

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

931 CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS
Petitioner,

v.

GENERAL ACCESS SOLUTIONS, LTD.
Patent Owner.

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

EXHIBIT 2028

DECLARATION OF DOUGLAS A. CHRISSAN, Ph.D.

I, Douglas A. Chrissan, declare as follows:

I. INTRODUCTION

1. I have been retained as a technical expert on behalf of Patent Owner General Access Solutions, Ltd. (“General Access”) for the above-captioned interpartes review (“IPR”). I have been asked to provide my opinions on the technology disclosed in U.S. Patent No. 7,230,931 (“the ’931 Patent”) (Ex. 1001) and on the unpatentability arguments presented in Verizon’s (“Petitioner”) Petition (“Pet.”) alleging that claims 28 and 29 of the ’931 Patent (the “Challenged Claims”) are invalid under 35 U.S.C. § 103.

2. I make this declaration based on my personal knowledge, consideration of the materials I discuss herein, and my expert opinion.

3. I am being paid for my work on this matter on an hourly basis at \$300/hour. My compensation is not contingent on reaching any particular findings or conclusions, or on any particular outcome in this matter. I have no financial interest in the outcome of this matter.

4. In preparing this Declaration, I have reviewed the ’931 Patent, the ’931 Patent’s prosecution history, and considered each of the documents cited herein. I have also read and considered the IPR Petition concerning the ’931 Patent and the exhibits and evidence cited therein as grounds for invalidity, including but not

limited to Exhibits 1001–19, the Patent Owner’s Preliminary Response and related exhibits, 2018–26, Petitioner’s reply to POPR, Patent Owner’s Sur-Reply, and the Board’s Decision Granting Institution of this IPR. Additional documents reviewed are discussed in Section III below.

5. In formulating my opinions, I have also relied upon my experience, education, knowledge and expertise in the area of wireless and mobile communications systems. In reviewing the material relevant to these proceedings, I have considered the viewpoint of a person of ordinary skill in the art in the January–September 2001 timeframe.

II. BACKGROUND AND QUALIFICATIONS

6. The following sections recite the most relevant aspects of my educational, professional, and technical background. A copy of my curriculum vitae, which describes my qualifications in more detail, is attached to this report as Exhibit 2032.

7. I am presently a technical consultant in the areas of communications systems, multimedia systems, computer systems, and digital signal processing. I have spent well over 1000 hours performing source code review of cellular base stations, from several manufacturers, related to a variety of technical topics including physical layer signal processing, remote radio heads and distributed

antennas.

8. I earned a B.S. and M.S. in Electrical Engineering from the University of Southern California in 1988 and 1990, respectively, and a Ph.D. in Electrical Engineering from Stanford University in 1998.

9. From 1993 to 1997, I was a full-time doctoral student at Stanford University. My Ph.D. dissertation and related publications were in the fields of statistical signal processing and communication systems, and more specifically in the area of impulsive noise modeling for low-frequency communication systems. In 1995, I was the instructor for the graduate Statistical Signal Processing class (EE278) in the Electrical Engineering department at Stanford University. Prior to teaching this class, I was a teaching assistant for ten different classes in signal processing and radio frequency electronics at Stanford.

10. I was a Masters Fellow and Member of the Technical Staff at Hughes Aircraft Company in El Segundo, California, from 1988–1993. While at Hughes Aircraft, I designed and developed wireless communication systems for commercial and military spacecraft, including for the MILSTAR satellite program.

11. Between 1992 and 1993, while at Hughes Aircraft Company, I designed and built a state-of-the-art, 800 megabit-per-second (Mbps) telecommunications modem for the NASA Lewis Research Center.

12. From 1997–2003, I worked at 8x8, Inc., starting as a DSP software engineer in 1997, becoming a manager in 1998, a director in 1999, and Vice President of Engineering in 2000 (managing a team of approx. 60 engineers in the company’s microelectronics group). I played a key role in developing several semiconductor products used worldwide in multimedia and communications devices, mainly for video conferencing systems and Internet Protocol (“IP”) telephones. Some of these semiconductor products were in production more than ten years.

13. From 2003–2007, I was a Systems Architect and Engineering Program Manager at Texas Instruments in the Digital Subscriber Line (“DSL”) product business unit. At Texas Instruments, I was directly involved in the architecture, design, development and production of multicarrier DSL modem products. My work specifically included architecting a multicarrier DSL semiconductor and software product and managing all aspects of its development from inception to production. I also gained further experience with IEEE 802.11 (WLAN/WiFi) and WiMAX systems.

14. I have developed, and managed the development of, several successful semiconductor, software and systems products in the communications and multimedia fields. These products are listed in the attached curriculum vitae.

III. BASES OF OPINIONS

15. In the course of performing my analysis and forming my opinions, I have reviewed the Petition for this IPR2023-00978 and its exhibits 1001–1019, Patent Owner’s Preliminary Response (“POPR”) for this IPR2023-00978 and its exhibits 2018–2026, Petitioner’s reply to POPR, Patent Owner’s Sur-Reply, and Decision Granting Institution. I have also considered the claim construction order issued in the co-pending Civil Action No. 2:22-CV-00394-JRG involving the ’931 Patent.

16. Exhibits 1001–1019 and 2018–2026 include:

- U.S. Patent No. 7,230,931 (“the ’931 Patent”) (Ex. 1001) and its file history (Ex. 1012)
- Declaration of Dr. Kevin Almeroth in IPR2023-00978 (Ex. 1002)
- Vornefeld et al., “SDMA Technologies for Wireless ATM,” IEEE Communication Magazine, November 1999 (“Vornefeld”) (Ex. 1004)
- U.S. Patent No. 6,160,800 (“Atsuta”) (Ex. 1005)
- U.S. Patent No. 6,154,661 (“Goldburg”) (Ex. 1006)
- U.S. Patent No. 6,795,409 (“Youssefmir”) (Ex. 1007)
- Michael Tangemann, “Influence of the User Mobility on the Spatial Multiplex Gain of an Adaptive SDMA System,” 5th IEEE International

Symposium on Personal, Indoor and Mobile Radio Communications, Wireless Networks – Catching the Mobile Future, The Hague, Netherlands, 1994 (“Tangemann”) (Ex. 1008)

- IPR2017-01889 (Patent 7,230,931), Paper 43, Final Written Decision (Ex. 1009)
- IPR2017-01889 (Patent 7,230,931), Paper 61, Final Written Decision on Remand (Ex. 1010)

IV. APPLICABLE LEGAL STANDARDS

A. Ordinary Skill in the Art

17. My opinions in this declaration are based on the understandings of a person of ordinary skill in the art—sometimes referred to as an “ordinary artisan” or by the acronyms “POSA” or “POSITA”—as of the time of the invention, which I understand to be the September 5, 2001 filing date of the application leading to the ’931 Patent. I understand that the person of ordinary skill in the art is a hypothetical person who is presumed to have known the art relevant to the Challenged Claims of the ’931 Patent at the time of the invention.

18. I understand that, in assessing the level of skill of a person of ordinary skill in the art, one should consider the type of problems encountered in the art, the prior solutions to those problems found in the prior art references, the rapidity with

which innovations are made, the sophistication of the technology, the level of education of active workers in the field, and one's own experience working with those of skill in the art at the time of the invention.

19. Petitioner submits that a POSITA at the time of the '931 Patent would have a bachelor's degree in computer science, electrical or computer engineering, or a related field, and at least 2 years of work or research experience in digital communications systems, such as wireless communications systems and networks, or equivalent, or a Master's degree in electrical engineering, computer engineering, computer science or similar field. Patent Owner has not offered a different understanding of a POSITA, and the PTAB accepted Petitioner's submission. In my opinion, given the complexity of adaptive beamforming, a POSITA would have a bachelor's degree plus at least three years of work experience. However, for the purposes of the subject IPR proceedings, I accept and use Petitioner's and the PTAB's definition of a POSITA. My opinions are the same under either definition.

20. I was at the time of invention, and am, one of more than ordinary skill in the art through my education, research experience and work experience. As of the date of the invention, I was familiar with the types of problems encountered in mobile communications systems and the rapidity at which innovations were made. I was and am familiar with people having this level of skill in the area of mobile

communication systems.

B. Claim Construction

21. I understand that the Challenged Claims of the '931 Patent in this IPR are generally interpreted according to their ordinary and customary meaning taking into consideration the so-called “intrinsic evidence” of the patent consisting of (1) the claim language; (2) the specification; and (3) the prosecution history.

22. I understand that claim terms may be explicitly defined in the patent specification or they may be implicitly defined through consistent usage in the specification. I also understand that the scope of claim terms may be limited by statements in the specification or prosecution history where the applicant clearly disavows or disclaims subject matter.

23. I understand that claim construction is a matter of law. To the extent the Board has already provided claim construction guidance for claim terms in the '931 Patent, including in earlier IPRs such as IPR 2017-01889 involving this same '931 Patent, I follow that guidance. Furthermore, in a co-pending district court case involving this same '931 Patent, the Court issued a claim construction order on January 12, 2024. Ex. 2027 (2:22-cv-00394-JRG, Doc. 86). I use the claim constructions provided by the Court. I discuss the Court's constructions of specific terms in the Challenged Claims in section VI below.

C. Obviousness

24. Counsel has informed me, and I understand, that an issued patent claim is invalid as obvious if it can be shown that the differences between the patented subject matter and the prior art are such that the subject matter as a whole would have been obvious, at the time the invention was made, to a person having ordinary skill in the art. Relevant considerations include the level of ordinary skill in the art; the scope and content of the prior art; differences between the prior art and the claims at issue; and the objective indicia, or secondary considerations, of nonobviousness.

25. In this regard, I am informed and I understand that the secondary considerations of nonobviousness could include factors such as commercial success, long felt but unresolved needs, the failure of others, skepticism by experts, praise by others, award and accolades, and copying.

26. Counsel has informed me, and I understand, that in order to evaluate the obviousness of any claim of the '931 Patent over a given prior art combination, I should analyze whether the prior art references, included collectively in the combination, disclose each and every element of the allegedly invalid claim as those references are read by the person of ordinary skill in the art at the time of the invention.

27. Counsel has informed me, and I understand, that even where all of the

claim limitations are expressly disclosed in the prior art references, there must be some showing that a person of ordinary skill in the art would have been motivated to combine such prior art references, and explanation of how the combination would be achieved, and that there would have been a reasonable expectation of successfully achieving the claimed invention from such combination.

28. Counsel has informed me, and I understand, that absent some additional reasoning, mere routine optimization for a person of ordinary skill in the art to arrive at the claimed invention through combination of prior art references is insufficient to support a conclusion of obviousness.

29. Counsel has informed me, and I understand, that to rely on a reference it must be analogous prior art. Counsel has informed me and I understand that a reference is considered analogous prior art: (1) if the reference is from the same field of endeavor as the claimed subject matter, or (2) if the reference “is reasonably pertinent to the particular problem with which the inventor is involved,” even though the reference is not within the field of the inventor’s endeavor.

30. Counsel has informed me, and I understand, in considering the obviousness of a claimed invention, one should not view the invention and the prior art with the benefit of hindsight. In an obviousness analysis, one must be aware of the distortion caused by hindsight bias and must be cautious of arguments reliant

upon ex post reasoning. Counsel has instructed me and I understand that when considering obviousness, I should not consider what is known today or what was learned from the asserted patents. Instead, obviousness is assessed by the person of ordinary skill in the art at the time the invention was made.

31. In this regard, I am informed and I understand that the '931 Patent may not be used as a guide to select and understand the prior art, because such an approach, at a minimum, discounts the value of combining various existing features or principles in a new way so as to achieve a new result.

32. Counsel has informed me, and I understand, that obviousness cannot be predicated on what was unknown at the time of the invention, even if the inherency of a certain feature is later established. Counsel has also informed me, and I understand, that unknown properties of the prior art may not be relied upon to provide the rationale for modifying or combining the prior art to reach the claimed subject matter.

33. Counsel has informed me, and I understand, that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant of the '931 Patent.

V. OVERVIEW OF THE '931 PATENT

34. I generally agree with Section II (“Background”) from the POPR, including Sections II.A (“The ’931 Patent”), II.A.3 (“Time Division Duplexing”), II.A.4 (“Beamforming”), II.A.5 (“The Teachings of the ’931 Patent”) and II.A.6 (“Challenged Claims 28 and 29”). Therefore, some of this technical overview section is reproduced from Section II of the POPR, with minor edits.

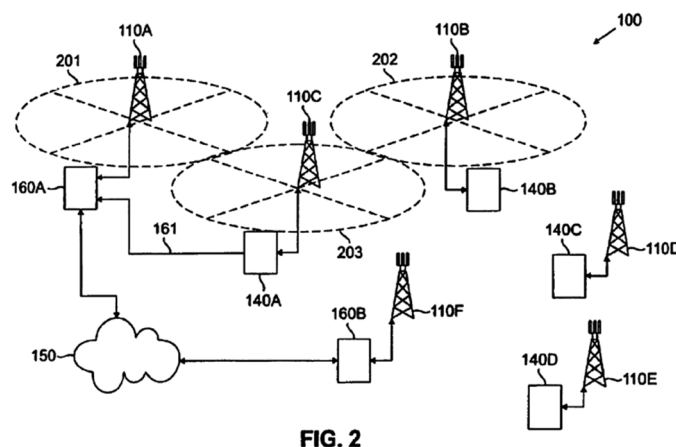
A. The ’931 Patent

35. 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”). Challenged Claims 28 and 29 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.

B. Cellular Base Stations

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

networks, each base station is equipped with multiple antennas, with each antenna (typically a panel containing multiple antenna elements) covering its own “sector” of the cell. In such an arrangement, each antenna transmits to, and receives transmissions from, wireless devices in its sector of the cell. Figure 2 of the ’931 patent, reproduced below, 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.



C. Smartphones Drive Demand for Downlink Data Transmissions

37. When mobile phones became prevalent in the 1990s, they were used to make voice calls away from traditional, wired “landlines.” But with the widespread adoption of “smartphones,” beginning with Apple’s iPhone in 2007, the transmission of data took on increased importance. 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. With this shift in how consumers used their mobile

phones, the demand for data on wireless cellular networks grew exponentially. In the five-year period from 2016-2021, for example, mobile data traffic increased 17-fold. *See* Ex. 2018 (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.

D. Time Division Duplexing

38. Cellular wireless networks must be able to communicate bi-directionally with wireless devices. 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. However, downlink and uplink transmissions can interfere with one another, requiring the use of a duplexing protocol. There are two main approaches to manage bi-directional communications in cellular wireless networks: Frequency Division Duplexing (“FDD”) and Time Division Duplexing (“TDD”). Ex. 1001, 5:62–64.

39. In the late 1990s and early 2000s, FDD was the dominant approach employed in the marketplace. *See* Ex. 2031, 2 (which states, regarding LTE deployments as of 2012, that “in the US FDD-LTE has so far been the mode of choice”).

40. In FDD, downlink and uplink transmissions are each made using separate, dedicated frequencies or “channels.” Ex. 1001 at 5:64–66. Interference between the downlink and uplink transmissions is avoided by spacing (i.e., separating) the downlink and uplink frequencies. Ex. 1001 at 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 much less efficient in modern cellular networks, which are focused on data transmission. Most smartphone users typically demand much more downlink data transmissions than uplink. *Id.* at 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. In FDD, such a request can leave the channel dedicated to uplink transmissions largely unused.

41. 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. *Id.* at 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 or more time slots to downlink or uplink transmissions. *Id.* at 14:10–14.

42. In TDD, downlink and uplink transmissions are organized into “TDD

frames.” *Id.* at 14:10–16:3. The portion of Figure 3 of the ’931 Patent excerpted below provides an exemplary illustration of a TDD frame, showing a downlink portion followed by an uplink portion.

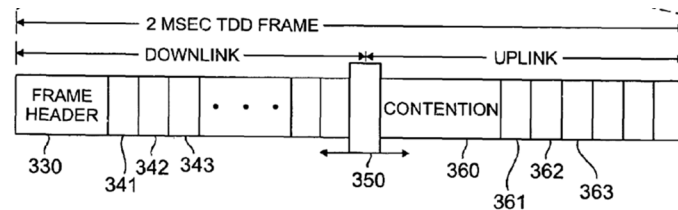


FIG. 3

43. I note that TDD is a different concept than Time Division Multiple Access (TDMA). Again, TDD is a method of bi-directional communication between a base station and mobile devices. TDMA, by contrast is a multiplexing scheme used to support communications with multiple wireless devices. In a TDMA system, subscribers share a frequency channel but separate time slots are allocated to different users. *Id.* at 5:40–42. However, TDMA does not imply TDD. For example, wireless communications systems can employ TDMA but with FDD rather than TDD.¹ In fact, as discussed above, FDD was much more commonly used in cellular wireless systems prior to the ’931 patent. Furthermore, TDD does not necessarily 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

¹ See, e.g., Ex. 2022, p. 7 of 13 (Table 8.1 shows systems with various multiple access techniques).

(i.e., no “multiple access”) or to use another known multiplexing scheme such as Code Division Multiple Access (“CDMA”) or Orthogonal Frequency Division Multiple Access (“OFDMA”).

44. As explained in a treatise expressly incorporated by reference into the ’931 patent (see Ex. 1001 at 6:23-31), Time Division Multiple Access (“TDMA”) systems use “*either* FDD or TDD,” which are “called TDMA/FDD or TDMA/TDD access systems.” Ex. 2022 (Rappaport) at p. 6 of 13 (native p. 397).

E. Beamforming

45. The ’931 Patent describes:

A beam-forming network is a series of antenna elements combined with a delay-weight network that combines the RF energy of a wave front incident on the antenna elements. This enhances gain in a given direction or steers a null in a specific direction. A beam-forming system consisting of N antenna elements is generally arranged in a line or in a rectangular array. The N element array can theoretically steer N–1 nulls.

Ex. 1001, 26:10–17. Beamforming is used to transmit “directed scanning beam signals in a sector of a cell site.” *Id.* at Abstract. The ’931 Patent also describes the benefits of beamforming:

The present invention applies beam forming in the transmit and receive paths of wireless access network 100 for a number of reasons, including greatly improved to carrier to-interference

ratio, which allows frequency reuse patterns that require less spectrum, two to four times the amount of spatial reuse using multiple simultaneous beams, and increased cell radius, particularly for the band where the uplink from the subscriber to the base can use higher receive gain to overcome uplink loss problems.

Ex. 1001, 25:29–37.

46. To create beamformed signals, antenna arrays with multiple antenna elements arranged in a line or rectangular grid are used. *Id.* at 26:10–16. By delay-weighting 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. *Id.*, 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 minimizing 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. Figure 9 of the ’931 Patent, reproduced below, and its associated text, explain techniques that can be used to create beamformed signals.

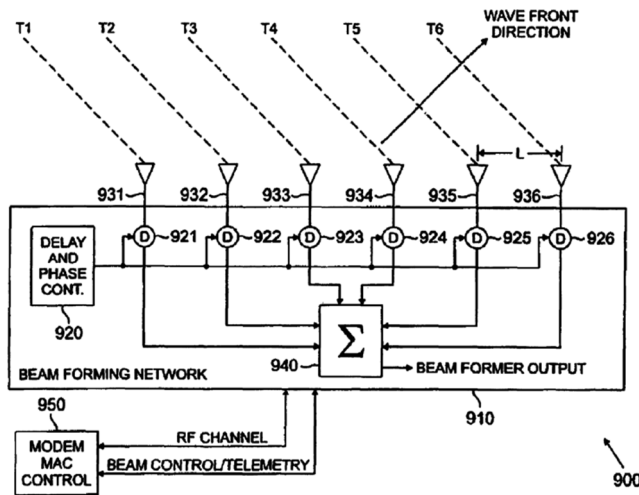


FIG. 9

Ex. 1001, Fig. 9.

F. Teachings of the '931 Patent

47. 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. *Id.*, 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. *Id.*, 16:20–34, 25:63–26:2.

48. 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. The patent further explains

that this interference problem extends across adjacent sectors (and even cells) of the network. *Id.*, 16:20-38.

49. For example, the patent explains that “antennas for different sectors in the same cell site are mounted on the same tower and are located only a few feet apart,” and that 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. *Id.*, 16:13–19. The patent goes on to explain that it is therefore critical that all downlink transmissions included 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 ensur[ing] 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.

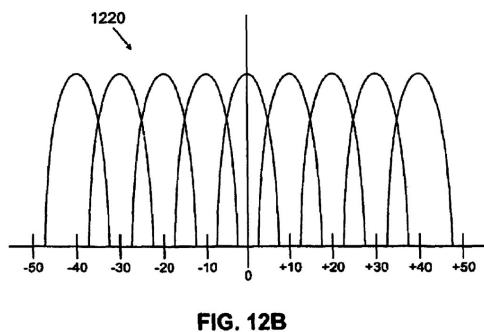
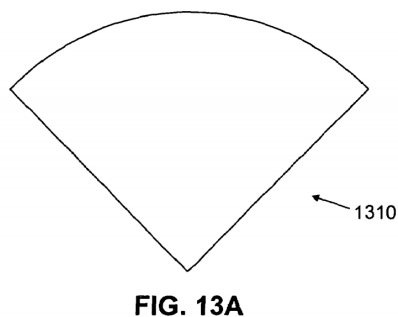
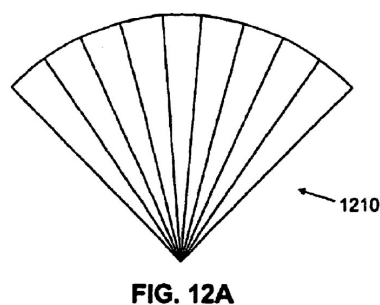
50. Beamforming can significantly improve the quality of signals received by wireless devices, but also introduces new challenges not experienced by systems that transmit omnidirectionally. For example, “[b]eam forming and advanced antennas change the basic paradigm that all subscribers have the capability of simultaneously receiving broadcast information from the base station.” *Id.*, 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. In other words, while communications with the specific wireless devices being served by a beamformed signal can be significantly improved, beamforming can create latency and actually slow down a wireless network; if only one beam is formed at a time, other users may experience communication gaps before the base station forms a beam in their direction. 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.

51. 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 transmit, 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. *Id.*, 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

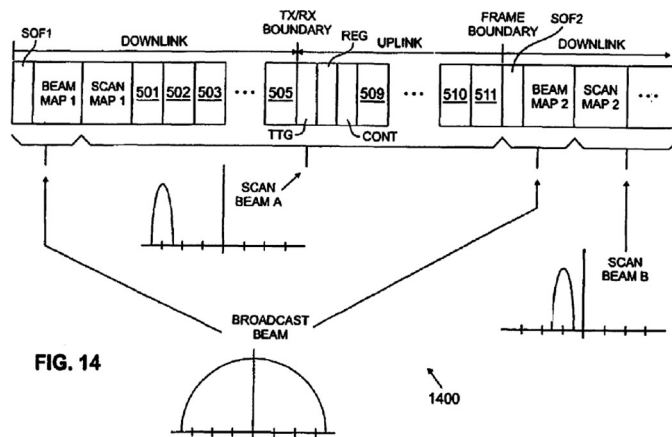
beam signal may also optionally transmit a variety of additional control information to enable the wireless devices to acquire the appropriate beamformed signal and decode subsequent downlink transmissions from the base station. After the broadcast beam signal is transmitted, directed scanning beams are used to transmit downlink data to wireless devices located in two or more sectors of the cell site. *Id.*, 25:61–26:2; 33:1–34:6.

52. Figures 12A, 12B and 13A of the '931 Patent, reproduced below, depict a simple example in which a “broadcast beam” is transmitted to a 90-degree portion of a cell site, and nine beamformed “directed scanning beams” are subsequently transmitted to smaller 10-degree portions of that area:



Id. at Fig. 12A, 12B, 13A. FIG. 12A illustrates an exemplary beam scanning pattern according to one embodiment of the present invention; FIG. 12B represents the spatial response of the transmit and receive scanning beams in the exemplary beam scanning pattern in FIG. 12A; FIG. 13A illustrates an exemplary broadcast pattern. *Id.* at 11:30–36.

53. Figure 14 of the '931 Patent illustrates an example of a TDD frame in accordance with the teachings of the patent. As shown in Figure 14, reproduced below, 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.



Id., Fig. 14.

54. 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. 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.” *Id.*, 25:63–26:2.

G. Challenged claims 28 and 29

55. Claim 28 is a dependent claim of claim 1. Claims 1 and 28 recite as follows:

1. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access network, a transceiver associated with a first of said plurality of base stations comprising:

transmit path circuitry associated with a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site associated with said first base station, wherein said transmit path circuitry

transmits, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of said sectors, the broadcast beam signal comprising a start of frame field, and

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.

28. The transceiver as set forth in claim 1 wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals.

56. Claim 29 is a dependent claim of claim 19. Claims 19 and 29 recite as follows:

19. For use in a wireless access network comprising a plurality of base stations, each of said plurality of base stations capable of bidirectional time division duplex (TDD) communication with wireless access devices disposed at a plurality of subscriber premises in an associated cell site of said wireless access

network, a method of communicating with a first of said plurality of base stations comprising the steps of:

transmitting, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of a plurality of sectors within said associated cell site, the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and

transmitting, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices in a first of said sectors using a first directed scanning beam signal.

29. The method as set forth in claim 19, further comprising:

transmitting, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices in a second of said sectors using a second directed scanning beam signal.

57. 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. 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.” *Id.*, 30:44–52; 32:24–34. The “directed scanning beam signals” are focused transmissions made using beamforming techniques. *Id.*, 9:23–34.

58. Unlike claims 1 and 19, which were surrendered in a prior IPR,² Challenged Claims 28 and 29 add a requirement that the base station also transmits—in addition to the first directed scanning beam signal required by Claims 1 and 19—“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. I understand that Petitioner has conceded in related litigation that the correct meaning of this language is “*in the same downlink portion of the same TDD frame.*” Ex. 2019, Defs.’ Corrected P.R. 4-2 Disclosure, Ex. A at 4.

59. In sum, Claims 28 and 29 require the use of a single, common TDD

² I understand that the prior IPR was conducted under the former “broadest reasonable construction” standard, which is no longer applicable.

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* Ex. 1009, IPR Final Written Decision at 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.”).

60. As discussed in the ’931 Patent, “timing of the downlink and uplink portions of each TDD frame must be precisely aligned in order to avoid interference” *Id.*, 16:4–8. To address this issue, the invention “determines the length of the longest downlink transmission and ensures that none of the uplink transmissions begin, and none of the base station receivers begin to receive, until after the longest downlink is completed.” *Id.*, 16:23–27.

61. As stated above in Paragraph 45, the ’931 Patent describes one of the benefits of the claimed coordinated and interference-avoiding beamforming as “two to four times the amount of spatial reuse using multiple simultaneous beams.” *Id.*, 25:29–37. The ’931 Patent also describes:

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.

Ex. 1001, 25:63–26:2 (emphasis added). These passages and others make it clear that the ability to allow multiple downlink data transmissions at the same time is one of the key benefits of the '931 Patent. A POSITA would thus understand that the language of claim 28 (“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”) and of claim 29 (“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”) embraces situations where multiple downlink transmissions occur at precisely the same time (or overlapping in time) and that they would not necessarily be limited to different slots within the a larger downlink portion of the claimed TDD frame. *Id.*; *see also id.* at 25:29–26:9, 33:4–34:6 (claims 28 & 29). As such, a POSITA would be discouraged from following the path set out in any prior art reference that *precludes* the ability to perform multiple downlink transmissions in the same time slot within a downlink portion of a TDD frame. As per Paragraph 33 above in Section IV.C

(“Obviousness”), such a reference would be said to teach away from claims 28 and 29.

VI. CLAIM CONSTRUCTION OF '931 PATENT CLAIM TERMS

A. “wireless access network,” “wireless access devices,” “subscriber premises,” “sector[s],” “start of frame field” and “in said downlink portion of said TDD frame”

62. The United States District Court for the Eastern District of Texas Marshall Division has construed the following terms of the '931 Patent:

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.
“sector[s]”	Sectors are “areas defined by an arc around the cell site, each covered by its own antenna.” As a further clarification, a “sector” cannot be the area covered by any one directed scanning beam. As shown in Figures 12–14, “directed scanning beams” are beamformed <i>within</i> sectors, whereas broadcast beams cover the whole sector for synchronization purposes.
“start of frame field”	“a field used to indicate the start of a frame.”

Term	Court's Construction
"in said downlink portion of said TDD frame"	"in the same downlink portion of the same TDD frame"

Ex. 2027 (2:22-cv-00394-JRG, Doc. 86). I use these constructions in my analysis.

63. 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." Ex. 2027, pp. 11-12, 18-20. In so ruling, the 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.

Ex. 2027, p. 16.

64. I note that the Court's construction of "sector" is more limiting than Patent Owner's proposed construction, which was "a portion of the geographic area around the cell site." Since Petitioner and Petitioner's expert Dr. Almeroth use Patent

Owner's proposed construction for much of their analysis, that analysis must be revisited. I address their analysis herein.

65. Even under Patent Owner's proposed construction of "sector," it is my opinion that the prior art combinations asserted by Petitioner in this IPR do not teach or disclose the Challenged Claims 28 and 29. It is also my opinion that those combinations do not teach or disclose the Challenged Claims any more than Vornefeld alone, and both the Board and the Federal Circuit have previously determined that Vornefeld does not render claims 28 and 29 invalid (see Section VII.B below). That said, given the Court's recent construction of "sector," my analysis and opinion become even stronger. I provide further details in later sections, but at a high level: 1) Vornefeld, Goldberg and Youssefmir discuss sectors only minimally, and do not teach or disclose a broadcast beam signal to more than one sector³, interference at sector borders, or a need to coordinate between sectors; 2) Atsuta also does not teach or disclose a broadcast beam signal at all, or anything about interference at sector borders, or anything about TDD, antenna arrays or beamforming, and in fact teaches using different frequencies for different sectors; 3) Tangemann does not discuss sectors at all, but only "minisectors," which correspond

³ Notwithstanding the proceedings of IPR2017-01889, in my opinion, under the Court's recent construction of "sector," Vornefeld also does not teach or disclose transmitting the same broadcast signal to a plurality of sectors at the same time.

to directed scanning beams and do not qualify as sectors under the Court’s construction.

66. In addition, I note 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. As discussed above in Paragraph 61, it is my opinion that the Challenged Claims *include* simultaneous transmission (which in the context of the Challenged Claims could mean multiple beamformed transmissions of downlink data during one or more of the same time slots included in the downlink portion of the claimed common TDD frame), not that the Challenged Claims must necessarily be *limited to* simultaneous transmission. Although I discusses simultaneity as a goal of Vornefeld⁴ and not Atusta with respect to a POSITA’s lack of a motivation to combine the two references, I do not address a construction limiting the Challenged Claims “to the simultaneous transmission of signals” because none of my analyses turn on whether the Claims 28 or 29 require “simultaneous” transmissions.

B. “transmits/transmitting in said downlink portion of said TDD frame”

67. Claim 28 is a dependent claim of claim 1. Claim 1 includes the phrase

⁴ I note that, as discussed more fully below, Vornefeld discusses the objective of using multiple “simultaneous” beams but does not disclose scheduling all downlink data transmissions in the same downlink portion of the same TDD frame.

“transmitting, in a downlink portion of said TDD frame, first downlink data traffic to substantially only wireless access devices in a first of said sectors using a first directed Scanning beam signal” and claim 28 includes the phrase “transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within another of said sectors using another of said directed scanning beam signals.” Independent claim 19 and its dependent claim 29 have similar language, and my opinion applies equally for those claims.

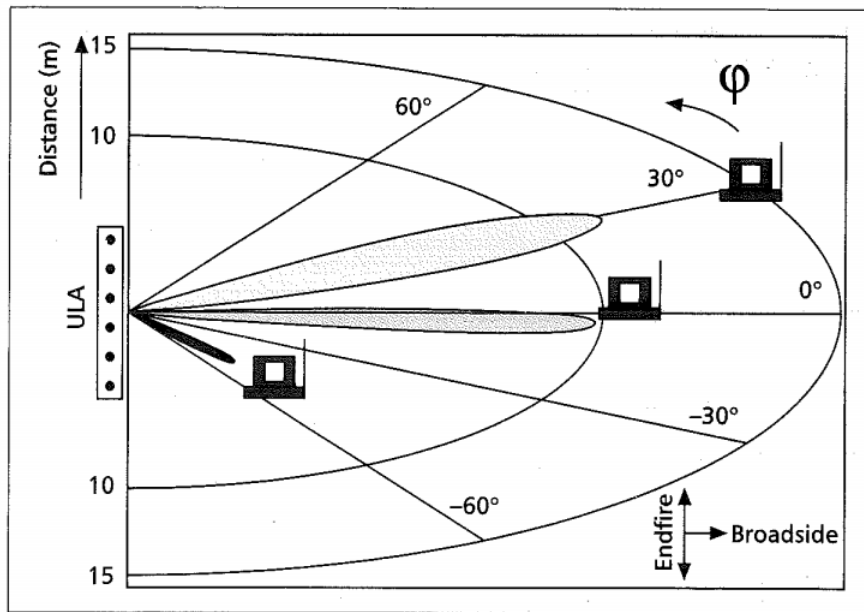
68. The Court has construed “in said downlink portion of said TDD frame” to mean “in the same downlink portion of the same TDD frame,” as described above. However, the Board noted in its institution decision that there may be a dispute over whether claims 28 and 29 require the first and second data transmissions to be simultaneous. Paper 20, pp. 30–32. For the reasons I describe in Sections V.E–V.G above, the scope of Claims 28 and 29 include (but do not necessarily require) simultaneous transmissions. Ex. 1001, 25:29–26:9, 33:4–34:6 (claims 28 & 29). As such, any prior art reference that *precludes* the ability to perform simultaneous transmission teaches away from claims 28 and 29. A POSITA would not find such a reference relevant or applicable to beamforming, or to space-division multiple access (“SDMA”), or to claims 28 and 29.

VII. THE ASSERTED PRIOR ART

A. Vornefeld (Ex. 1005)

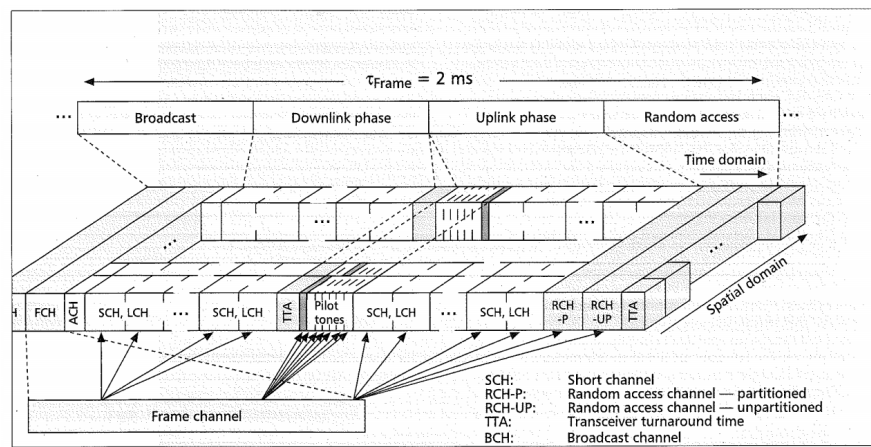
69. The Vornefeld reference, “SDMA Techniques for Wireless ATM” by Ulrich Vornefeld et. al., is a paper published in the November 1999 edition of the IEEE Communications magazine. Ex. 1004. It describes the use of space-division multiple access (SDMA) and beamforming within a single sector. *Id.*, p. 52, Fig. 2. Much has been written about Vornefeld in the papers of IPR2017-01889, which challenged the same '931 Patent as this IPR. *See* Ex. 1009, 1010, 1011, 1014, 1015. Therefore, I discuss only its most relevant points for this IPR herein.

70. Vornefeld is substantially described by its Figures 2 and 3, reproduced below:



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

Ex. 1004, Figure 2;



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

Ex. 1004, Figure 3. In Figure 2, a uniform linear array (ULA) antenna is used to transmit multiple antenna beams (e.g., the three shown), which can each be electronically directed to specific mobile terminal (MT) locations. *Id.*, p. 52 (“The Spatial Dimension” section). Doing so leads to an increase in capacity and reduces signal interference. *Id.* For phased array antennas, beamforming is performed at the RF level by controlling the amplitudes and phases of the feeding currents via attenuators and phase shifters. *Id.* Smart antennas form their beams in the baseband, that is, the feeding currents of the sensor elements are directly proportional to the modulated baseband signals. *Id.* 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.

71. Vornefeld does not use the word “sectors” at all, and only once even

implies the possible existence of more than one sector: it states 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. Ex. 1004 at p. 52 (middle of second column: “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).”).

72. Unlike the '931 patent, Vornefeld provides no teaching of any need to coordinate the timing of downlink and uplink transmissions in such an arrangement. *See* Ex. 1001, 16:13-19. Nor does it disclose how to organize beamformed transmissions to multiple sectors of the cell.

73. The district court construed “sectors,” as “areas defined by an arc around the cell site, each covered by its own antenna.” Ex. 2027 (2:22-cv-00394-JRG, Doc. 86), p. 18. In Vornefeld, each ULA is an antenna. 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.” Therefore, in Vornefeld’s Figure 2, the entire span from -90 degrees to 90 degrees could be considered to represent one sector in a two sector site. Alternatively, the span from

-60 degrees to 60 degrees could represent one sector in a three sector site. The one sector would encompass the three directed beams shown (or “directive beams” as per the Figure 2 caption). 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). 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.

74. Vornefeld does not teach or disclose any needs or issues regarding radio operation or interference at sector boundaries. To the extent one were to surmise that Vornefeld even hypothesizes such a problem, Vornefeld in fact provides its own solution... use beamforming, and use 120 degree ULAs instead of 180 degree ULAs so that the transmitted RF beams can be remain narrow enough. Ex. 1004 at p. 52. Vornefeld only discusses SDMA and beamforming within a single sector. *Id.*, pp. 52–57. This is emphasized by Vornefeld’s performance analysis, which uses a single ULA (i.e., sector). *Id.*, pp. 56–57 (“Performance Analysis”).

B. Vornefeld Does Not Teach or Disclose the Challenged Claims

75. Both the Patent Trial and Appeal Board *and* the U.S. Court of Appeals for the Federal Circuit ruled that Vornefeld does not teach or disclose the

claims at issue in the present IPR. Ex. 1009, pp. 22–24; Ex. 1010, p. 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.* I agree with their rulings.

C. Atsuta (Ex. 1005)

76. 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.

77. Atsuta is directed to a TDMA method and TDMA receiving apparatus, and has a priority date Sept 9, 1996. Ex. 1005, p. 1. Its 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.

Id. at 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.* Atsuta discloses a basic, conventional TDMA method for organizing non-beamformed uplink communications from wireless devices to base stations in cellular wireless networks.

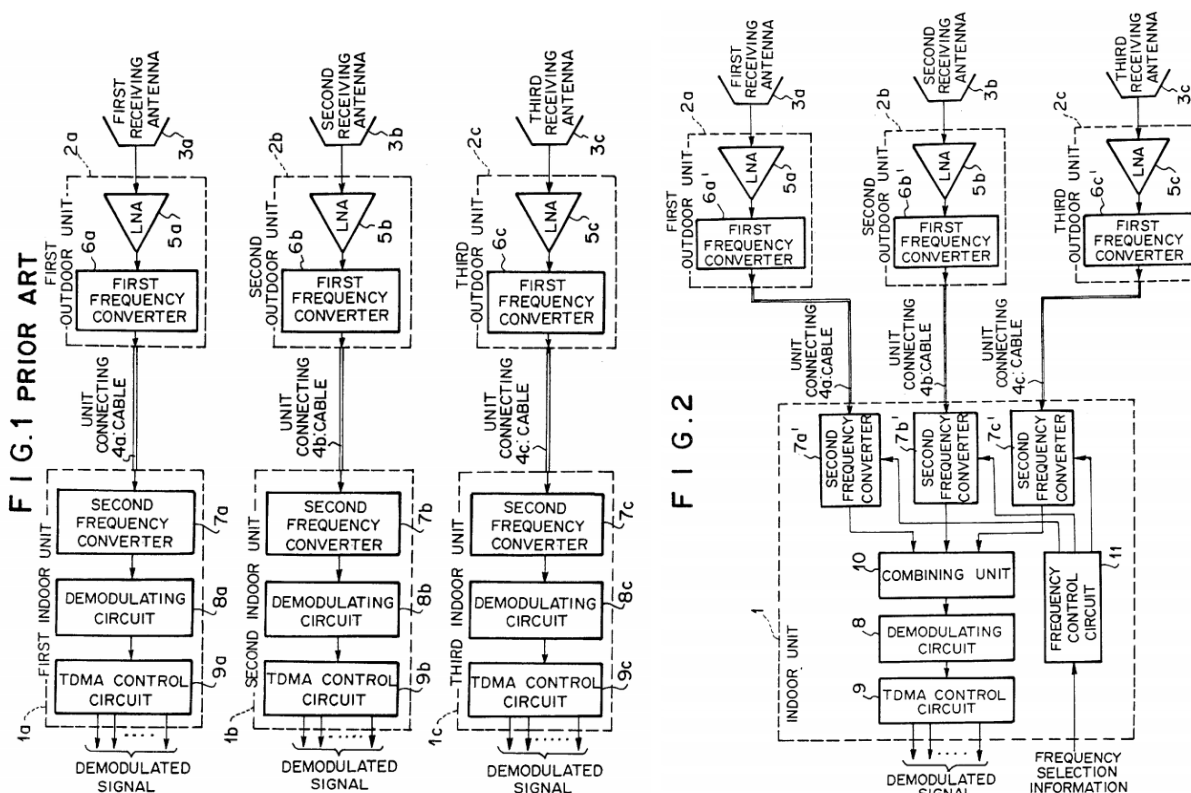
78. Atsuta teaches that uplink signals from each wireless device to the base station must be put in a separate portion of a TDMA frame, so they are each transmitted in a separate time slot so they "do not overlap." Ex. 1005, 3:67-4:1, 5:36-39, 5:62.

79. Atsuta does not teach or suggest time division duplex (TDD) anywhere. As I discuss in Section V.D, TDD (which provides a means for bidirectional communication) is not the same as TDMA (which provides a means for multiplexing).

80. Atsuta has no concept of beamforming or of different mobile stations

(“MSs”) 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). Atsuta also does not teach or suggest 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.

81. Atsuta’s invention is most easily seen by comparing Atsuta’s Figure 2 versus Figure 1, both reproduced below:



Ex. 1005, Figures 1 and 2. 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. A POSITA would presume that three sector zones collectively provide 360 degrees of coverage around a base station site. The three sector zones are serviced by the three indoor units, three outdoor units and three antennas. All MSs 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 reproduced above. There is no concept of the antennas having multiple antenna elements to support beamforming capability. Nor is there any teaching directed to the coordination of beamformed transmission, either *within* a single sector, or across multiple sectors.

82. 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. Atsuta has no concept of an antenna array, beamforming, or spatial division multiplexing of a plurality of phones within a single sector.

83. Comparing Figure 2 to Figure 1, Atsuta's invention from a hardware perspective is to time share one "Demodulating Circuit" (8) and one "TDMA control circuit" (9) among the three previously independent transceivers a, b, and c. On the surface, this may look beneficial, but as I describe in Section VII.F below, a POSITA would in fact recognize that the associated tradeoff costs make it impractical.

84. In addition, as per its Abstract reproduced above, Atsuta's invention is about uplink reception at the base station. *Id.* at Abstract. Figs. 1, 2, 3 and 5 and

related discussions are all related to uplink operation; Downlink operation is only described minimally in Figure 4 and its associated text at column 6, lines 24–57, and in the last claim 11. *Id.*, *passim*. Petitioner and Petitioner’s expert use Fig. 3 to discuss downlink operation, but Atsuta does not state or imply that Fig. 3 applies to downlink. *See, e.g.*, Ex. 1002, ¶¶ 88, 106, 108 (with cites to Ex. 1005, Fig. 3, implying it is describing the downlink); *see also* Ex. 1005 at 5:17–30 (explaining Fig. 3).

85. Lastly, even if Atsuta’s general concept were to be applied to the downlink, it is clear from Atsuta’s Fig. 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 (see Sections VII.D and VII.F below, including reproductions of Fig. 3). This fact teaches away from the claimed interference-reducing aspects of beamforming and SDMA.

86. For the reasons above, and as also discussed in Sections VII.D and VII.F below, Atsuta teaches away from the Challenged Claims 28 and 29.

D. Atsuta Does not Teach or Disclose Any Aspect of Challenged Claims 28 and 29.

87. In my opinion, for the reasons discussed in Section VII.C above, Atsuta does not teach any aspect of the Challenged Claims 28 and 29. Furthermore, a POSITA would not look to use it or combine it with any other cited reference. I now

discuss my opinions further, especially in light of Petitioner's and Petitioner's expert's arguments.

88. 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**. Claims 28 and 29 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, and 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.

89. Atsuta does not teach or describe TDD (time division duplexing). The '931 Patent explains "[i]n 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." Ex. 1001 at 6:2–5; *see also* POPR § II.A.3 ("Time Division Duplexing"), incorporated herein. In the '931 Patent, downlink and uplink transmissions are then organized into "TDD frames." *Id.*, 14:10–16:3. The portion of Figure 3 of the '931 patent excerpted below provides an exemplary illustration of a TDD frame, showing a downlink portion followed by

an uplink portion.

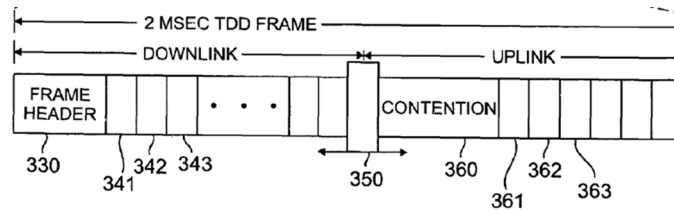


FIG. 3

90. However, Atsuta does not mention or describe “TDD,” or any frequency reuse between uplink and downlink (i.e. “single channel”), or time division of uplink and downlink.

91. Instead, Petitioner admits that “Atsuta is directed to TDMA frame-based communication between a base station and subscribers.” Petition, p. 24. A POSITA would understand that TDD is a different concept than TDMA (as explained in Section V.D above), such that Atsuta’s use of TDMA does not disclose transmitting “in said downlink portion of said *TDD frame*,” as Claims 28 and 29 recite.

92. When describing how to allocate time slots, Atsuta only describes allocation between subscribers or uplink transmission requests as in TDMA, and not between uplink and *downlink transmission* as required for TDD (and thus for Claims 28 and 29). Ex. 1005, 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.”).

93. When discussing the benefits of its invention, Atsuta 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). Ex. 1005, 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 reasons, a POSITA would understand that Atsuta does not teach or suggest TDD.

94. In a TDMA system like Atsuta’s, subscribers share a frequency channel but allocate spans of time to different users. Ex. 1005 5:39–43. TDD allocates slots between downlink and uplink transmissions, while TDMA allocates slots between different users.

95. A POSITA would know that TDMA does not imply TDD. For example,

a system that employs TDMA may employ FDD to the exclusion of TDD. *See* Ex. 2022, p. 7 of 13 (native p. 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)). 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”) or to use another known multiplexing scheme such as Code Division Multiple Access (“CDMA”) or Orthogonal Frequency Division Multiple Access (“OFDMA”).

96. Atsuta does not teach or describe beamforming. As discussed above, every mobile station in a sector communicates with the one base station receive antenna for that sector. Atsuta has no concept of an antenna array, beamforming, or spatial division multiplexing of a plurality of phones within a single sector. As such, Atsuta does not teach or suggest any aspect of the ’931 Patent’s claims 28 and 29, and a POSITA would not look to use it or combine it with any other cited reference.

97. To whatever extent Atsuta describes multiple transmissions in a TDMA frame—a concept known before Atsuta—Atsuta still does not teach any of the key aspects of the ’931 Patent’s claims 28 and 29: beamforming, TDD, “broadcast beam signal,” “directed scanning beam signals” and “another of said directed scanning

beam signals.” As such, Atsuta does not teach any element of claims 1, 19, 28 and 29 (reproduced in Section V.G above), including the language specifically added by dependent claims 28 and 29.

98. Regarding a “broadcast beam signal,” Petitioner’s expert opines “Atsuta generalizes the opening broadcast portion as ‘added bits,’” referring to the “added bits” shown in Atsuta’s Fig. 3, reproduced in Paragraph 102 below. Ex. 1002, ¶ 94. However, Atsuta provides no description of what these added bits are, or their format, or that they are broadcast. Given that Fig. 3 is an uplink diagram (see Paragraph 84 above), the “added bits” would in fact originate at a mobile station and would not be broadcast.

99. Petitioner claims that a POSITA would have understood that Atsuta’s explicitly-described TDMA frames are actually TDD frames. *See* Petition, 31–32. 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 Ex. 1005, 5:65-6:12). In my opinion, Petitioner’s assertions are

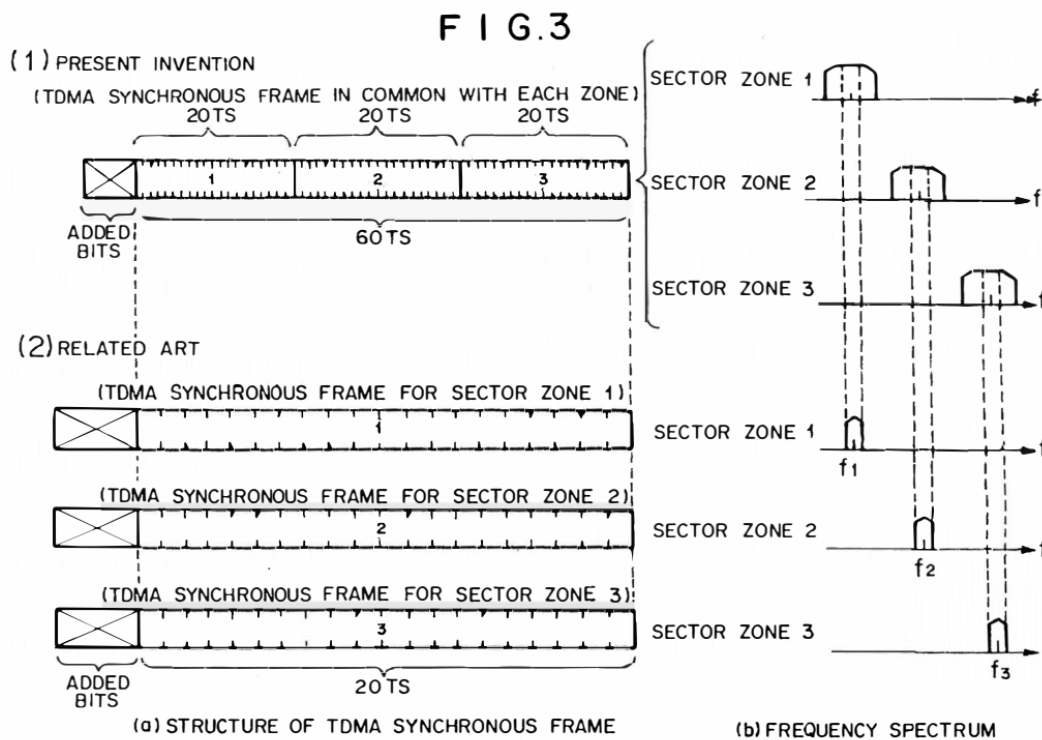
incorrect, for multiple reasons described below.

100. Petitioner asserts that “Atsuta describes a ‘single synchronous frame.’” The term “single synchronous frame” is presented as a quote in Atsuta by both the Petition and Petitioner’s expert declaration, but in fact appears nowhere in Atsuta.

101. Furthermore, even if a POSITA were to hypothesize that Atsuta teaches a “single synchronous frame,” the POSITA would interpret it 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. Atsuta provides only a cursory overview of downlink hardware, in Fig. 4 and at column 6, lines 24–57, and this overview does not disclose any format or detail of a synchronous frame, let alone a “single synchronous frame” shared with the uplink.

102. In Atsuta’s invention, as shown in Figures 3(a) and 3(b), copied 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.” Ex. 1005, 5:46-49. 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 that that of the conventional frame are required.” Ex. 1005, 5:51-54.



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,” and citing Ex. 1005, 5:65-6:12 for support. *See* Ex. 1002, ¶ 105. However, these reasons—either individually or collectively—do not imply TDD. Atsuta’s passage at 5:65-6:12 in fact references only FDD, as explained next.

104. Atsuta recognizes that its invention is wasteful of spectrum (requiring

three times more bandwidth for each of the three sector zones, as discussed in Paragraph 102 above), so at 5:65-6:12, Atsuta attempts to provide a use case where such a waste of uplink spectrum might still be acceptable. The use case provided is a video distribution system (analogous to cable TV, or “CATV”), wherein the downlink data requirement is “much larger” than the uplink data requirement. Ex. 1005, 5:65-6:12. Atsuta states, for this use case,

“Thus, 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.”

Id., 6:6–12. Atsuta describes that the uplink frequency band is “small,” which a POSITA recognizes to mean “small” relative to the larger downlink frequency band, because of the asymmetric data rates. Atsuta is saying that if the uplink frequency band is already “small” relative to the downlink frequency band, then maybe it would be acceptable to expand the uplink frequency band’s size without too much of a problem. However, independent of whether it would be acceptable to expand the uplink bandwidth or not, 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. By definition, such a system is FDD not TDD, since TDD uses the same frequency band (or “channel”) in both directions (see Ex. 1001, 5:62–6:5).

105. As a final note, the example above makes clear that Atsuta’s invention is implemented in the uplink direction *only*. 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.” Ex. 1005, 6:7-12. Put another way, Atsuta does not disclose or even contemplate a scenario in which the downlink transmission capacity is so small that the system can afford to “ha[ve] a larger transmission capacity than that is actually used,” as Atsuta’s invention requires..

106. 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, p. 32. Instead, Atsuta is directed to the organization only of ***uplink*** transmissions from multiple wireless devices to the base station (using conventional non-beamformed signals). As discussed above, Atsuta explicitly 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.

107. 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.") *See, e.g.*, Ex. 1001, 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.”).

108. In contrast to Atsuta, Claims 28 and 29 of the '931 patent 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. *See, e.g.,* Ex. 1001, 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

109. 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). I disagree for the reasons described above in Section V.D that differentiate TDMA and TDD. For these reasons, a POSA would not understand that any given TDMA frame that might be implied or described by Atsuta is “compatible with a TDD frame.” Additionally, as discussed above, Atsuta contemplates its invention as one directed to **uplink** transmissions, i.e., “[a] TDMA receiving apparatus for use

⁵ Claims 28 and 29 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.” Ex. 1001, 28:66-67.

with a base station including a plurality of receiving antennas”. Ex. 1005, Abstract. Because Atsuta provides no meaningful explanation as to how its invention could be modified to apply to downlink transmissions at all, let alone in addition to uplink, a POSITA would not have applied Atsuta’s invention to downlink transmissions in a TDD frame as Petitioner alleges.

110. For all the reasons above, Atsuta does not disclose 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” as Claims 28 and 29 recite.

111. Additionally, as I discuss in Section VI.B (Paragraphs 67–68 above), any reference that teaches *away* from the ability to perform simultaneous transmission to two mobile stations would not be considered by a POSITA to be relevant or applicable to Challenged Claims 28 or 29. Therefore, even if a POSITA attempted to apply Atsuta’s scheme to the downlink, Atsuta would in fact preclude simultaneous transmission to two mobile stations. As per Atsuta’s Fig. 3, Atsuta specifically precludes and avoids simultaneous transmission to mobile stations. Ex. 1005, Fig. 3. As such, Atsuta teaches away from claims 28 and 29. This is an additional reason why a POSITA would not look to Atsuta for guidance or combine Atsuta with Vornefeld or any other asserted reference.

E. Vornefeld in Combination with Atsuta does not Teach or Disclose Challenged Claims 28 or 29

112. For the reasons discussed in Sections VII.A, VII.B, VII.C and VII.D above, Atsuta adds nothing to Vornefeld with respect to claims 28 and 29 and does not teach or disclose claims 28 and 29. Therefore, the combination of Vornefeld and Atsuta does not teach or disclose claims 28 and 29.

F. A POSITA Would Not Have Been Motivated to Combine Vornefeld and Atsuta

113. Atsuta addresses different issues in a different context than Vornefeld. Petitioner fails to provide any reason why a POSITA would look to a patent that deals with conventional uplink transmissions to figure out how to coordinate downlink beamformed transmissions.

114. Petitioner's expert states "A POSA would have been motivated to combine Vornefeld and Atsuta because Atsuta provides a solution to a transmission interference problem recognized by Vornefeld, while providing the additional benefit of simplified hardware requirements. Vornefeld recognizes that certain sets of subscribers are not suited for concurrent transmission to different sectors due to signal interference constraints. Ex. 1004, 56." Ex. 1002, ¶ 91. Regarding the first sentence ("A POSA would have..."), the only interference problem recognized by Vornefeld is that concurrently transmitted directed beams can interfere with each other. *See* Ex. 1004, p. 56 ("Downlink Scheduling"). Atsuta does not provide a

solution for this, in part because Atsuta does not discuss beamforming at all. In fact, Vornefeld provides its own obvious solution for this issue... don't schedule them concurrently. *Id.* Because Vornefeld provides a solution to its recognized interference problem, Petitioner has not explained why a POSITA would look to Atsuta or any other reference to solve a problem that Vornefeld claims to have already solved.

115. Even if a POSITA 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. Atsuta also does not teach or suggest interference between sectors, within sectors, or at sector boundaries.

116. Regarding the second sentence ("Vornefeld recognizes that..."), this relies on a construction of "sector" that was rejected by the Court. Under the Court's construction, Vornefeld does not teach or disclose any needs or issues regarding interference at sector boundaries or transmission to different sectors. In light of these facts, a POSITA would not have been motivated to combine Atsuta with Vornefeld.

117. Additionally, for the reasons discussed in Sections VII.D above, Atsuta teaches away from TDD, beamforming and SDMA. In light of this fact, a POSITA would especially not have been motivated to combine Atsuta with Vornefeld.

118. As described above, Atsuta deals only with uplink transmissions, not with downlink transmissions addressed by Vornefeld and the Challenged Claims of the '931 patent. 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).

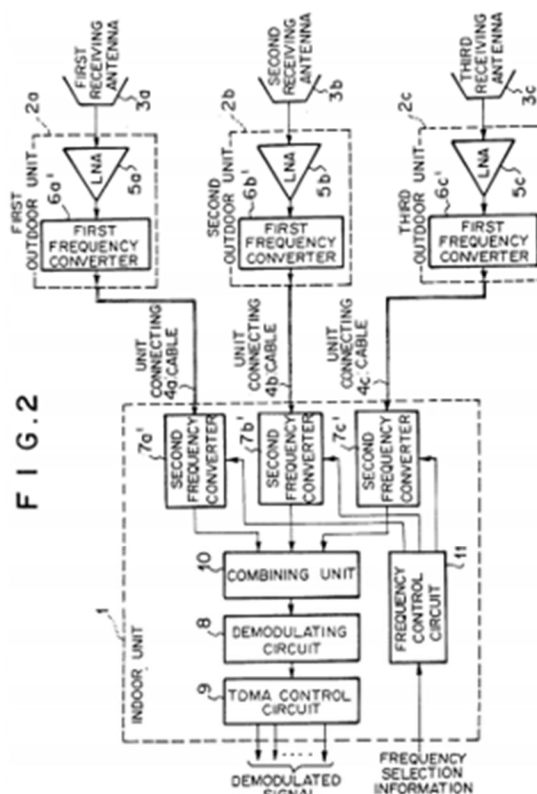
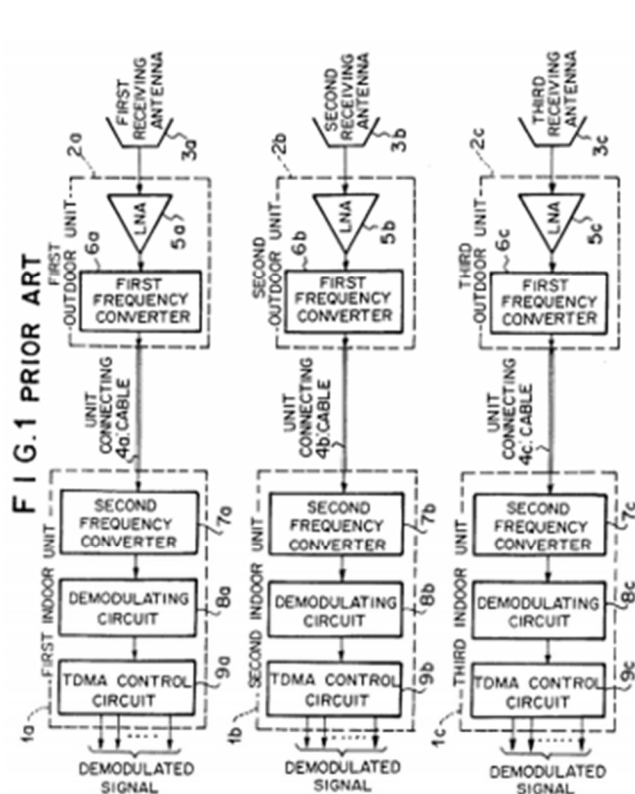
119. Beamforming and organization of the downlink transmissions are at the heart of the '931 patent. The title of the '931 patent is “Wireless Access System Using Selectively Adaptable *Beam Forming* in TDD Frames and Method of Operation.” Ex. 1001, Cover. The abstract, specification, and claims of the '931 patent all address beamforming. Claims 28 and 29 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.

120. Atsuta does not address beamforming in any way. It does not even address the use of an antenna array capable of beamforming. Nor does it speak to how multiple beamformed signals carrying downlink data should be organized or coordinated.

121. 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.” Ex. 1005, 1:13-18. Of course, conventional base station antennas at the time did not use beamforming. Atsuta does not address antennas capable of beamforming (e.g., including multiple elements with means for controlling their weights and/or phases). In context, Atsuta’s “fan-shaped beam antenna” is just a conventional antenna designed to transmit a typical fan-shaped beam. *See generally* Ex. 2021, Fan Beam, Britannica.com, <https://www.britannica.com/science/fan-beam> (defining “fan beam” and depicting conventional antennas capable of transmitting a fan-shaped beam).

122. Atsuta’s hardware modification is most easily seen by comparing Atsuta’s Figure 2 versus Figure 1, both reproduced below:



Ex. 1005, Figures 1, 2. 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. Ex. 1005, Figure 1. A POSITA would presume that three sector zones collectively provide 360 degrees of coverage around a base station site. The three sector zones are serviced by the three indoor units, three outdoor units, and three antennas. Ex. 1005, Figure 1. 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 reproduced above. 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.

123. 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. 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. Atsuta has no concept of an antenna array, beamforming, or spatial division multiplexing of a plurality of phones within a single sector. As such, Atsuta does not teach or suggest any aspect of the '931 patent's Claims 28 and 29, which both require beamforming, and a POSITA would not look to use it or combine it with Vornefeld's beamforming techniques.

124. Petitioner's expert states "Specifically, 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." Ex. 1002, ¶ 89. However, this is a misrepresentation. The antenna Atsuta discusses is "a fan-shaped beam antenna for sectoring a service area." *Id.* (citing Ex. 1005, 1:13–25). 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. 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. 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. Again, Atsuta does not teach or describe beamforming anywhere, and a POSITA would not look to combine Atsuta with Vornefeld to achieve the Challenged Claims.

125. 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." Ex. 1002, ¶ 91. I disagree. To the extent Atsuta is relevant at all, it teaches away from Claims 28 and 29.

126. Again comparing Figure 2 to Figure 1, a POSITA would understand that the TDMA control circuit 9 must now have three times as many outputs and handle three times as many mobile stations, increasing its size and complexity. Furthermore, the block 10 "combining unit" is new, additionally increasing complexity.

127. Second, Atsuta requires the receivers to time share in a way shown in Figure 3, reproduced below:

(1) PRESENT INVENTION

(TDMA SYNCHRONOUS FRAME IN COMMON WITH EACH ZONE)

(2) RELATED ART

(TDMA SYNCHRONOUS FRAME FOR SECTOR ZONE 1)

(TDMA SYNCHRONOUS FRAME FOR SECTOR ZONE 2)

(TDMA SYNCHRONOUS FRAME FOR SECTOR ZONE 3)

(a) STRUCTURE OF TDMA SYNCHRONOUS FRAME

(b) FREQUENCY SPECTRUM

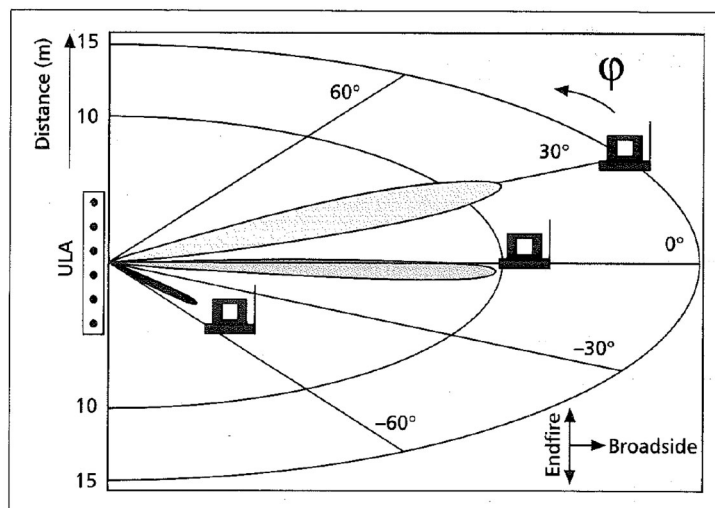
128. Atsuta's requirement to have three times wider bandwidth per channel also affects the analog components. The antennas (3a, 3b, 3c), low noise amplifiers (5a, 5b, 5c), outdoor frequency converters (6a, 6b, 6c) and indoor frequency converters (7a, 7b, 7c) all must be redesigned to support three times the bandwidth,

adding cost and complexity. And each is used only one-third of the time, wasting two-thirds of its capacity. In my opinion, in view of my own modem hardware design experience in 1996, Atsuta's design would have provided little to no benefit of reduced power or hardware complexity relative to the added costs of its implementation, let alone the costs of securing additional frequency spectrum. As discussed in Paragraph 104 above, Atsuta recognizes that its invention has limited (if any) use cases, describing only a video distribution system as an example.

129. To summarize, Atsuta's "optimization" would not make sense to a POSITA in light of the fact that 1) the Combining unit 10 is new and the TDMA control circuit 9 has three times more outputs, 2) the Combining Unit 10, the TDMA control circuit 9 and the Demodulating Circuit 8 have to run at three times higher clock rate, 3) additional frequency spectrum must be utilized, with two-thirds of it being wasted (because each band is only used one-third of the time), and 4) the frequency converters, LNAs and receive antennas are much complex due to supporting three times the bandwidth, and are all being used at one-third capacity (i.e., one-third of the time).⁶

⁶ As a follow-on note, a POSITA would in fact agree that combining the three indoor units of Figure 1 into one *enclosure* would make sense, but would see that this should be done without changing the functionality as Atsuta describes, for all the reasons provided. Using a configurable "modem shelf," as described in the '931 Patent, was the practical solution a POSITA would implement. Ex. 1001, 12:21–45, 16:49–17:10. Atsuta teaches no such thing.

130. A POSITA also would not seek to combine Atsuta with Vornefeld because such a combination would thwart the very purpose of Vornefeld. The system disclosed in Vornefeld was intended to allow for the simultaneous transmission of beamformed signals to different wireless devices. Ex. 1004, 53 (“Depending on the number of antenna elements and the applied algorithm, array antennas are able to *simultaneously* direct several beams to different positions conveying individual user signals.”). Figure 2 of Vornefeld (reproduced below) shows that its system uses “simultaneous transmission using directive beams.”



■ Figure 2. Simultaneous transmission using directive beams.

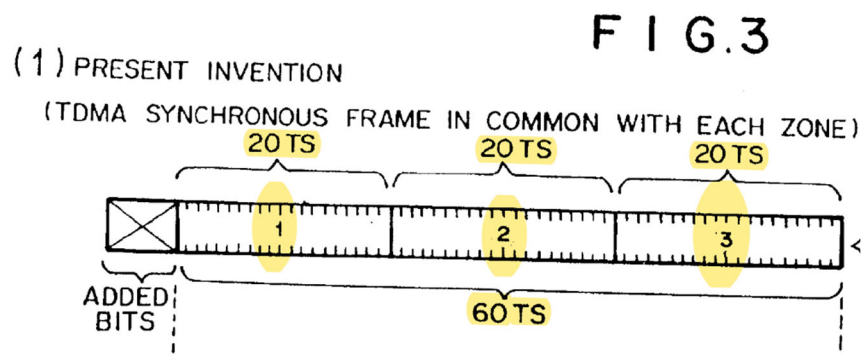
131. As discussed above, the Board previously determined (and Verizon does not dispute in this proceeding) that Vornefeld teaches the use of separate TDD frames for each beamformed signal rather than organizing all of the beamformed downlink data transmissions in the same portion of the same TDD frame, and sought

to allow for simultaneous transmission of multiple beamformed signals.

132. Atsuta 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.” *See, e.g.*, Ex. 1005, 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”).

133. 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. 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.



Indeed, Petitioner concedes that Atsuta “assigns different timeslots within a single [uplink] frame to subscribers in different sectors.”⁷ Petition, 26. Thus, there can be no dispute that Atsuta does not disclose or even permit multiple simultaneous transmissions. A POSITA 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 never overlap in time.

134. Because Atsuta never describes transmission to more than one mobile station at a time, let alone in more than one sector, a POSITA would understand that Atsuta is not compatible with one of the principal objectives of beamforming and

⁷ 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).

SDMA—which is taught by Vornefeld—i.e., that of supporting simultaneous transmission. *See* Ex. 1004, 52. For this reason, a POSITA would not seek to combine Atsuta with Vornefeld’s beamforming device.

G. Goldberg (Ex. 1005)

135. In Ground 2, Petitioner asserts Goldberg in combination with Vornefeld, and suggests that Goldberg also supplies the additional elements of Claims 28 and 29 that the Board previously found were not disclosed in Vornefeld.

136. 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.” Ex. 1006, 1:11-13; 6:6-7. Goldberg has a priority date December 10, 1997. Ex. 1006, p. 1. Its 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...

Id. With regards to disclosing beamforming within a sector, it is similar to Vornefeld. 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. 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.

Id. 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. *See id.* at 4:6–18, stating:

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).

137. Goldberg defines sectors and discusses beamforming concepts in essentially the same way as Vornefeld. Like Vornefeld, Goldberg does not teach or disclose any needs or issues regarding radio operation or interference at sector boundaries.

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

139. To the extent Goldberg does add information over Vornefeld, that information is: 1) mathematical discussion about how to choose beamforming weights for the antenna array, and especially, as described above, 2) how to choose beamforming weights for the antenna array such that the array radiates with a near omnidirectional pattern when needed. *Id.* at 12:64–24:60. However, Goldberg is cumulative to Vornefeld with regards to claims 28 and 29, in that it adds nothing. Like Vornefeld, Goldberg fails to teach or disclose both claim 28 (“[t]he transceiver

as set forth in claim 1 wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals”) and claim 29 (“[t]he method as set forth in claim 19, further comprising: transmitting, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices in a second of said sectors using a second directed scanning beam signal”).

140. Petitioner’s expert states “Goldburg describes sending downlink signals from a base station to users in different regions within a single TDD frame.” Ex. 1002, ¶ 117, citing Ex. 1006, 12:11–24. However, Goldburg makes no mention of TDD frames. The Goldburg citation at Ex. 1006, 12:11–24, describes GSM, which Goldburg describes as using FDD. Ex. 1006, 9:66–10:9. Petitioner’s expert also makes use of Patent Owner’s proposed construction of “sector” in Paragraphs 117–120 of his declaration, equating Goldburg’s “region” with a sector, but the Court rejects this construction. Only the term “sector” as actually used in Goldburg matches the Court’s construction of “sector”; Goldburg’s use of the term “region” does not. Therefore, as stated above, Goldburg does not teach or disclose any needs or issues regarding radio operation or interference at sector boundaries.

H. Goldberg is Cumulative (i.e., adds nothing) to Vornefeld with respect to claims 28 and 29.

141. Petitioner's expert states, "A POSA would have been motivated to combine Goldberg's frame structure with Vornefeld's system because Goldberg provides a solution to a transmission interference problem recognized by Vornefeld." However, as described above in Paragraph 114 for the Vornefeld and Atsuta combination, the only interference problem recognized by Vornefeld is that concurrently transmitted directed beams within a sector can interfere with each other. Ex. 1004, p. 56 ("Downlink Scheduling").⁸ Furthermore, Vornefeld provides its own obvious solution for this issue... don't schedule them concurrently. *Id.*

142. Petitioner's expert states, "Goldberg transmits to multiple subscribers within the same frame as part of the TDMA protocol." Once again, Petitioner improperly conflates TDMA with TDD. In an attempt to shoehorn Goldberg's TDMA disclosure into the language of the Challenged Claims, Petitioner alleges that "Goldberg describes sending downlink signals from a base station to users in different regions within a single TDD frame." Petition, 39 (citing Ex. 1006, 12:11–24). But Goldberg 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

⁸ Again, under the court's construction of "sector," neither Vornefeld nor Goldberg teaches or discloses any needs or issues regarding radio operation or interference at sector boundaries.

network. Goldberg does not even contain the terms “TDD” or “time division duplexing.”

143. The Goldberg citation upon which Petitioner relies (Ex. 1006, 12:11–24) discusses only GSM, which Goldberg describes as using an **FDD** multiplexing scheme. Ex. 1006 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 Goldberg use the GSM standard. Ex. 1006, 9:66–10:9. And as Goldberg explains, “GSM uses **frequency division duplexing**, which means that downlink and uplink communications between a BS and a MS occur at different frequencies.” Ex. 1006, 9:67-10:2 (where “BS” means “base station” and “MS” means “mobile station”).

144. Goldberg only provides a minimal description of a frame structure, and it is based on the existing GSM standard. Ex. 1002, ¶ 120, citing Ex. 1006, 3:47–4:18, 9:59–11:23, 12:11–24. For Goldberg’s actual invention, 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. A POSITA 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 even the required TDD). Put another way, there is nothing in Goldberg that teaches "transmit[ing] to multiple subscribers within the same frame" (as Petitioner's expert asserts) beyond what Vornefeld teaches or in any materially different way than Vornefeld teaches. 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."

145. As described above, a POSITA 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. To the contrary, as explained in a treatise expressly incorporated by reference into the '931 patent, (Ex. 1001, 6:23-31), TDMA systems use "*either* FDD or TDD," which are "called TDMA/FDD or TDMA/TDD access systems." Ex. 2022 (Rappaport) at p. 6 of 13 (native p. 397); Ex. 2030, 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). Goldberg discloses only a TDMA/FDD system.

146. Just like Atsuta, Goldberg fails to teach the transmission of multiple beamformed downlink transmissions in the same portion of the same *TDD frame*.

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 Claims 28 and 29 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*.

I. A POSITA Would Not Combine Goldberg with Vornefeld.

147. Petitioner argues that a POSITA 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. I disagree.

148. As described above, the only interference problem recognized by Vornefeld is that multiple directed beams concurrently transmitted *within a single sector* can interfere with each other. Ex. 1004, 56 (“Downlink Scheduling”). Vornefeld provides its own solution for this issue, which is—don’t schedule them concurrently. Ex. 1004, p. 52. Because Vornefeld provides a solution to its

recognized interference problem, Petitioner has not explained why a POSITA would look to Goldberg or any other reference to solve a problem that Vornefeld claims to have already solved.

149. Petitioner's assertion that a POSITA 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 above. Petition, 42. 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." Ex. 2027, pp. 11–12, 18–20. Vornefeld does not teach or disclose any problems regarding interference at sector boundaries or transmission to different sectors. In light of these facts, a POSITA would not have been motivated to combine Goldberg with Vornefeld.

150. Petitioner's further allegation that a POSITA 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, p. 42. I understand that Petitioner's expert admitted that this portion of his

opinions did not apply under the district court’s construction of “sector.” Ex. 2029, 35:1-37:3. 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. Therefore, as stated above, Goldberg does not teach or disclose any needs or solutions regarding radio operation or interference at sector boundaries.

151. A POSITA would recognize that Goldberg does not add anything to Vornefeld’s disclosure, and so there is no reason to combine the two. Petitioner’s expert argues that “Goldberg transmits to multiple subscribers within the same frame as part of the TDMA protocol.” However, as described above, a POSITA would understand that Goldberg only provides a minimal description of a frame structure, and it is based on the existing GSM standard. Ex. 1002, ¶120 (citing Ex. 1006, 3:47–4:18, 9:59–11:23, 12:11–24). Given that the Board and Federal Circuit have already ruled that Vornefeld does not teach the ’931 Patent’s claims 28 and 29, the same logic applies that Goldberg also does not, and the combination of Goldberg and Vornefeld also does not.

152. A POSITA 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 FDD. FDD is an older approach to bi-directional communication generally better suited to voice communications. TDD networks, by contrast, are generally superior for asymmetrical data transmission. 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.

Ex. 1001, 14:10-17. Moreover, the primary thrust of Goldberg is “to achieve a near omnidirectional pattern throughout [the antenna’s] area of coverage.” Ex. 1006, 1:12-13. It would make no sense for a POSITA 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.

J. Youssefmir (Ex. 1007)

153. In Ground 3, Petitioner asserts Atsuta in combination with Youssefmir as the primary reference instead of Vornefeld.

154. Youssefmir is directed to “Cooperative Polling in a Wireless Data Communication System Having Smart Antenna Smart Antenna Processing” (its title), and has a priority date September 29, 2000. Ex. 1007, p. 1. Its abstract states:

A method, communication device, and machine-readable medium. The method includes sending a first poll from a first base station having a smart antenna system to a first user terminal. The first base station receives a first uplink response signal from the first user terminal as a result of the first user terminal successfully receiving the first poll. The first base station also receives at least one other uplink response signals as a result of at least one other remote user terminal successfully receiving a second poll from a second base station. The first base station transmits downlink data to the first user terminal using a downlink smart antenna processing strategy for transmitting to the first user terminal, 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 and that may be receiving during transmission of downlink data to the first user terminal. The downlink smart antenna processing strategy is using the first and other received uplink response signals. The first base station uses a first protocol with its associated user terminals and the second base stations uses a second protocol that is coordinated with the first protocol to enable the first base station to receive the first and other uplink response signals from second and one or more other remote communication devices that may be receiving during the step of transmitting downlink data to the first user terminal....

Id. In summary, Youssefmir is describing 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 latter receives as interference). The latter part of the Abstract 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” (emphasis added).⁹

155. The configuration Youssefmir envisions is shown in its Figure 1, reproduced below.

⁹ Note that the “second user terminal” is the “first... other remote communication device[.]” (emphasis added).

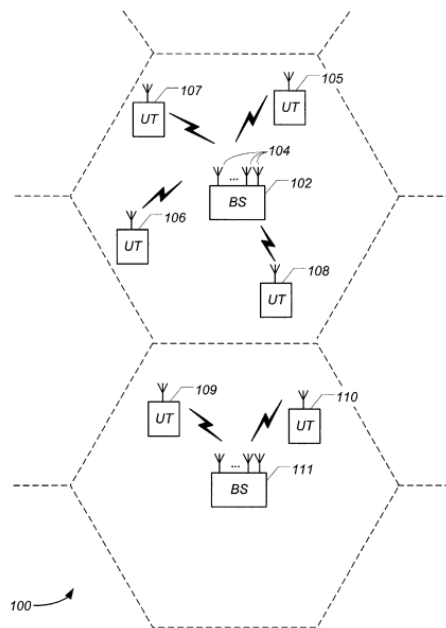


FIG. 1

Id. at Fig. 1; *see also id.* at 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).

156. 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.* at 4:54–18:12, Figs. 2A, 2B. 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. *Id.* at 18:15–27:42, Figs. 3–5. These discussions, and Youssefmir’s claims, do not extend materially beyond the

concepts described in the Abstract. *Id.* at 29:14–34:62.

157. Youssefmir acknowledges that a system may 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.” *Id.* at 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, or how sectors may affect his invention, or how his invention might incorporate sectors, or about coordination between sectors. Instead, Youssefmir does nothing more than acknowledge that a base station’s coverage area (e.g., one of the hexagons in reproduced Fig. 1 above) can be sectorized. *Id.*

K. Youssefmir does not teach or disclose claim 1 or claim 19 of the ‘931 Patent.

158. Petitioner’s only ground that includes Youssefmir is Ground 3, Youssefmir in combination with Atsuta. Pet. at § III, p. 6. However, Petitioner’s expert opines primarily on Youssefmir for claims 1 and 19 (the independent claims from which the Challenged Claims 28 and 29 depend), mentioning Atsuta only for a clarifying statement regarding element 1[e]. Ex. 1002, ¶¶ 149–159, 174–179.

Petitioner’s expert opines on the combination of Youssefmir and Atsuta mainly for the claim language added by dependent claims 28 and 29. *Id.* at ¶¶ 160–173, 180–181.

159. Petitioner’s expert opines that Youssefmir teaches or discloses claim 1. *Id.* at ¶¶ 149–159. I disagree that Youssefmir teaches or discloses claim elements 1[d] and 1[e].

160. Claim element 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.” Nothing in Youssefmir’s disclosure describes that a broadcast beam signal is sent to more than one sector of the cell. 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, p. 51.

161. While Youssefmir acknowledges that a base station’s coverage area (e.g., one of the hexagons reproduced in Figure 1 reproduced below) may be sectorized, it has no other discussion about sectors, or how sectors may affect its invention, or how its invention might incorporate sectors, or about coordination between sectors. Ex. 1007 at 9:13–15, 14:13–15. In contrast, the ’931 Patent discusses coordination between sectors. Ex. 1001 at 8:57–59, 9:5–8, 16:4–8, 16:20–

23, 22:49–65. The '931 Patent specifically points out that a limitation of the prior art is that it only “concern[s] the allocation of services in an individual sector of a cell,” as does Youssefmir. *Id.* at 8:12–13.

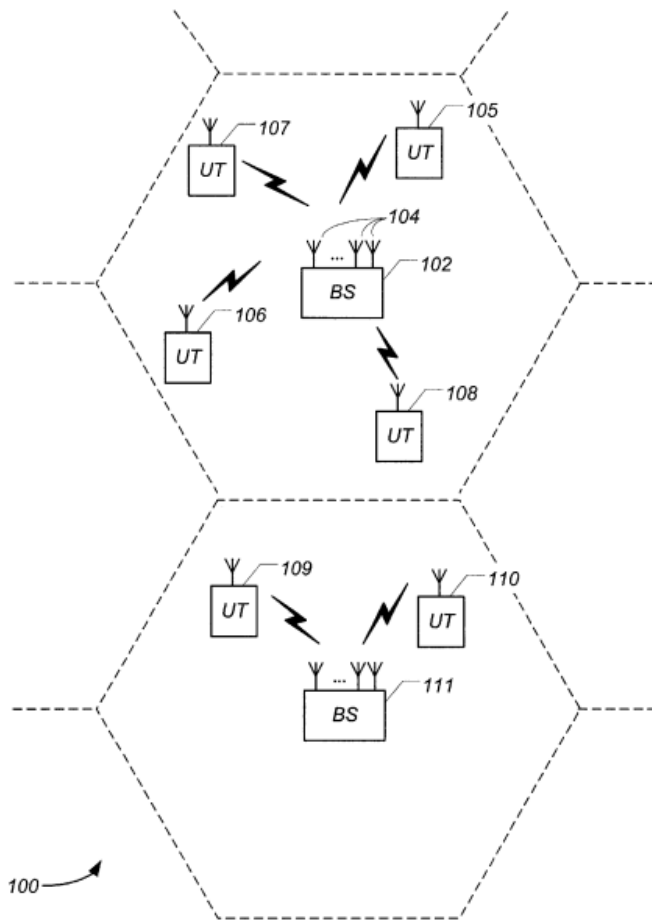


FIG. 1

162. Petitioner’s expert states:

Regarding transmitting the starting signal 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 the timing sequence with the base station. Ex. 1007, Fig. 5A. As Youssefmir explains, the cell site may be sectorized such that the transmission would be to devices across sectors since subscribers in different sectors would be receiving the transmission. Ex. 1007, 9:6–19, 14:13–19; *see also* Ex. 1005, 1:13–24 (explaining that the conventional sector system, as referred to by Youssefmir, uses different antenna apparatuses for different sectors to form a “fan-shaped beam antenna” for each sector). Thus, those starting signals are sent to all sectors of the cell.

Ex. 1002, ¶155. However, nothing in this description or its cites describes that a broadcast beam signal is sent to different sectors. As I explain in Paragraph 157 above, Youssefmir acknowledges that a system may 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.” Ex. 1007 at 9:13–15, 14:13–15. Youssefmir has no other discussion about sectors, or how sectors may affect his invention, or how his invention might incorporate sectors, or about coordination between sectors. Furthermore, Petitioner’s expert’s reference to Atsuta (Ex. 1005) 1:13–24 in the recitation above does not add information, for all the reasons cited in Sections VII.C, VII.D and VII.L herein.

163. Claim element 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 element 1[d], there is no basis for a subsequent transmission.

164. For the reasons described above, Youssefmir does not teach or disclose claim 1. For essentially the same reasons, it also does not teach or disclose claim 19.

L. Youssefmir in combination with Atsuta does not teach or disclose claims 28 and 29.

165. Petitioner’s expert opines that Youssefmir in combination with Atsuta teaches or discloses claims 28 and 29. Regarding claim element 28[a], Petitioner’s expert states:

As discussed above, Youssefmir describes transmitting downlink data from a base station to subscribers throughout the cell site within a single TDD frame. Ex. 1007, 13:1–44, 18:66–19:8, 24:18–34. And Atsuta describes transmitting to subscribers in different sectors within a single TDD frame. Ex. 1005, 6:24–61, Fig. 3.

Ex. 1002, ¶161. However, this is a misrepresentation. As I explain in Sections VII.C and VII.D, Atsuta does not teach or disclose TDD. Furthermore, Fig. 3 is an uplink diagram, and it is unclear how it might relate to downlink operation (e.g., there is no description at all about the “added bits”). Ex. 1005, Fig. 3. For these

reasons and the additional reasons I provide in Sections VII.C, VII.D and VII.M, a POSITA would find no added information in Atsuta over Youssefmir with regard to claims 28 and 29.

166. Other misrepresentations by Petitioner’s expert include: 1) “and a ‘separating unit’ in Atsuta—to distribute the downlink data to the appropriate transmitting antenna array” (Ex. 1002, ¶ 164), because Atsuta does not teach or describe an antenna array; 2) “Similarly, Atsuta describes TDD frame with both ‘up link’ and ‘down link’ capacity. Ex. 1005, 5:65–6:64. The frames described by Atsuta are TDD frames, as claimed, because they reserve timeslots for data in the uplink and downlink direction within a single ‘synchronous frame.’ Ex. 1005, 5:65–6:64.” (Ex. 1002, ¶ 165), because Atsuta does not describe TDD—the single “synchronous frame” shown in Atsuta’s Fig. 3 is clearly for only one direction of transmission only; 3) “Atsuta describes how the users in different sectors may be assigned to downlink slots in a single TDD frame. Ex. 1005, 6:24–58, Fig. 3. Atsuta’s Fig. 3 (below) illustrates data transmission to subscribers in different sectors within a single TDD frame” (Ex. 1002, ¶ 168), because Atsuta does not teach or disclose TDD, 4) Ex. 1002, ¶¶ 170 (because Atsuta does not have an antenna array), and 172, 173 (because Atsuta does not disclose TDD).

167. Petitioner’s expert agrees with me that “Youssefmir does not explicitly

disclose that the users assigned to certain downlink timeslot are in different sectors, but does recognize sectorization of the cell site” Ex. 1002, ¶ 167. As I explain in Section VII.J, “recognize” is in fact the furthest extent to which Youssefmir describes sectors. Youssefmir has no other discussion about sectors, or how sectors may affect its invention, or how its invention might incorporate sectors, or about coordination between sectors.

168. Petitioner’s expert opines that “[a]pplying Atsuta’s feature of transmitting downlink data to different sectors within a single frame to Youssefmir permits usage of simplified hardware.” Ex. 1002, ¶ 169. However, as described in Sections VII.C, VII.D and VII.F above, Atsuta’s invention on its own is not an improvement or simplification. And described in Section VII.M below, given Youssefmir’s already much more complicated system than Atsuta’s system, a POSITA would not be motivated to combine Atsuta with Youssefmir at all.

169. Petitioner’s expert provides various other discussions regarding Atsuta and Youssefmir in his Paragraphs 161–173 (Ex. 1002, ¶¶ 161–173), but for all the reasons stated in this section above and in Sections VII.C, VII.D, VII.J and VII.K, none of these are sufficient to teach or disclose “wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an

other of said directed scanning beam signals.”

170. I also note that Youssefmir essentially discloses no more than Vornefeld with respect to Challenged Claims 28 and 29. Therefore, I also incorporate Sections VII.A–VII.E herein.

171. For the reasons described above, the combination of Atsuta with Youssefmir does not teach or disclose claim 28. For essentially the same reasons, it also does not teach or disclose claim 29.

M. A POSITA Would Not Have Been Motivated to Combine Youssefmir and Atsuta

172. Petitioner’s expert states, “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, including simplifying the necessary signal processing circuitry.” Ex. 1002, ¶ 145. However, as I explain above in Sections VII.C and VII.F, Atsuta has significant flaws that render it inapplicable to combine with any invention related to beamforming, SDMA or active antenna arrays. I also explain in Section VII.F above that a POSITA would *not* have been motivated to combine Vornefeld and Atsuta. I hereby incorporate those sections herein, because for much the same reasons, a POSITA also would not have been motivated to combine Youssefmir and Atsuta.

173. Petitioner’s expert makes some statements related to Youssefmir and Atsuta that I consider misrepresentations. He states “This is made clear in Atsuta, which shows that each antenna element is an array that is responsible for a section of the overall site. Ex. 1005, 1:13–18.” Ex. 1002, ¶ 140. As I describe above in Section VII.C, Atsuta does not show antennas that are arrays, especially beamforming arrays. Atsuta only shows fixed, directional antennas, not adaptive arrays. Petitioner’s expert also states “A POSA would understand that each antenna array in a sectorized system transmits beams to substantially only the subscribers within its corresponding sector given Youssefmir’s discussion of sectorization and beamforming, and in view of Atsuta’s explanation of the same. Ex. 1007, 1:29–2:12.” *Id.* However, Youssefmir’s has no discussion of sectorization other than to mention it exists for the purpose of clarifying the definition of “non-directional” and “omnidirectional.” Ex. 1007 at 9:13–15. Furthermore, as described above, Youssefmir’s whole invention is about dealing with the fact that transmissions *do* emanate beyond intended coverage areas. Ex. 1007 at Abstract. Therefore, a POSITA reading Youssefmir would in fact understand that each antenna array in a sectorized system does transmits beams to subscribers beyond its corresponding sector. Lastly, Atsuta has no discussion of beamforming. *See* § VII.C above.

174. Petitioner’s expert states, “Because 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." Ex. 1002, ¶ 146. This statement overlooks at least two key points that render it inaccurate: 1) Youssefmir's framing discussion is substantially more complex 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. Ex. 1007, Figs. 3–5. Atsuta's framing is trivial and not based on TDD, and is only described for the uplink. Ex. 1005, Fig. 3. Therefore, it is not the case that Atsuta merely "describes details... that are already suggested by Youssefmir's system." 2) Atsuta's "invention" reduces uplink system capacity by a factor of three, and requires three times more bandwidth to compensate. *See* § VII.C and ¶¶ 102 & 104 above. Therefore, applying Atsuta to Youssefmir's system very much results in a difference in function.

175. For the reasons described in this section above, a POSITA would not have been motivated to combine Youssefmir with Atsuta, and in fact would not have combined them.

N. Tangemann

176. Tangemann discloses SDMA and beamforming, and is primarily

concerned with capacity increases they may provide. Ex. 1008, 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 the “sectors” of Claims 28 and 29 under the construction Petitioner successfully obtained in the related district court proceeding.

O. Tangemann is Cumulative to Petitioner’s Other Prior Art Combinations, Especially Under the Court’s Claim Construction of Sector.

177. Petitioner’s “ground 4” prior art combination is Vornefeld and Atsuta (the ground 1 combination) in Further View of Tangemann, and Petitioner’s “ground 5” prior art combination is Vornefeld and Goldberg (the ground 2 combination) in Further View of Tangemann. Pet. at §§ III and VIII, pp. 6, 75–82.

178. Tangemann discloses SDMA and beamforming, and is primarily concerned with capacity increases they may provide. Ex. 1008 at p. 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.* at pp. 746 (§ 2.2, “[t]his is achieved by dividing the cell into small

minisectors”) and 748 (§ 3.1, “where the cell has been divided into $I = 100$ minisectors of 3.6°).

179. Both Petitioner and Petitioner’s expert state that Tangemann is used as an additional reference in light of Patent Owner’s originally proposed construction of “sector” to mean “geographic portion of the cell site.” Pet. at p. 75 (§ VIII), Ex. 1002, ¶ 183. Under that construction, Petitioner and Petitioner’s expert assert that Tangemann’s “minisector” satisfies a “sector” as recited in the ’931 Patent’s claims. Pet. at p. 75 (§ VIII), Ex. 1002, ¶ 183. However, in light of the Court’s construction of “sector,” Tangemann’s “minisector” is not a “sector” as used in the claims of the ’931 Patent or as used in Vornefeld, Atsuta or Goldberg. As a result, I assume that Petitioner and Petitioner’s expert agree that their discussion of Tangemann does not apply to the ’931 Patent’s use of the word “sector.”

180. 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. I therefore disagree with Petitioner’s Grounds 4 and 5 for the same reasons as Grounds 1 and 2.

181. Notwithstanding any construction of “sector,” Petitioner’s expert also opines, “[a] POSA would have been motivated to combine Tangemann’s minisectors with Vornefeld’s system because both Tangemann describes a method to optimize

the use of available frequency bandwidth and reduce transmission interference, which are both issues Vornefeld seeks to address” and “[a] POSA would also have a reasonable expectation of success in combining Vornefeld and Tangemann. Tangemann’s minisector technique to calculate angular user density aligns with Vornefeld’s system, which already considers subscriber location.” Ex. 1002, ¶ 188. However, Tangemann’s technique is for traffic and queue modeling of moving mobiles (specifically cars on a motorway), not optimization of beamforming parameters. *Id.* at p. 748 (§ 3.1) Vornefeld has no discussion of numeric or geometric resolution or of anything related to fixed “minisectors.” *See* Ex. 1004 *generally*. While it is possible that a POSITA might try geometrically fixed slices on the order of “ $I = 100$ minisectors of 3.6° ” (see above) to analyze and improve beamforming and SDMA operation, because of the unnecessary resolution restriction this adds, a POSITA would not have had reasonable expectation of success without undue experimentation.

182. In my opinion, and as described above, Tangemann provides no teachings that add to any of the other asserted prior art or combinations of prior art—especially with respect to Challenged Claims 28 and 29 and especially in light of the Court’s construction of “sector.” Therefore, Petitioner’s ground 4 is cumulative to ground 1, and ground 5 is cumulative to ground 2. Neither ground 4 nor ground 5

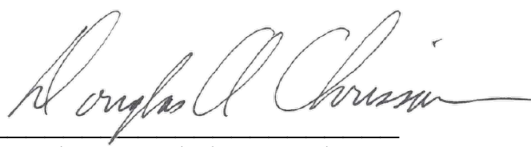
render the challenged claims 28 or 29 obvious, for the same reasons that grounds 1 and 2 do not.

VIII. OPINIONS

183. For all the reasons described above, it is my opinion that none of Petitioner's Grounds 1–5 render obvious the Challenged Claims 28 and 29 of the '931 Patent.

I declare under penalty of perjury that the foregoing is true and correct. I acknowledge that willful false statements and the like are punishable by fine and/or imprisonment, that all statements made of my own knowledge are true, and that all statements made on information and belief are believed to be true.

Executed April 17, 2024, in Los Gatos, CA.

By: 
Douglas A. Chrissan, Ph. D.