provide 360 degrees of coverage around a base station site. (EX2028, ¶122.) The three sectors are serviced by the three indoor units, three outdoor units, and three antennas. (*Id.*; EX1005, Figure 1.) All mobile stations in one sector transmit to the base station receive antenna for that sector, i.e., antenna 3a, 3b or 3c in Figure 1 (above). (EX2028, ¶122.) There is no concept of an antenna array or of beamforming within one sector zone, or of different mobile stations within a sector zone utilizing different space-division

transmission paths as a result of an antenna array or beamforming within one sector zone. (*Id.*)

Comparing Figure 2 to Figure 1, Atsuta's invention is to time share one "Demodulating Circuit" (8) and one "TDMA control circuit" (9) among the three previously independent transceivers a, b, and c. (EX2028, ¶123.) Thus, in Atsuta's invention, Atsuta teaches that every mobile station in a sector communicates with the one base station receive antenna for that sector. (*Id.*) Atsuta has no concept of an antenna array, beamforming, or spatial division multiplexing of a plurality of phones within a single sector. (EX2028, ¶¶82, 123) As such, Atsuta does not teach or suggest any aspect of the Challenged Claims, which both require beamforming, and a POSA would not look to use it or combine it with Vornefeld's beamforming techniques. (EX2028, ¶123.)

Petitioner's expert additionally states that a POSA would be apt to combine Vornefeld and Atsuta because "Atsuta's 'sector zone[s]' are 'fan-shaped' subsections of the total service area, and each zone is assigned its own antenna array, just like the sectors in Vornefeld." (EX1002, ¶ 89.) However, this is a misrepresentation. The antenna Atsuta discusses is "a fan-shaped beam antenna for sectoring a service area." (*Id.* (citing EX1005, 1:13–25); EX2028, ¶124.). Atsuta says nothing about the design of its fan-shaped beam antenna, and does not use the word "array" in its patent at all, let alone when describing a specific antenna

structure. (EX2028, ¶124.) Atsuta’s fan-shaped beam antenna need not be an array, and if it were to use an array element design, that would be a fixed element array whereby the antenna as a whole is still driven with one signal. (*Id.*) This is significantly different than the active antenna array of Vornefeld (and Goldberg and Youssefmir and Tangemann), whereby each element of an antenna array is driven with a different, actively generated signal. (*Id.*) Again, Atsuta does not teach or describe beamforming anywhere, and a POSA would not look to combine Atsuta with Vornefeld to achieve the Challenged Claims. (*Id.*)

c. A POSA Would Not Have Looked to Atsuta to Address an Unsolved Transmission Interference Problem in Vornefeld.

Petitioner’s expert additionally states that “a POSA would have been motivated to combine Vornefeld and Atsuta because Atsuta provides a solution to a transmission interference problem recognized by Vornefeld....” (EX1002, ¶ 91.) But the only interference problem recognized by Vornefeld is that concurrently transmitted directed beams can interfere with each other. (EX1004, 56 (“Downlink Scheduling”); EX2028, ¶114.) Vornefeld provides its own solution for this issue, which is—do not schedule them concurrently. (*See* EX1004, 52; EX2028, ¶114.)

Because Vornefeld provides a solution to its recognized interference problem, Petitioner has not explained why a POSA would look to Atsuta or any other reference to solve a problem that Vornefeld claims to have already solved.

(EX2028, ¶114.) *See Winner Int’l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349-50 (Fed. Cir. 2000) (affirming nonobviousness where “there was no apparent disadvantage” to the prior art mechanism); *Apple Inc. v. Uniloc Luxembourg S.A.*, IPR2017-02041, Paper 10 at 24-25 (PTAB Mar. 8, 2018) (declining to institute IPR because “Petitioner, however, fails to articulate or show sufficiently why achieving a Passwordable ID with uniqueness to a device and user would be necessary or helpful to Schull’s system. For instance, Petitioner does not address whether Schull’s existing methods of generating a Passwordable ID already attain such uniqueness.” (citation omitted)). Even if a POSA were to look outside of Vornefeld for a solution to its already-solved interference problem, Atsuta does not provide a solution for this, in part because, as discussed above, Atsuta does not discuss beamforming at all. (EX2028, ¶115.) Atsuta also does not teach or suggest interference between sectors, within sectors, or at sector boundaries. (*Id.*)

Additionally, Petitioner’s expert asserts that a POSA would look to Atsuta because “Vornefeld recognizes that certain sets of subscribers are not suited for concurrent transmission to different sectors due to signal interference constraints.” (EX1002, ¶ 91.) However, this assertion relies on a construction of “sector” different from the district court’s construction as discussed in Section III. (EX2028, ¶116.) The district court construed “sector[s]” as “areas defined by an arc around the cell site, each covered by its own antenna,” which “cannot be the

area covered by any one directed scanning beam.” (EX2027, 11-12, 18-20.)

Vornefeld does not disclose any problems regarding interference at sector boundaries or transmission to different sectors. (EX2028, ¶116.) In light of these facts, a POSA would not have been motivated to combine Atsuta with Vornefeld. (EX2028, ¶116.)

Petitioner’s expert further states that “a POSA would have been motivated to combine Vornefeld and Atsuta” to “provid[e] the additional benefit of simplified hardware requirements.” (EX1002, ¶ 91.) This is incorrect. Specifically, by comparing Atsuta’s Figure 2 to Figure 1 (below), a POSA would understand that in Atsuta’s invention (shown in Figure 2), the TDMA control circuit 9 must now have three times as many outputs and handle three times as many mobile stations as the prior art device, substantially increasing the size and complexity of TDMA control circuit 9. (EX2028, ¶¶125-126.) Furthermore, the block 10 “combining unit” is new to Atsuta’s invention, additionally increasing complexity. (EX2028, ¶126.)

FIG. 1 PRIOR ART

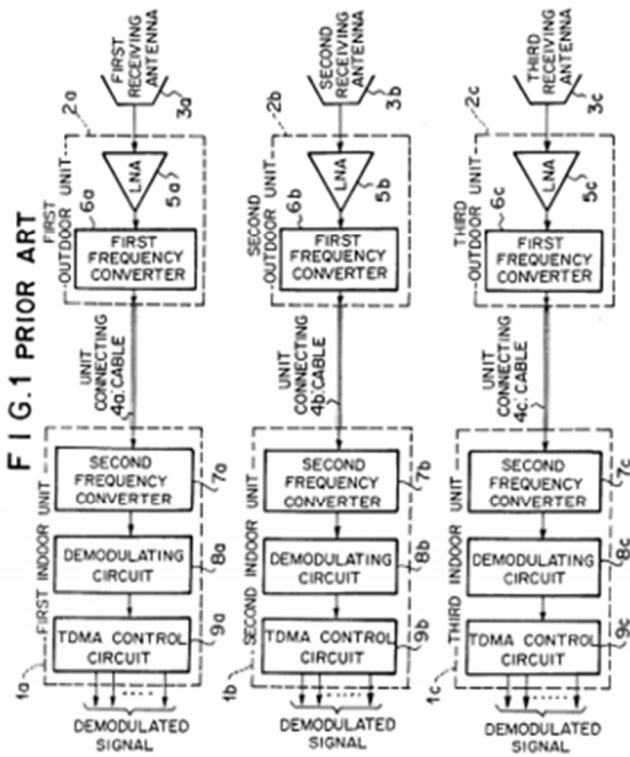
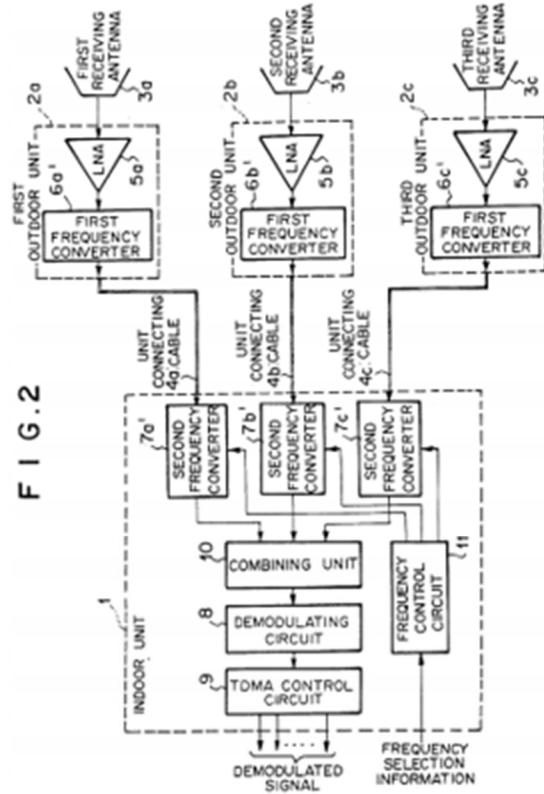
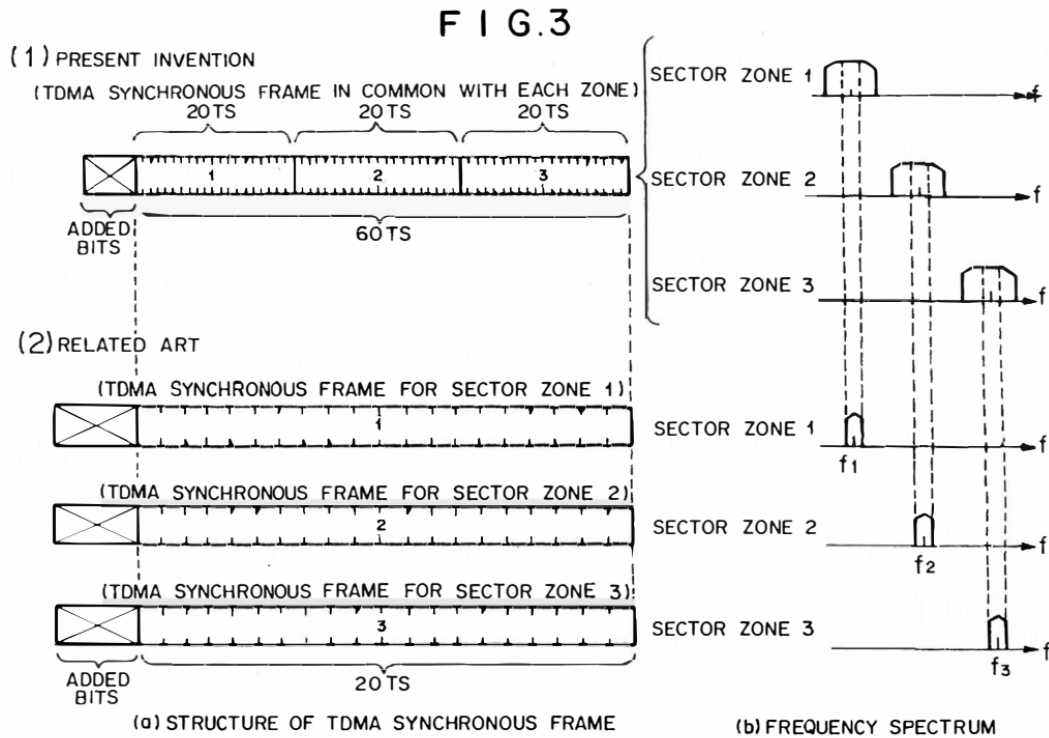


FIG. 2



Second, Atsuta forces the receivers to time share in the way shown in Figure

3 (below):



(EX1005, Figure 3; EX2028, ¶127.) Atsuta's Figure 3 makes clear that Atsuta's invention requires 60 time slots in the span of time where there were previously 20 time slots, in order to maintain the same total throughput as the prior art device. (EX2028, ¶127.) This corresponds to the tripled frequency bandwidths shown in Figure 3. (*Id.*) Therefore, Atsuta's Combining Unit 10, Demodulating Circuit 8, and TDMA control circuit 9 have to run at three times higher clock rate, offsetting most if not all power savings from Atsuta's invention. (*Id.*)

Third, a POSA would recognize that Atsuta's invention requires a three times wider bandwidth per channel to maintain the same total throughput.

((EX2028, ¶128; EX1005, Figure 3 (showing that the three frequency bands in the upper right quadrant each has three times the bandwidth of the three frequency

bands in the lower right quadrant).) This means the antennas (3a, 3b, 3c), low noise amplifiers (5a, 5b, 5c), outdoor frequency converters (6a, 6b, 6c) and indoor frequency converters (7a, 7b, 7c) all must be redesigned to support three times the bandwidth, adding significant cost and complexity to Atsuta’s invention. (EX2028, ¶128.) And each is used only one-third of the time, wasting two-thirds of its capacity. (*Id.*)

For these reasons, a POSA would have recognized that Atsuta’s design would have provided little to no benefit of reduced power or hardware complexity relative to the added costs of its implementation in Vornefeld, and on top of the costs of securing additional frequency spectrum. (*Id.*) Indeed, even Atsuta recognized that its invention has limited (if any) uses, thus describing only a single video distribution system as an example. (*Id.*) For these reasons, a POSA would not have made this combination. (EX2028, ¶129.)

B. Ground 2 (Vornefeld + Goldberg) Fails Because Goldberg Does Not Include the Missing Limitations of Claims 28 and 29.

1. Goldberg Discloses Transmitting in an FDD Frame, not a TDD Frame as the Challenged Claims Recite.

As with Atsuta, despite the fact that the Challenged Claims are specifically directed to transmitting “in said downlink portion of said *TDD frame*,” Petitioner argues that Goldberg discloses transmission “to subscribers in different regions using one frame as part of the *TDMA* protocol.” (Petition, 41.) Once again,

Petitioner improperly conflates TDMA with TDD. (EX2028, ¶141; *see* Petition, 39 (“Like Vornefeld, Goldberg [sic] is also directed to TDMA frame-based communications...”)).)

In an attempt to shoehorn Goldberg’s TDMA disclosure into the language of the Challenged Claims, Petitioner alleges that “Goldburg describes sending downlink signals from a base station to users in different regions within a single TDD frame.” (Petition, 39 (citing EX1006, 12:11–24).) But, like Atsuta, Goldburg provides no disclosure of TDD or any TDD frame structure, and does not in any way address how such transmissions should be organized in a TDD network. (EX2028, ¶141.) The reference does not even contain the terms “TDD” or “time division duplexing.” (*Id.*; *see* EX1006, *passim*.)

Indeed, the Goldburg citation upon which Petitioner relies (EX1006, 12:11–24) discusses only GSM, which Goldburg describes as using an **FDD** multiplexing scheme. (EX2028, ¶¶142–143; EX1006 at 6:58–61 (“In the particular embodiment disclosed, the communication station is part of a base station which operates using a variant of the GSM air interface.”), 9:50–10:2 (“The preferred embodiment described will be for a cellular system which uses SDMA and a variant of the GSM protocol...In GSM, frequency channels (called “carriers”) are separated by 200 kHz.”).) In fact, all embodiments of the invention disclosed in Goldburg use the GSM standard. (EX2028, ¶142; EX1006, 9:66–10:9.) And as Goldburg explains,

“GSM uses *frequency division duplexing*, which means that downlink and uplink communications between a BS and a MS occur at different frequencies.” (EX2028, ¶142; EX1006, 9:67-10:2.)

As described in Section II.A.3., a POSA would understand that FDD is *not TDD*, and the fact that Goldberg discloses TDMA does *not* imply that Goldberg is utilizing a TDD frame structure. (EX2028, ¶144.) To the contrary, as explained in a treatise expressly incorporated by reference into the ’931 patent, (EX1001, 6:23-31), TDMA systems use “*either* FDD or TDD,” which are “called TDMA/FDD or TDMA/TDD access systems.” (EX2022, 397; EX2030, 9-10 (showing that in the LTE standard, either FDD or TDD can be chosen as the frame type, to the exclusion of the other); EX2028, ¶¶44, 144.) Goldberg discloses only a TDMA/FDD system. (EX2028, ¶144.)

Thus, just like Atsuta, Goldberg fails to teach the transmission of multiple beamformed downlink transmissions in the same portion of the same *TDD frame*. (EX2028, ¶145.) Faced with this same gap in Goldberg, Petitioner ignores the language of the Challenged Claims and argues that Goldberg discloses “using one frame” for multiple downlink transmissions. (Petition, 41.) But the Challenged Claims require more. They expressly require that the multiple beamformed downlink signals be transmitted to users located in different sectors “in said downlink portion of said *TTD frame*.” Goldberg fails to address with the unique

challenges associated with beamforming to multiple users, located in multiple sectors, *in the same TDD frame*. (EX2028, ¶145.)

For this reason, Petitioner’s Ground 2 challenge based on Vornefeld in view of Goldberg also fails. (*Id.*)

2. A POSA Would Not Combine Goldberg with Vornefeld.

Petitioner argues that a POSA would combine Goldberg with Vornefeld because “Vornefeld recognizes that certain sets of subscribers are not suited for concurrent transmission due to signal interference constraints” and thus “divides transmissions on the time axis,” and “Goldberg does the same, while also defining different regions for each subscriber to minimize interference, using weight vectors already disclosed in Vornefeld.” (Petition, 42.) This is inaccurate for numerous reasons. (EX2028, ¶146.)

First, as described in Section IV.B.2.c., the only interference problem recognized by Vornefeld is that multiple directed beams concurrently transmitted *within a single sector* can interfere with each other. (EX2028, ¶147; EX1004, 56 (“Downlink Scheduling”).) Vornefeld provides its own solution for this issue, which is—do not schedule them concurrently. (EX1004, 52.) Because Vornefeld provides a solution to its recognized interference problem, Petitioner has not explained why a POSA would look to Goldberg or any other reference to solve a problem that Vornefeld claims to have already solved. (EX2028, ¶147.) *See BMW*

of North America, LLC v. Carrum Techs., LLC, IPR2019-00904, Paper 10 at 14 (PTAB Oct. 18, 2019) (no motivation to combine because when “[one prior art reference] discloses methods for identifying when a vehicle has entered a curve..., it is not evident why [a POSA] would have looked to [a second prior art reference] to obtain additional methods of determining curve entry.”).

Second, Petitioner’s assertion that a POSA would combine Goldberg with Vornefeld because “Vornefeld recognizes that certain sets of subscribers are not suited for concurrent transmission due to signal interference constraints” relies on a construction of “sector” different from the district court’s construction as discussed in Section III. (Petition, 42; EX2028, ¶148.) The district court construed “sector[s]” as “areas defined by an arc around the cell site, each covered by its own antenna,” which “cannot be the area covered by any one directed scanning beam.” (EX2027, 11-12, 18-20.) Vornefeld does not disclose any problems regarding interference at sector boundaries or transmission to different sectors. (EX2028, ¶148.) In light of these facts, a POSA would not have been motivated to combine Goldberg with Vornefeld. (*Id.*)

Petitioner’s further allegation that a POSA would look to modify Vornefeld with Goldberg because while Vornefeld “divides transmissions on the time axis,” “Goldberg does the same, while also defining different regions for each subscriber to minimize interference, using weight vectors already disclosed in Vornefeld” is

also inapplicable under the district court’s construction of “sector.” (Petition, 42; EX2028, ¶149.) Indeed, Petitioner’s expert admitted that this portion of his opinions did not apply under the district court’s construction of “sector.” (EX2029, 35:1-37:3.) Rather, Petitioner’s expert acknowledges that this argument only applies under Patent Owner’s previously proposed construction of “sector”—equating Goldberg’s “region” with a sector—a construction that the district court has rejected. (*Id.*) Only the term “sector” as actually used in Goldberg aligns with the district court’s construction of “sector”; Goldberg’s use of the term “region” does not so align. (EX2028, ¶149.) Therefore, as stated above, Goldberg does not disclose any needs or solutions regarding radio operation or interference at sector boundaries. (*Id.*)

Third, a POSA would recognize that Goldberg does not add anything to Vornefeld’s disclosure, and so there is no reason to combine the two. (EX2028, ¶150.) Petitioner’s expert argues that “Goldberg transmits to multiple subscribers within the same frame as part of the TDMA protocol.” (EX1002, ¶120.) However, a POSA would understand that Goldberg only provides a minimal description of a frame structure, and it is based on the existing GSM standard. (EX2028, ¶150; EX1002, ¶120 (citing EX1006, 3:47–4:18, 9:59–11:23, 12:11–24).) For Goldberg’s actual invention, a POSA would understand that the frame structure would be a hypothetical expansion of the existing GSM standard in some way that

is not described in any detail by Goldberg. (EX2028, ¶143.) A POSA making a best guess at what the frame structure of Goldberg's invention might be would arrive at nothing more than Vornefeld's Figure 3, i.e., a broadcast portion plus a portion with directed beams (but Goldberg would still be missing the required TDD). (*Id.*) Put another way, there is nothing in Goldberg that teaches "transmit[ing] to multiple subscribers within the same frame" beyond what Vornefeld teaches. (*Id.*) Petitioner's expert admits that Goldberg "aligns with Vornefeld's teachings, which reserves timeslots at the start of the frame for common information, and allows later timeslots to be used for downlink and uplink data for specific subscribers." Given that the Board and Federal Circuit have already ruled that Vornefeld does not teach the '931 patent's Challenged Claims, the same logic applies that Goldberg also does not, and so the combination of Goldberg and Vornefeld also does not teach each limitation of the Challenged Claims. (EX2028, ¶150.)

Finally, a POSA seeking to develop a protocol for the transmission of multiple beamformed signals in a TDD wireless network would not turn to a patent directed to an FDD multiplexing scheme. (EX2028, ¶151.) FDD is an older approach to multiplexing generally better suited to voice communications. (*Id.*) TDD networks, by contrast, are generally superior for asymmetrical data transmission. (*Id.*) As the '931 patent explains:

A great advantage of TDD operation is the ability to dynamically allocate the portions of a frame allocated between the downlink and the uplink. This results in an increased efficiency of operation relative to frequency division duplex (FDD) techniques. TDD operations typically may achieve a forty to sixty percent advantage in spectral efficiency over FDD operations under typical conditions.

(EX1001, 14:10-17.) Moreover, the primary thrust of Goldberg is “to achieve a near omnidirectional pattern throughout [the antenna’s] area of coverage.”

(EX1006, 1:12-13; EX2028, ¶151.) It would make no sense for a POSA seeking to develop an efficient protocol for beamforming in a TDD network such as in Vornefeld to turn to a patent focused on omnidirectional broadcasting in FDD such as Goldberg. (EX2028, ¶151.)

C. Ground 3 (Youssefmir + Atsuta) Fails Because Atsuta Does Not Supply the Missing Elements of Claims 28 and 29.

1. Youssefmir Does Not Disclose Claims 1 or 19 and Therefore Does Not Disclose Dependent Claims 28 and 29.

Petitioner’s only ground that includes Youssefmir is Ground 3, Youssefmir in combination with Atsuta. (Petition, 6.) However, Petitioner primarily relies on Youssefmir for claims 1 and 19 (the independent claims from which Challenged Claims 28 and 29 depend), mentioning Atsuta only for a clarifying statement

regarding claim 1[e]. (Petition, 53-62.) However, Youssefmir does not disclose claim 1[d] or 1[e]. (EX2028, ¶158.)

Claim 1[d] recites “wherein said transmit path circuitry transmits, at a start of a TDD frame, a ***broadcast beam signal to wireless access devices within more than one of said sectors***, the broadcast beam signal comprising a start of frame field.” Trying to transform Youssefmir’s disclosure into one that matches claim 1[d], Petitioner argues that Youssefmir’s “starting signal is sent to ‘wireless access devices within more than one of said sectors.’ Youssefmir’s signaling segment and frame marker are sent to all users in the cell site to coordinate timing with the base station. As discussed, the cell site is sectorized such that the transmission to all users would be understood to be across sectors.” (Petition, 59-60 (citing EX1007, Figure 5A).) Not so.

To the contrary, nothing in Youssefmir’s disclosure describes that a broadcast beam signal is sent to more than one sector of the cell. (EX2028, ¶159.) Petitioner even concedes that “Youssefmir does not explicitly state that the different downlink slots D1, D2 would be allocated to user terminals in different sectors.” (Petition, 51.)

Although Youssefmir acknowledges that a base station’s coverage area (e.g., one of the hexagons in Figure 1, below) may be sectorized, it only mentions sectorization to clarify that the definition of “non-directional” and

“omnidirectional” would then be limited to mean non-directional or omnidirectional “within the sector.” (EX2028, ¶¶160-161; EX1007, 9:13–15 (“Non-directional manner, as used herein, refers to not intentionally directing energy towards any particular user or users. In a sectorized system, this means non-directional within the sector.”), 14:13–15 (“In a sectorized system, omnidirectional means substantial omnidirectional within the sector.”).) Youssefmir provides no other discussion about sectors, how sectors may affect its invention, how its invention might incorporate sectors, or about coordination between sectors as required by claim 1[d]. (See EX1007, 9:13–15, 14:13–15.)

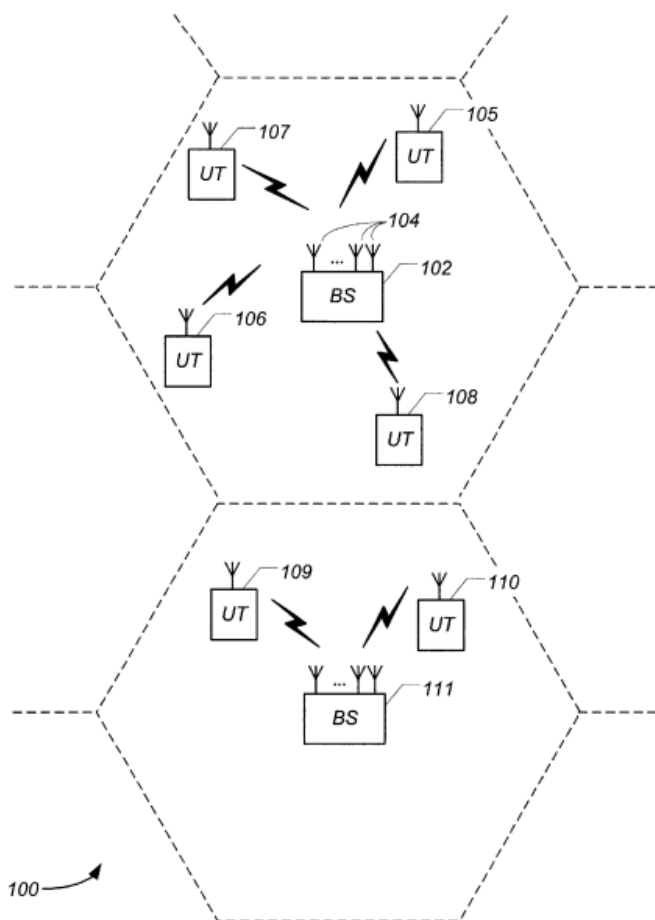


FIG. 1

(EX1007, Figure 1.)

Additionally, claim 1[e] recites “*subsequently transmits*, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices within one of said sectors using one of said directed scanning beam signals.” However, because Youssefmir does not teach a broadcast beam signal satisfying claim 1[d], there is no basis for a subsequent transmission to satisfy claim 1[e]. (EX2028, ¶162.)

For these reasons, Youssefmir does not disclose claim 1. (EX2028, ¶163.)

For essentially the same reasons, it also does not disclose claim 19. (*Id.*)

Petitioner's Ground 3 challenge to Challenged Claims 28 and 29, which depend from claims 1 and 19, respectively, must therefore fail. (*Id.*)

2. Youssefmir in Combination with Atsuta Does Not Disclose the Challenged Claims.

In addition to the limitations of claims 1 and 19, the Challenged Claims recite transmitting “in said *downlink portion* of said *TDD frame*, second downlink data” to devices “*in a second of said sectors* using a second directed scanning beam signal.” Petitioner alleges that the combination of Youssefmir and Atsuta discloses these limitations. Specifically, Petitioner relies on Youssefmir for disclosure of “transmitting downlink data from a base station to multiple remote users within a single TDD frame,” and “mak[ing] clear that the cell site may be sectorized using directional antenna systems.” (Petition, 63). But Petitioner concedes that “Youssefmir does not explicitly disclose that the users assigned to certain downlink timeslots are in different sectors.” (Petition, 63, 66.) In this combination, Petitioner relies on Atsuta to “describe[] transmitting downlink data to subscribers in different sectors within a single TDD frame.” (Petition, 63.)

But this is the same alleged disclosure from Atsuta upon which Petitioner relied in its Ground 1 combination of Atsuta and Vornefeld. Petitioner's Ground 3 combination therefore fails for at least the same reasons as Ground 1. (EX2028,

¶164.) Specifically, as discussed in Section IV.B.1., Atsuta does not disclose either (1) *TDD* or (2) transmitting *downlink* data to subscribers in different sectors in the same downlink portion of the frame as the Challenged Claims recite. (EX2028, ¶¶164-165.)

3. A POSA Would Not Combine Youssefmir with Atsuta.

Petitioner argues that a “POSA would have been motivated to combine Youssefmir and Atsuta for at least the same reasons discussed above with respect to the combination of Vornefeld and Atsuta.” (Petition, 52.) But as discussed in Section IV.B.2., a POSA would not have combined Vornefeld and Atsuta. (EX2028, ¶171.)

Petitioner additionally argues that “Atsuta’s method also allows the signal processing circuitry to be simplified, reducing its size and power consumption.” (Petition, 52.) But as discussed in Section IV.B.2.c., this is not the case at all. Indeed, as explained previously, Atsuta has significant flaws that render it inapplicable to combine with any invention related to beamforming, SDMA or active antenna arrays. (EX2028, ¶167; *see* Section IV.B.2.c.)

Finally, Petitioner argues that the combination of Youssefmir and Atsuta would not change Youssefmir’s function, citing to its expert declaration. (Petition, 52.) In that declaration, Petitioner’s expert argues that “[b]ecause Atsuta merely describes details about frame structures and timeslot data assignments that are

already suggested by Youssefmir’s system, this combination would not result in any difference in function.” (EX1002, ¶ 146.) However, this statement is inaccurate for two reasons. **First**, Youssefmir’s framing discussion is substantially more complex and detailed than Atsuta’s, and involves acknowledgement messages sent in the uplink direction to acknowledge earlier downlink transmissions, as well as acknowledgement messages sent in the downlink direction to acknowledge earlier uplink transmissions. (EX2028, ¶173; EX1007, Figures 3–5.) On the other hand, Atsuta’s framing is trivial, not based on TDD, and is only described for the uplink. (EX1005, Figure 3; EX2028, ¶173.) Therefore, it is not the case that Atsuta merely “describes details...that are already suggested by Youssefmir’s system.” (EX2028, ¶173; *see* EX1002, ¶ 146.) **Second**, as described in Section IV.B.2.c., Atsuta’s “invention” reduces uplink system capacity by a factor of three, and therefore requires three times more bandwidth to compensate. (EX2028, ¶173.) Therefore, applying Atsuta to Youssefmir’s system would absolutely result in a difference in function. (*Id.*)

For these reasons, a POSA would not have been motivated to combine Youssefmir with Atsuta, and so Petitioner’s Ground 3 fails on this additional basis. (EX2028, ¶174.)

C. Grounds 4 and 5 Fail for the Same Reasons as Grounds 1 and 2.

In Grounds 4 and 5, Petitioner adds the Tangemann reference to Grounds 1 (Vornefeld + Atsuta) and 2 (Vornefeld + Goldberg). Petitioner relies on Tangemann because its disclosed “minisectors” allegedly describe “sectors” to mean a “geographic portion of the cell site,” coinciding with Patent Owner’s originally-proposed construction of “sector.” (Petition, 75.) Petitioner’s Grounds 4 and 5 challenges fail for two reasons.

First, none of the deficiencies in Petitioner’s Grounds 1 or 2 are based on a construction of “sector” as a portion of the cell smaller than the coverage area of an antenna. (EX2028, ¶¶179-181.) Petitioner’s Grounds 4 and 5 therefore fail for the same reasons as Grounds 1 and 2. (*Id.*)

Second, as discussed in Section III., the district court has rejected the construction of “sector” allegedly disclosed by Tangemann in favor of a construction meaning “areas defined by an arc around the cell site, each covered by its own antenna,” which “cannot be the area covered by any one directed scanning beam.” (EX2027, 11-12, 18-20; EX2028, ¶178.) Thus, Petitioner’s Grounds 4 and 5 are not needed under the district court’s construction of sector. (EX2028, ¶178.)

V. CONCLUSION

Patent Owner respectfully requests the Board confirm that the Challenged Claims of the ’931 patent are patentable.

Dated: April 17, 2024

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

Under the provisions of 37 C.F.R. § 42.24(d), the undersigned hereby certifies that the Microsoft Office word count for the foregoing Patent Owner's Response under 37 C.F.R. § 42.120, excluding the table of contents, table of authorities, claim listing, certificate of word count, and certificate of service, totals 13,964 words, which is less than the 14,000 words allowed under 37 C.F.R. § 42.24(b)(2).

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CERTIFICATE OF SERVICE

The undersigned certifies that on this 17th day of April, 2024, the foregoing document is being served by e-mail on counsel of record for Petitioner as follows:

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