

Filed on behalf of: Cellco Partnership d/b/a Verizon Wireless

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS
Petitioner

v.

GENERAL ACCESS SOLUTIONS, LTD.
Patent Owner

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

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,230,931**

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Exhibit List

Ex. No.	Description
1001	U.S. Patent No. 7,230,931 (the “’931 patent”)
1002	Declaration of Kevin Almeroth, Ph.D.
1003	Curriculum Vitae of Kevin Almeroth, Ph.D.
1004	Ulrich Vornefeld et al., “SDMA Techniques for Wireless ATM,” IEEE Communication Magazine, November 1999 (“Vornefeld”)
1005	U.S. Patent No. 6,160,800 (“Atsuta”)
1006	U.S. Patent No. 6,154,661 (“Goldburg”)
1007	U.S. Patent No. 6,795,409 (“Youssefmir”)
1008	Michael Tangemann, “Influence of the User Mobility on the Spatial Multiplex Gain of an Adaptive SDMA System,” 5 th <i>IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, Wireless Networks – Catching the Mobile Future</i> , The Hague, Netherlands, 1994 (“Tangemann”)
1009	<i>Sprint Spectrum L.P. v. General Access Solutions, Ltd.</i> , IPR2017-01889, Paper 43 (P.T.A.B. Mar. 7, 2019)
1010	<i>Sprint Spectrum L.P. v. General Access Solutions, Ltd.</i> , IPR2017-01889, Paper 61 (P.T.A.B. Jan. 29, 2021)
1011	<i>Sprint Spectrum L.P. v. General Access Solutions, Ltd.</i> , IPR2017-01889, Paper 25 (P.T.A.B. Aug. 3, 2018) (PO response)
1012	File History for U.S. Patent No. 7,230,931
1013	Claim Construction Order, dated September 29, 2020, from <i>General Access Solutions, Ltd. v. Virgin Mobile USA, L.P. et al.</i> , Case No. 2-20-cv-00007 (E.D. of Texas)
1014	<i>Sprint Spectrum L.P. v. General Access Solutions, Ltd.</i> , IPR2017-01889, Paper 1 (P.T.A.B. July 28, 2017) (Sprint Petition)

Petition for *Inter Partes* Review of USP 7,230,931

Ex. No.	Description
1015	<i>Sprint Spectrum L.P. v. General Access Solutions, Ltd.</i> , IPR2017-01889, Paper 42 (P.T.A.B. Jan. 15, 2019) (Hearing Transcript)
1016	<i>General Access Solutions, Ltd. v. Verizon Communications, Inc.</i> , No. 2:22-cv-394 (Jan. 5, 2023) (infringement contentions)
1017	<i>General Access Solutions, Ltd. v. Virgin Mobile USA, L.P. et al</i> , Case No. 2:20-cv-00007, Document 350 (E.D. Tex. July 21, 2021)
1018	George McDaniel, IBM Dictionary of Computing (1994)
1019	Declaration of Sylvia D. Hall-Ellis, Ph.D.

CLAIM LISTING

The following claim listing adds bracketed labels ([preamble], [a]), etc.) for reference:

1. [a] 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,
 - [b] a transceiver associated with a first of said plurality of base stations comprising:
 - [c] 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,
 - [d] 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
 - [e] 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.
19. [a] 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:
 - [b] 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,

- [c] the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and
- [d] 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.

28. [preamble] The transceiver as set forth in claim 1

- [a] 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.

29. [preamble] The method as set forth in claim 19,

- [a] 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.

I. Introduction

Cellco Partnership d/b/a Verizon Wireless (“Verizon”) requests *inter partes* review of claims 28-29 (“Challenged Claims”) of U.S. Patent No. 7,230,931 (“’931 patent”), owned by General Access Solutions, Ltd. (“GAS”).

The ’931 patent underwent a prior IPR (by a different party), with claims 1-27 being found unpatentable. In that prior IPR, Patent Owner conceded that Vornefeld anticipated independent claims 1, 10, and 19. While Patent Owner attempted to salvage the dependent claims, only claims 28 and 29 survived. For claims 28 and 29, the Board found that the prior petitioner had not established that Vornefeld was an anticipatory reference and that the prior petitioner had not relied on secondary references for the recited features. This Petition combines Vornefeld with secondary references to demonstrate the obviousness of claims 28 and 29, in addition to presenting other grounds.

For context, claims 28 and 29 depend from cancelled independent claims 1 and 19, respectively. Claims 1 and 19 are directed to a wireless network in which a base station communicates bidirectionally with wireless devices. The claimed network uses time division duplex (TDD) communication, while the base station uses beam forming to transmit scanning beam signals to different sectors of the base station’s cell site, all of which was known in the prior art, as conceded by Patent Owner.

TDD communication uses a frame structure wherein the frame defines a number of time slots for different transmissions (*e.g.*, to different devices, uplink vs. downlink, etc.). Per the cancelled independent claims, at the start of the TDD frame, the base station sends a broadcast beam to multiple sectors of the cell site. Subsequently, in a downlink portion of the TDD frame, one directed scanning beam provides first downlink data traffic to a device within one sector. Patent Owner conceded all of this was disclosed in Vornefeld.

The Challenged Claims add one simple, known element to the cancelled independent claims—specifically, in the downlink portion of the TDD frame, the base station sends a second directed scanning beam that provides second downlink data traffic to a device in a different sector from the first downlink data traffic. While Patent Owner conceded that Vornefeld teaches sending a broadcast beam to multiple sectors and a directed scanning beam to one sector within one TDD frame, the Board found that the prior petitioner had not proven that Vornefeld taught sending a second directed scanning beam to a second sector in the *same* TDD frame. However, using one frame to define the timeslots for transmission to different sectors was known in the field.

In particular, Atsuta (not considered previously) describes a “simpl[ified]” cellular transmission system that uses common circuitry to control transmissions to different sectors of the cell site, wherein a single frame defines the timing for

transmissions across multiple sectors. Ex. 1005, 2:60-3:8, 1:13-24. Thus, Atsuta teaches including multiple sector beam transmissions in a single TDD frame as recited in the Challenged Claims. The claimed concept is also described in Goldberg, which is combined with Vornefeld in another ground. Moreover, Tangemann also discloses dividing cell sites into sectors and aiming directed beams into each sector and, when combined with the above references, further renders the Challenged Claims obvious.

Finally, this petition applies Youssefmir as another primary reference. Youssefmir (not considered previously) not only teaches all of the features of the independent claims, but also teaches a single TDD frame for transmitting downlink traffic to different user devices within the cell site. Atsuta, as combined with Youssefmir, establishes that those user devices could be located in different sectors of the cell site.

For these reasons, the Challenged Claims are unpatentable over the prior art and Verizon requests *inter partes* review of those claims.

II. Mandatory Notices under 37 C.F.R. § 42.8

A. Real Parties-in-Interest

The real party in interest is Cellco Partnership d/b/a Verizon Wireless. Additionally, out of an abundance of caution in light of prior challenges to the named real parties-in-interest in separate and unrelated IPR petitions, Petitioner further

identifies Verizon Communications Inc. and Verizon Corporate Resources Group LLC as real parties-in-interest for the IPR requested by this Petition, solely to the extent that Patent Owner contends that these separate legal entities should be named real parties-in-interest in the requested IPR, and Petitioner does so to avoid the potential expenditure of resources to resolve such a challenge. No unnamed entity is funding, controlling, or otherwise has an opportunity to control or direct this Petition or Petitioner's participation in any resulting IPR. Also, Petitioner notes that Petitioner has several hundred affiliated entities and each of these entities agrees to be estopped under the provisions of 35 U.S.C. § 315 as a result of any final written decision in the requested IPR to the same extent that Petitioner is estopped.

B. Related Matters

The '931 patent is being asserted in *General Access Solutions, Ltd. v. Cellco Partnership d/b/a Verizon Wireless et al.*, Case No. 2-22-cv-00394 (E.D. of Texas) ("Related Litigation"). The '931 patent was previously asserted in the following district court cases that are no longer pending:

- *General Access Solutions, Ltd. v. Virgin Mobile USA, L.P. et al.*, Case No. 2-20-cv-00007 (E.D. of Texas); and
- *General Access Solutions, Ltd. v. Sprint Corp. et al.*, Case No. 2-16-cv-00465 (E.D. of Texas).

The '931 patent was also subject to the following *inter partes* review petition:

- *Sprint Spectrum LP v. General Access Solutions, Ltd.*, IPR2017-01889

(“Sprint IPR”), which resulted in the cancellation of claims 1-27.

C. Grounds for Standing

Verizon certifies that the ’931 patent is available for *inter partes* review and that Verizon is not barred from requesting this proceeding.

D. Lead and Backup Counsel and Service Information

Pursuant to 37 C.F.R. §§ 42.8(b)(3), 42.8(b)(4), and 42.10(a), Verizon designates the following lead counsel:

Lead Counsel Justin J. Oliver Reg. No. 44,986 VENABLE LLP 600 Massachusetts Avenue, NW Washington, D.C. 20001 Telephone: 202-721-5423 Facsimile: 202-344-8300 JOliver@Venable.com	Backup Counsel Stephen K. Yam Reg. No. 64,927 VENABLE LLP 600 Massachusetts Avenue, NW Washington, D.C. 20001 Telephone: 202-721-5429 Facsimile: 202-344-8300 SYam@Venable.com
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Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney from Verizon is attached. Verizon consents to electronic service at the following email address:

VerizonIPR@venable.com.

E. Fee for *Inter Partes* Review

The Director is authorized to charge the fee specified by 37 C.F.R. § 42.15(a) to Deposit Account No. 22-0261.

III. Identification of Challenges (37 C.F.R. § 42.104(B))

Ground 1: The Challenged Claims are unpatentable under 35 U.S.C. § 103 in view of Ulrich Vornefeld et al., “SDMA Techniques for Wireless ATM,” IEEE Communication Magazine, November 1999 (“Vornefeld”; Ex. 1004) and U.S. Patent No. 6,160,800 (“Atsuta”; Ex. 1005).

Ground 2: The Challenged Claims are unpatentable under 35 U.S.C. § 103 in view of Vornefeld and U.S. Patent No. 6,154,661 (“Goldburg”; Ex. 1006).

Ground 3: The Challenged Claims are unpatentable under 35 U.S.C. § 103 in view of U.S. Patent No. 6,795,409 (“Youssefmir”; Ex. 1007) and Atsuta.

Ground 4: The Challenged Claims are unpatentable under 35 U.S.C. § 103 in view of Vornefeld, Atsuta, and 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, 1994 (“Tangemann”; Ex. 1008).

Ground 5: The Challenged Claims are unpatentable under 35 U.S.C. § 103 in view of Vornefeld, Goldburg, and Tangemann.

IV. Background

A. The '931 Patent

The '931 Patent is directed to wireless communication between a base station and subscribers. Ex. 1001, Abstract. In Fig. 1, the base stations are broadcast towers that transmit to fixed devices in subscribers' homes.

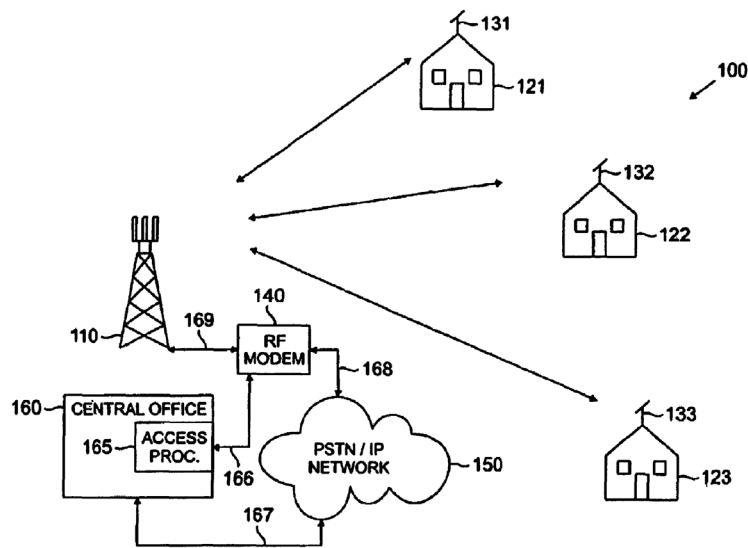


FIG. 1

Ex. 1001, Fig. 1.

As the '931 Patent acknowledges, the field already employed various techniques to allow sharing of a wireless channel across multiple devices, a concept known as “multiple access.” Ex. 1001, 5:32-58. These techniques included:

- frequency division multiple access (FDMA), which divides the frequency spectrum of the wireless channel into frequency bands assigned to users,

- time division multiple access (TDMA), where users share a frequency channel at different times, Ex. 1001, 5:32-52, and

- space division multiple access (SDMA), where users share a frequency channel through directionally oriented antennas (relative to the base station), which provides multiple channels in different directions using antenna beam forming techniques. Ex. 1001, 5:32-52; Ex. 1002, ¶¶46-47.

The '931 Patent admits that existing cellular systems often employed combinations of these techniques (*e.g.*, “a combination of FDMA and ... TDMA”) “to support a number of users in a cell.” *Id.*, 5:53-58. In particular, the '931 Patent explains the combination of TDMA and SDMA. Regarding SDMA, an exemplary “sectorized” cell site shows (in the '931 Patent) each sector is serviced by an antenna directed to that area. *Id.*, 9:23-28, 12:21-45 (“each of the RF modems ... may be assigned to modulate and demodulate signals in a particular sector”), 16:4-19 (“Each RF modem uses an individual antenna to transmit and to receive in its assigned sector”). The '931 Patent recognized that sectorization was already known. Ex. 1001, 8:12-30 (“prior art concern[ing] the allocation of services in an individual sector of a cell”); Ex. 1002, ¶¶48-49, 54-56.

Regarding TDMA, the '931 patent describes structuring transmissions as “frames” comprised of timeslots. Ex. 1001, 7:21-8:11. A frame is a data structure

consisting of fields (in this context, timeslots) for transmission of user data. Ex. 1001, 7:21-24; Ex. 1002, ¶50, 57; Ex. 1018, 285-286. Timeslots can be assigned to data for different subscribers in the uplink (subscriber to base station) or downlink (base station to subscriber) direction. Ex. 1001, 7:21-8:11, 14:23-15:47.

The technique of designating timeslots for uplink and downlink on a single channel is known as time division duplexing (TDD), which can be contrasted with frequency division duplexing. Ex. 1001, 5:59-6:5. The '931 Patent acknowledges existing approaches to providing duplexed multiple access in wireless systems by combining TDD and TDMA techniques (“TDD/TDMA”). *Id.*, 6:42-58; 7:10-8:19. In that way, a wireless channel is divided by time for (i) different users and, (ii) downlink and uplink transmissions for a particular user. Ex. 1002, ¶48, 58.

The '931 Patent describes using TDD frames in a “beam forming network capable of transmitting directed scanning beam signals in a sector of a cell site associated with ... [a] base station.” Ex. 1001, 9:16-34; Ex. 1002, ¶51. As detailed below, this concept (recited in claim 1) has already been found unpatentable.

In the '931 Patent, broadcast signals (“beam signals”)¹ are sent to “wireless access devices” in the cell site. According to the claims, at the start of each TDD

¹ The specification of the '931 patent does not describe transmitting a “broadcast beam” to multiple sectors, nor does it describe sending a “directed scanning beam

frame, a “start of frame field” is sent to “more than one” sector. Ex. 1001, claim 1. The start of frame field contains information such as how the TDD frame is configured. Ex. 1001, 7:52, 14:53; Ex. 1002, ¶52, 59, 61-66. Following this, per claim 1, during a downlink portion of the TDD frame, data is sent to *one* of the sectors. In the Challenged Claims, in that same frame, different downlink data is sent to *another* sector.

Thus, the Challenged Claims add the simple concept of transmitting to different sectors within the same TDD frame, rather than using different frames for different sectors. Ex. 1002, ¶53, 60, 67.

B. The Prosecution History

The patent application was filed on September 5, 2001, with 27 claims. The examiner issued an Office Action rejecting claims 1-7, 10-17, and 19-25 as anticipated over U.S. Patent No. 6,094,421 (“Scott”). The applicant amended claims 1 and 19 in an attempt to overcome the rejection and added claims 28 and 29. In a Final Office Action, the examiner rejected claims 1, 19, 28, and 29, among others, as anticipated. Ex. 1012, 273 (explaining, for claims 28 and 29, that Scott discloses

signal” to a second sector. However, the elements are being addressed because the claims recite the features. Petitioner reserves the right to challenge, in the Related Litigation, whether the claims have written description support.

that “the base station may transmit to a first user station, await a response, and, after receiving a response from the first user station, transmit to a second user station”).

The applicant filed a notice of appeal, arguing that Scott did not teach “using directional antennae to transmit a start of frame to all devices within all sectors.” Ex. 1012, 285. The applicant made no specific argument with respect to claims 28 or 29.

Subsequently, the application was allowed and the ’931 Patent issued.

C. The Sprint IPR

The ’931 Patent was reviewed in the Sprint IPR, which resulted in final written decisions finding claims 1-27 unpatentable. Ex. 1009, 32 (finding claims 1, 10, and 19 unpatentable); Ex. 1010, 26 (finding claims 2-9, 11-18, and 20-27 unpatentable on remand); *see* Ex. 1014. Notably, Patent Owner ***conceded*** the unpatentability of independent claims 1, 10, and 19 in light of Vornefeld (resulting in an adverse judgment). Ex. 1009, 7; Ex. 1011, 2 n.1; Ex. 1015, 56:19–57:9 (“[Vornefeld] knocks out our independent claims. We concede that.”). The Board found that claims 2-9, 11-18, and 20-27 were also unpatentable over various combinations of Vornefeld, Ahy and Andersson. Ex. 1010, 26.

Regarding claims 28 and 29, the Board determined that Sprint had not met its burden with respect to sending “first downlink data” and “second downlink data” to different sectors within the same frame. For Vornefeld, the Board’s view was that Sprint had not established that Vornefeld anticipated that feature. Ex. 1009, 23.

Although Vornefeld was applied in an obviousness-based ground in combination with a secondary reference, the Board noted that Sprint had relied only on Vornefeld for claims 28 and 29. Ex. 1009, 6, 24. Thus, those two claims survived.

D. The Person of Ordinary Skill in the Art

A person of ordinary skill in the art (“POSA”) at the time of the purported invention 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. Ex. 1002, ¶42. Additional education could compensate for less practical experience and vice versa. *Id.*

E. Claim Construction

Claims 28 and 29 would have been obvious under any reasonable construction pursuant to *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).² In a prior litigation involving the ’931 Patent (“prior litigation”), Patent Owner argued that “sector” means “a portion of a cell site.” Ex. 1017, 6-7; *see id.*, 17 (Sprint’s proposed construction required a “portion of the cell site that is pre-defined by the

² Petitioner reserves the right to argue alternative constructions before a district court, including with respect to indefiniteness.

transmission area of the antenna array”). The district court rejected this definition as contradicted by Patent Owner’s own previous arguments made to distinguish the Challenged Claims from Vornefeld in the Sprint IPR—namely, that downlink data transmitted to “spatially separated” parts of the cell site was not necessarily transmitted to “different sectors.” Ex. 1017, 14-16; *see generally id.*, 3-17.

Despite that prior adverse ruling, Patent Owner continues to advance a definition of sector as simply “a portion of the cell site,” as evidenced by Patent Owner’s infringement allegations in the Related Litigation. Ex. 1016, Ex. A at 35 (contending that the orange highlighted area and the blue highlighted area in the figure below are different sectors due to being different “geographic portions of the cell site”).



To the extent a construction is necessary, Petitioner relies on Patent Owner’s implicit construction in the Related Litigation, notwithstanding Petitioner’s intent

to challenge that construction in the Related Litigation. *10X Genomics, Inc. v. Bio-Rad Labs., Inc.*, IPR2020-00086, Paper 8, 17–22 (PTAB Apr. 27, 2020) (clarifying that a Petitioner need only identify “[h]ow the challenged claim is to be construed” for the petition and that “judicial efficiency will be enhanced by allowing Petitioner to rely upon a claim construction that Patent Owner is relying upon in the related district court litigation”); *Western Digital Corp. v. SPEX Techs., Inc.*, IPR2018-00082, Paper 11, 12 (PTAB Apr. 25, 2018) (“Petitioner’s statement that its Petition ‘is *based on* the claim constructions urged by Patent Owner’ in related District Court litigation . . . suffices to identify claim constructions Petitioner is adopting”).

Further, this Petition demonstrates that the Challenged Claims are obvious over the prior art under any reasonable construction of “sector,” including a narrower construction, such as a section of the cell site defined by the transmission area of a corresponding antenna array. *See* Ex. 1014, 10-11 (Sprint construing sector as “arc of a cell site served by an individual or antenna array”); Ex. 1009, 15 (noting that Patent Owner did not dispute Sprint’s construction of sector).

F. Legal Background

Obviousness requires determining the scope and content of the prior art, the differences between the claimed invention and the art, and the level of ordinary skill. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966). “The combination of familiar

elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR v. Teleflex*, 550 U.S. 398, 416 (2007). This analysis is provided below.

V. Ground 1: Vornefeld in Combination with Atsuta

Vornefeld published in November 1999, making it prior art under 35 U.S.C. § 102(b) (pre-AIA). Ex. 1019, ¶¶42-48, 56. In the Sprint IPR Patent Owner admitted that Vornefeld anticipates claims 1 and 19. It is being relied upon here for that same purpose, as the Challenged Claims depend from those independent claims.

Atsuta was filed on September 9, 1996, making it prior art under 35 U.S.C. §§ 102(a) and 102(e) (pre-AIA). Atsuta was not previously considered by the USPTO.

The application of Vornefeld to independent claims 1 and 19 is summarized in advance of addressing the combination applied against the Challenged Claims.

A. Patent Owner Conceded the Unpatentability of Claims 1 and 19 over Vornefeld

Claims 1 and 19 were confirmed to be anticipated by Vornefeld. Ex. 1009, 7; Ex. 1010, 26.

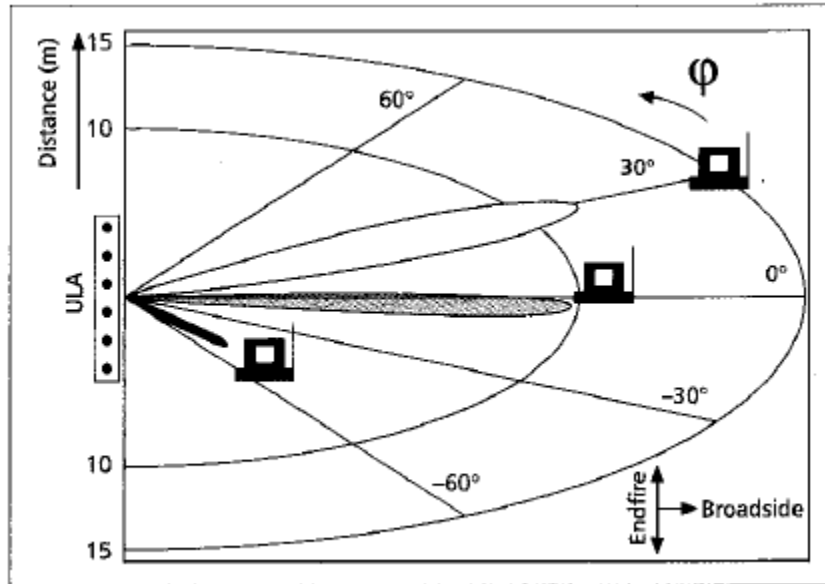
1. Independent Claim 1

Claim 1[a][b]: “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:

Vornefeld teaches the wireless access network comprising” “base stations” “capable of ... TDD[] communication with [] devices [] at ... subscriber premises in an associated cell site” by describing “an example of a modern broadband wireless access system.” Ex. 1009, 7. Vornefeld’s “cellular mobile communications system” has base stations with “multiple antenna beams that can be electronically directed to the mobile terminal (MT) locations.” Ex. 1004, 52, Fig. 2. Vornefeld’s “radio subsystem operates ... on a time-division duplex (TDD) channel with a bandwidth of 20 MHz/frequency channel.” Ex. 1004, 52. The TDD channel uses “the same frequency for up- and downlink.” Ex. 1002, ¶73; Ex. 1004, 53.

Figure 2 of Vornefeld shows a base station communicating with a plurality of mobile terminals (MTs). Ex. 1004, 52, Fig. 2.



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

Ex. 1004, Fig. 2. Each base station includes one or more uniform linear array (ULA) antennas, which are part of the transceiver for that base station. Ex. 1002, ¶74; Ex. 1004, 52, 56-57. Vornefeld notes that “smart antennas form their beams in the baseband.” Ex. 1004, 52.

Claim 1[c]: “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,”

Vornefeld teaches “transmit path circuitry” for “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.” Ex. 1009, 7. Vornefeld describes “[t]he ability to set up multiple antenna beams that can be electronically directed to the mobile terminal (MT)

locations adaptively leads to an increase in capacity and reduces signal interference.” Ex. 1002, ¶75; Ex. 1004, 52. Furthermore, “[f]or 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. 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.” Ex. 1004, 52, 57 (“[d]ownlink beamforming”).

Vornefeld’s Fig. 2 (above) shows a base station having three ULAs which cover the cell site (e.g., each ULA covers a 120° sector of the cell site). Ex. 1002, ¶76; Ex. 1004, 52. “A beamforming algorithm computes a weight matrix for each time slot that adjusts the phases at the antenna elements to steer the main beam pointing direction toward the estimated DoA of the desired MT.” Ex. 1004, 53. Also, “[d]epending 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 (Fig. 2).” Ex. 1004, 53. Vornefeld’s Fig. 2 depicts several MTs within an exemplary 120° sector covered by the ULA, with a directed scanning beam signal transmitted to each of the MTs using transmit path circuitry associated with the ULA (*i.e.*, the claimed “signals transmitted using a beam pattern directed within a sector”). Under Patent Owner’s definition of “sector,” the MTs are each within a different “geographic portion of a cell site.” As such, Vornefeld’s base

station comprises transmit path circuitry capable of transmitting to substantially only wireless access devices (MTs) within a different one of a plurality of sectors. Ex. 1002, ¶76.

Vornefeld also discloses this element under a narrower construction of “sector”—such as a section of the cell site defined by the transmission area of a corresponding antenna array—as each of the three ULAs transmits to substantially only MTs within a 120° sector corresponding to an antenna array.

Claim 1[d]: “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”

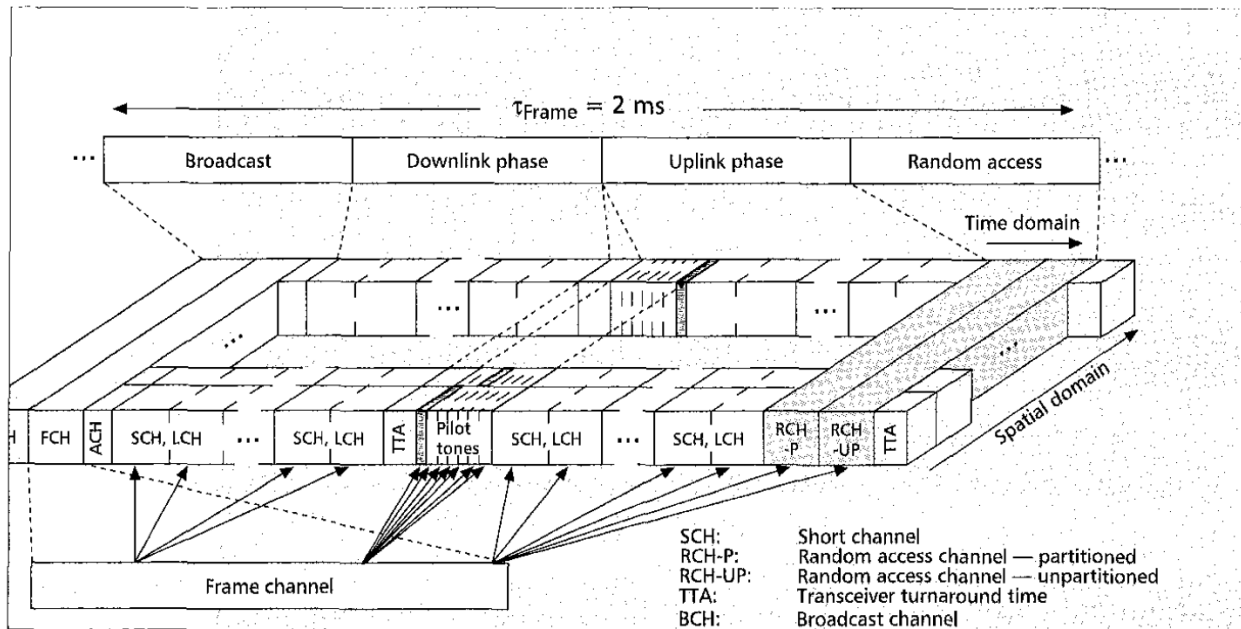
A scheduler at the base station groups various control and data channels into MAC frames that are transmitted to the MTs. Ex. 1009, 7. Each MAC frame “starts with two broadcast channels, the broadcast channel (BCH) and the frame channel (FCH), followed by a downlink phase, an uplink phase, and the random access channels (partitioned, RCH-P, and unpartitioned, RCH-UP).” Ex. 1002, ¶77; Ex. 1004, 54. In Vornefeld, the BCH “conveys signaling information concerning *the whole radio cell* in the downlink direction . . . Every frame starts with a BCH.” Ex. 1004, 54 (emphasis added); Fig. 3. Thus, a broadcast beam signal is transmitted at the start of a TDD frame to wireless access devices within more than one of said sectors (“the whole radio cell”). Ex. 1004, 54, 55 (“to inform all the terminals about

their individual transmission and reception schedules for the next MAC frame”). Further, the broadcast beam signal includes a start of frame field.

The '931 Patent admits that the HIPERLAN/2 specification in Vornefeld exemplifies a TDD system in which the base station controller “broadcast[s] the resource allocation at the start of every frame.” Ex. 1001, 7:43-54; Ex. 1002, ¶78.

Claim 1[e]: “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.”

Vornefeld teaches that the transmit path circuitry subsequently transmits downlink traffic data to substantially only wireless access devices within one of the sectors. Ex. 1009, 7. Figure 3 of Vornefeld shows the frame structure of a transmission:



Ex. 1004, Fig. 3.

As shown, each frame includes a “downlink phase,” which can include long channel (LCH) portions that serve to transmit user data (e.g., the payload) on the up- and downlink. Ex. 1004, 54. The LCHs dedicated to a single terminal are grouped together. Ex. 1004, 54. Vornefeld describes performing downlink transmission by forming “directive beams” which enable the base station to send information to several locations within a sector. Ex. 1002, ¶¶79-80; Ex. 1004, 55.

2. Independent Claim 19

Claim 19[a]: “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:”

Vornefeld teaches these features for reasons similar to those noted above at claim 1[a]. *See* Ex. 1002, ¶81; Ex. 1009, 7.

Claim 19[b]: “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,”

Vornefeld teaches these features for the reasons noted above at claims 1[b] and 1[c]. *See* Ex. 1002, ¶82; Ex. 1009, 7.

Claim 19[c]: “the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and”

Vornefeld teaches these features for the reasons including those noted above at claims 1[b]-1[c]. *See* Ex. 1009, 7. Furthermore, Vornefeld teaches that the start of frame field is capable of synchronizing receivers in the wireless access devices. Ex. 1002, ¶83. As noted above with respect to claims 1[b]-1[c], Vornefeld's frame includes two broadcast channels: the BCH and the FCH. Ex. 1004, 54. Every frame starts with the BCH, which conveys signaling information concerning the whole radio cell in the downlink direction and announces the location of the FCH within the MAC frame. Ex. 1004, 54. The FCH is "used to transmit the information about the structure of the MAC frame for the up- and downlink phases. This channel is broadcast in the downlink direction. It contains announcements and reservations of long and short transport channels the individual MTs have to transmit or receive in." Ex. 1004, 54. The signals synchronize the receivers in the wireless access devices by informing each MT which transport channels that MT has been assigned in the uplink and downlink, and together comprise a "start of frame," which is transmitted as a "broadcast beam signal." Ex. 1002, ¶83.

Also, Vornefeld is designed to be "embedded in the context of HIPERLAN/2, which serves here as an example of a modern broadband wireless system." Ex. 1004, 52. The frame structure of HIPERLAN/2 includes a basic frame with fixed length, which comprises five fields for broadcast control, frame control, downlink, uplink and random access. Ex. 1002, ¶84. Also, the BCH contains a preamble: "The

preamble in the broadcast control channel enables frames synchronization, automatic gain control, frequency synchronization as well as channel estimation.” Ex. 1002, ¶84. Because Vornefeld incorporates the HIPERLAN/2 frame structure, it was not disputed that Vornefeld uses a start of frame field capable of synchronizing receivers in the wireless access devices. Ex. 1009, 7.

Claim 19[d]: “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.”

Vornefeld teaches these features for the reasons noted above at Claims 1[b] and 1[d]. *See* Ex. 1002, ¶85; Ex. 1009, 7.

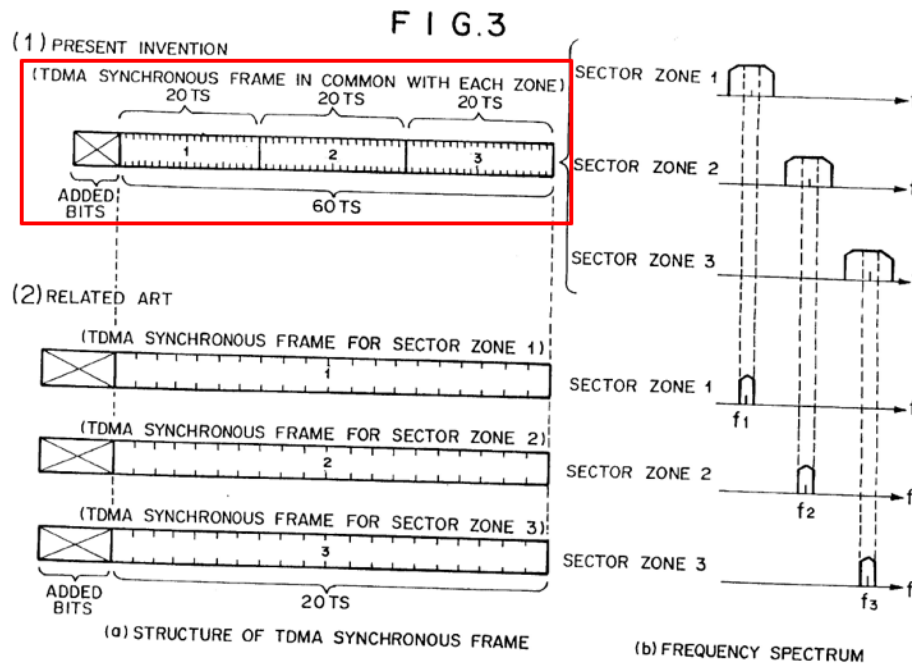
B. The Combination of Vornefeld and Atsuta

Like the '931 patent, as established above, Vornefeld describes a system for wireless communication between a base station and subscribers using space-division multiple access (SDMA) and time-division multiple access (TDMA) techniques. Vornefeld also uses a TDD frame structure for transmissions and “a smart array antenna” to create beams that can be directed to devices in different sectors. Ex. 1002, ¶86; Ex. 1004, 52-53.

In the Sprint IPR, the Board stated that Sprint did “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.” Ex. 1009, 23. However, using different beams to

transmit to different sectors in the downlink portion of one frame was known in the field—particularly, in Atsuta. Ex. 1002, ¶187.

Like Vornefeld, Atsuta is directed to TDMA frame-based communication between a base station and subscribers. Ex. 1002, ¶188; Ex. 1005, 2:64-3:8. Atsuta describes a base station that transmits downlink data to subscribers in different sectors within a single TDMA frame. Ex. 1005, 6:24-61. Like in the '931 Patent, the subscribers may be fixed devices (*e.g.*, televisions). Ex. 1005, 5:65-6:12. Figure 3 of Atsuta illustrates a TDMA frame comprising 60 time slots (“TS”), wherein every 20 TS is assigned to a subscriber in a different zone: first 20 TS to sector zone 1, second 20 TS to sector zone 2, last 20 TS to sector zone 3.



Ex. 1005, Fig. 3.

The “sector zone[s]” in Atsuta correspond to the “sectors” in the ’931 Patent. Ex. 1005, 1:13-25, 1:53-65; Ex. 1002, ¶89. Each of Atsuta’s “sector zone[s]” is a “fan-shaped” subsection of the total service area, and each zone is assigned its own antenna array. Ex. 1005, 1:13-25 (“using a fan-shaped beam antenna for sectoring a service area”), 2:41-57, 6:24-58; Ex. 1001, 8:12-19, 12:21-45, 16:4-19, 28:1-13, Fig. 12A; Ex. 1004, 52 (“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”), Fig. 2;. Notably, in Atsuta’s Fig. 4, “3d, 3e, and 3f are first to third transmission antennas that radiate ... [to] fan-shaped directional space.” Ex. 1005, 6:51-57; Ex. 1001, 16:12-14 (“Each RF modem uses an individual antenna to transmit and to receive in its assigned sector. The antennas for different sectors in the same cell site are mounted on the same tower”).

Atsuta addresses the issue that, in a conventional sectorized TDMA method, such as the one described in Vornefeld, if transmissions to different sectors occurs in separate TDMA frames, separate demodulating circuits and TDMA control circuits are typically used for each sector. Ex. 1002, ¶90; Ex. 1005, 2:22-57, 5:21-30 (“conventionally, each of the three fan-shaped divided zone has an independent TDMA synchronous frame”). By transmitting to multiple different users (in different sectors) in the *same* TDD frame, Atsuta allows the TDMA communication to run on a “simpl[i]fied” structure that only requires a single demodulating circuit and TDMA

control circuit, thus reducing the “size and power consumption” of the system. Ex. 1005, 2:60-3:8. Specifically, Atsuta’s system provides a “common”/“shared” functional circuit for the various antenna arrays. Ex. 1005, 2:60-63 (“object of the present invention is to share the same functional circuit”), 3:23-27, 3:58-60 (“As a result of ... the present invention, regardless of the number of divided zones, the demodulating circuit and the TDMA control circuit can be shared. Thus, the size of the receiving apparatus can be reduced and thereby the power consumption can be decreased.”).

A POSA would have had a reason to combine Vornefeld and Atsuta because they are both directed to the same field of endeavor and attempt to solve the same issues—*e.g.*, efficient broadcasting between a base station and subscribers using TDMA frame-structured transmissions. Ex. 1002, ¶91. Vornefeld recognizes that certain sets of subscribers are not suited for concurrent transmission due to signal interference constraints. Ex. 1004, 56. Vornefeld’s solution to multiple access involves splitting up transmissions on the time axis. Ex. 1004, 55. Similarly, Atsuta describes splitting on the time axis by assigning different timeslots within a single downlink frame to subscribers in different sectors, thus mitigating interference between subscribers and simplifying the signal processing structure at the base station. Ex. 1005, 6:24-58.

Vornefeld acknowledges that computational complexity is a common concern. Ex. 1004, 53, 57. Atsuta's design reduces the required number of functional circuits in order to simplify the overall design (*i.e.*, reduce complexity). Ex. 1002, ¶¶92-93. Because Vornefeld recognized the need to split up transmissions on the time axis, and Atsuta teaches a form of that technique with the benefit of using simpler hardware to transmit to different subscribers and sectors in a single frame, a POSA would have found the use of Atsuta's single-frame structure (and simplified hardware design) with Vornefeld's system to be an obvious design choice. *See SDI Technologies, Inc., v. Bose Corp.*, IPR2013-00350, Paper 36 at 26 (Nov. 7, 2014) ("known elements would have been an obvious matter of design choice"); Ex. 1002, ¶95.

Furthermore, the frame structures utilized by Vornefeld and Atsuta are consistent: Vornefeld includes a broadcast portion at the start of the frame, followed by downlink and uplink. Ex. 1004, Fig. 3, 54. Atsuta generalizes the opening broadcast portion as "added bits," and reserves the remaining time slots for different sectors, recognizing that transmissions may be downlink or uplink. Fig. 4, 6:2-7, 6:24-61. Both also consider the spatial dimension when broadcasting: Vornefeld by deploying "a smart array antenna" to broadcast to different parts of the cell site (Ex. 1004, 52, Fig. 2) and Atsuta by broadcasting to different sector zones using a "plurality of antennas" (Ex. 1005, 3:31-36, Fig 3). Vornefeld's system is capable of

directing beam transmissions to specific subscribers throughout the cell site in specific timeslots, which fits Atsuta's method of transmitting to subscribers in different sectors using different timeslots. Ex. 1002, ¶94. Given the fit between these technologies, this combination would not "result in a difference in function or give unexpected results." *In re Rice*, 341 F.2d 309, 314 (CCPA 1965).

In fact, the combination of broadcasting to multiple sectors within a single TDD frame "represents no more than 'the predictable use of prior art elements according to their established functions.'" *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1245 (Fed. Cir. 2010); *Ball Aerosol & Specialty Container, Inc. v. Limited Brands, Inc.*, 555 F.3d 984, 993 (Fed. Cir. 2009) ("predictable variation" is obvious as a matter of law). Specifically, Atsuta's single-frame structure would be used with Vornefeld's system, which already uses frames.

A POSA would also have a reasonable expectation of success in combining Atsuta and Vornefeld. Ex. 1002, ¶95-96. Atsuta's method for allocating time slots to subscribers in different sectors within a single TDMA frame matches Vornefeld's MAC protocol, which allows transmission to a subscriber with the "granularity of a single time slot." Ex. 1002, ¶96; Ex. 1004, 53-54. Both references assign subscriber data to timeslots and use directional antennas to transmit to subscribers in various sectors. While Vornefeld may have used different frames for different sectors, Atsuta combines the slots for different sectors into one frame, so as to provide the

same information Vornefeld would have provided, just in a single-frame format. Ex. 1002, ¶96. And by doing so, Atsuta allows for a simplification of the hardware used. Ex. 1005, 2:60-64. A POSA would have had no problem in simplifying the hardware and putting information that may have been in two frames into one frame.³ Ex. 1002, ¶96.

While Vornefeld does not explicitly state whether it uses different control circuits for its various antennas, Atsuta’s improvement would be applicable in either design. Ex. 1002, ¶97. Specifically, if Vornefeld were to use different control circuits for the various antennas, Atsuta’s solution would be preferable in that it combines circuitry for the various antennas to provide a “simpl[ified]” structure, thus reducing its “size and power consumption.” Ex. 1005, 2:60-3:8. Even if Vornefeld already used one control circuit, Atsuta’s design would still be applicable inasmuch as its single-frame structure is intended for that very design. Ex. 1002, ¶¶97-98.

1. Dependent Claim 28

Claim 28[p]: “The transceiver as set forth in claim 1”

As established above in Sec. V(A)(1), Vornefeld describes all the features of claim 1.

³ Petitioner does not concede that Vornefeld teaches different frames for different sectors, but uses Atsuta out of an abundance of caution.

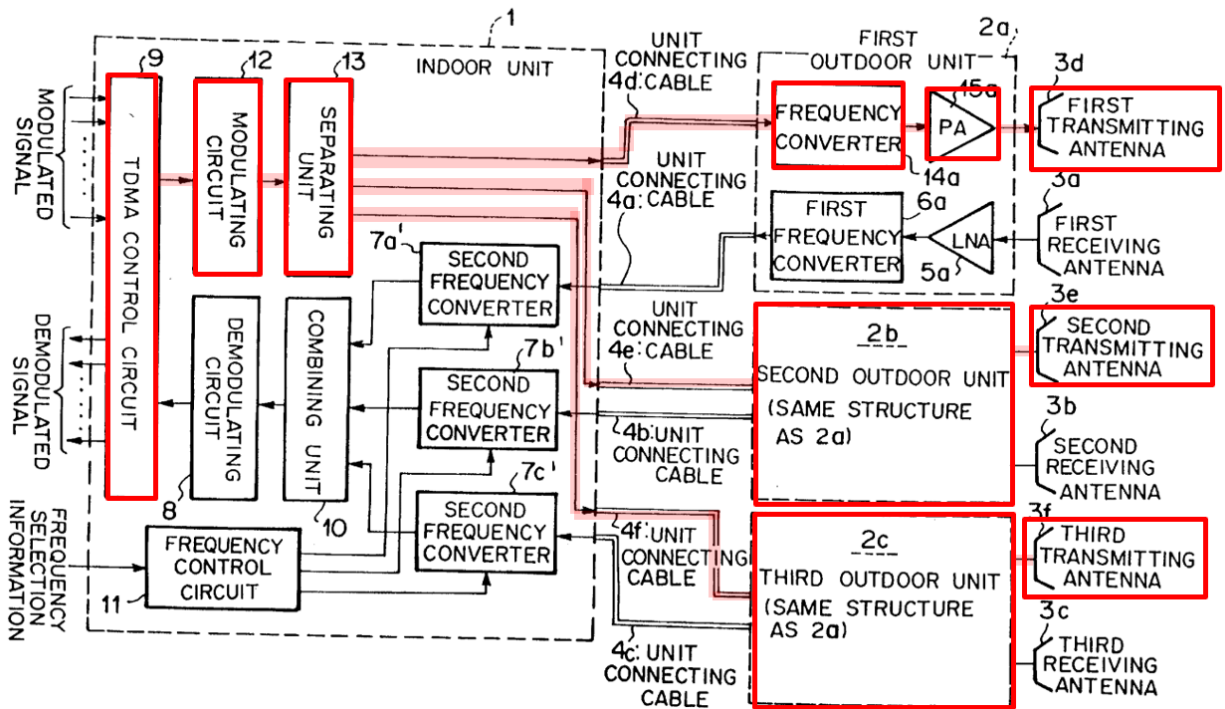
Claim 28[a]: “wherein said transmit path circuitry transmits, in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless access devices within an other of said sectors using an other of said directed scanning beam signals.”

Claim 28 involves using transmit path circuitry (*see* Sec. V(A)(1), *supra*) to transmit (in the downlink of the TDD frame discussed above in Sec. V(A)(1)) second downlink data traffic to substantially only wireless access devices in “another” sector using “another” scanning beam signal. For context, claim 1 recites that, in the downlink portion of the TDD frame, first downlink data traffic is transmitted “to substantially only wireless access devices within one of said sectors.” Thus, claim 28 is directed to, in the downlink portion of one frame, also transmitting to another sector. Ex. 1002, ¶100. Thus, the TDD frame has slots for transmitting to different sectors.

As already discussed above, Atsuta describes transmitting downlink data to multiple subscribers in different sectors within a single frame to allow for simplified hardware. Ex. 1002, ¶101; Ex. 1005, 6:31-55.

Regarding “transmit path circuitry,” the circuitry is already admittedly taught by Vornefeld. *See* Sec. V(A)(1), claim 1b, *infra*. Moreover, Atsuta also describes a control circuit, modulating circuit, separating unit, frequency converters, and power amplifiers. Ex. 1002, ¶102-103; Ex. 1005, 6:35-64, Fig. 4.

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Ex. 1005, Fig. 4 (annotated).

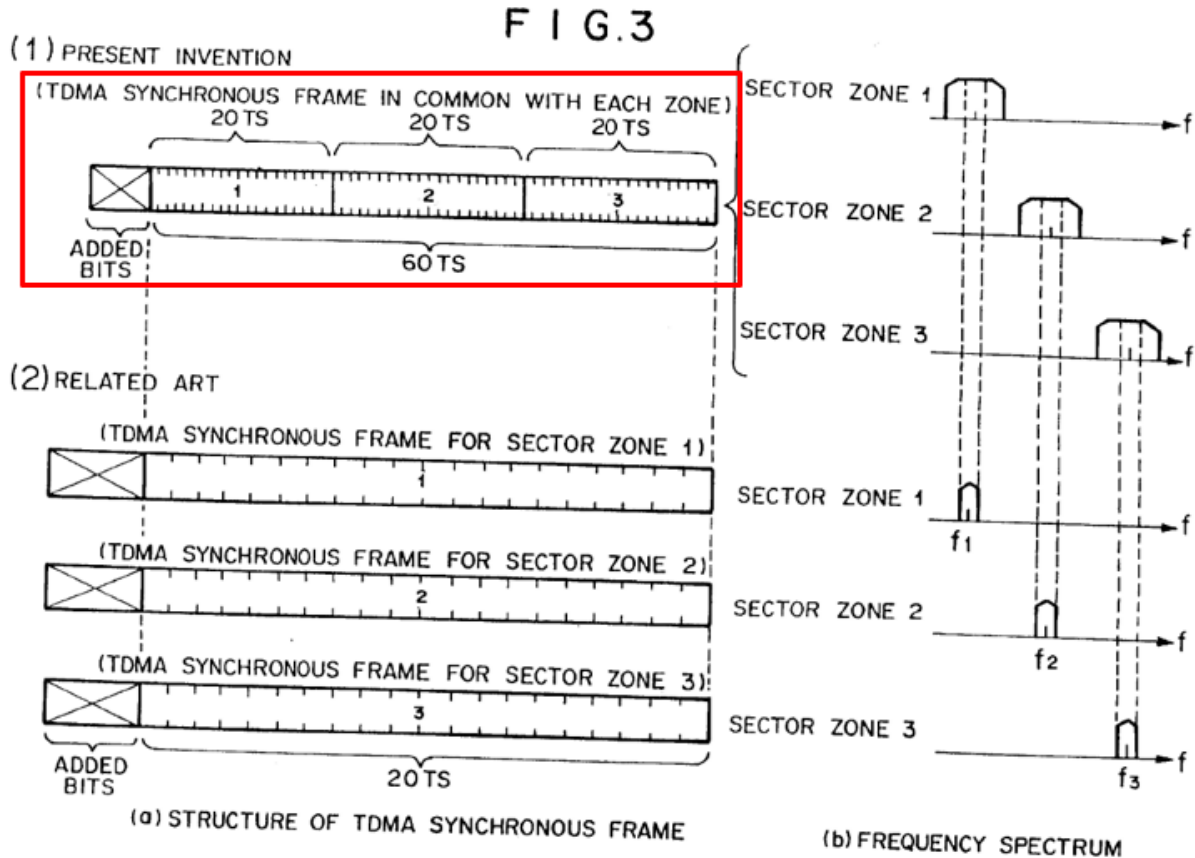
The highlighted apparatus is used to transmit downlink data from the base station to subscribers. Ex. 1005, 6:35-64 Either Vornefeld's circuitry or Atsuta's circuitry could be used, as would have been appreciated by a POSA. Ex. 1002, ¶104. Atsuta simply describes the benefit of using one set of circuitry for the various antenna arrays.

Regarding “transmit[ting], in said downlink portion of said TDD frame,” Atsuta describes a “single synchronous frame,” within which there are sequential downlink signals transmitted from the base station to subscriber stations in different zones. Ex. 1005, 6:35-64. 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.” Ex. 1002, ¶105; Ex. 1005, 5:65-6:12. Moreover, Vornefeld already teaches TDD frames and the ’931 Patent admits that the same were well known at the time. Ex. 1004, 53; Ex. 1001, 6:32-8:31. At the very least, because the frames in Atsuta are comprised of different timeslots reserved for downlink transmission (Ex. 1005, 6:35-58) a POSA would understand that they are compatible with a TDD frame. Ex. 1002, ¶105.

Regarding transmitting “second downlink data to substantially only wireless access devices within an[]other of said sectors,” Atsuta describes arranging downlink data for multiple subscribers in different zones⁴ into a single TDD frame, and transmitting that data through directional antennas. Ex. 1005, 6:31-64, Fig. 3. Figure 3 illustrates data transmission to subscribers in different sectors within a single TDD frame. The frame comprises 60 time slots (“TS”), and every 20 TS is assigned to a different zone: first 20 TS to sector zone 1, second 20 TS to sector zone 2, last 20 TS to sector zone 3.

⁴ Regarding “an[]other of said sectors,” Atsuta uses the terms “zones” or “sector zones” interchangeably to refer to “sectors.” Ex. 1002, ¶106; Ex. 1005, 1:13-25, 1:53-55.



Ex. 1005, Fig. 3 (annotated) (noting under “Present Invention” the use of a “TDMA synchronous frame *in common with each zone*”) (emphasis added). By transmitting to subscribers in different sectors within a single frame, Atsuta distinguishes itself from the “conventional” system that uses separate frames. Ex. 1005, 5:25-30.

The combination of Atsuta and Vornefeld applies under any reasonable interpretation of “sectors” because, in Vornefeld and Atsuta, each sector has a dedicated antenna array and different users in the paths of the different antenna arrays would be communicated with in the same frame. Ex. 1002, ¶106; Ex. 1004, 52; Ex. 1005, 1:13-18, 6:24-58. In addition, under Patent Owner’s implied definition

of “sector,” each subscriber is also within their own “geographic portion of a cell site.”

Regarding “wireless access devices,” Atsuta describes communication between a base station and “mobile stations” and/or “subscriber stations” using radio frequencies. Ex. 1005, 1:25-52; 2:64-3:8. Patent Owner conceded that Vornefeld teaches transmission to “substantially only wireless access devices.” Ex. 1004, 52-54 (“mobile terminals”); *see* Sec. V(A)(1) *supra*.

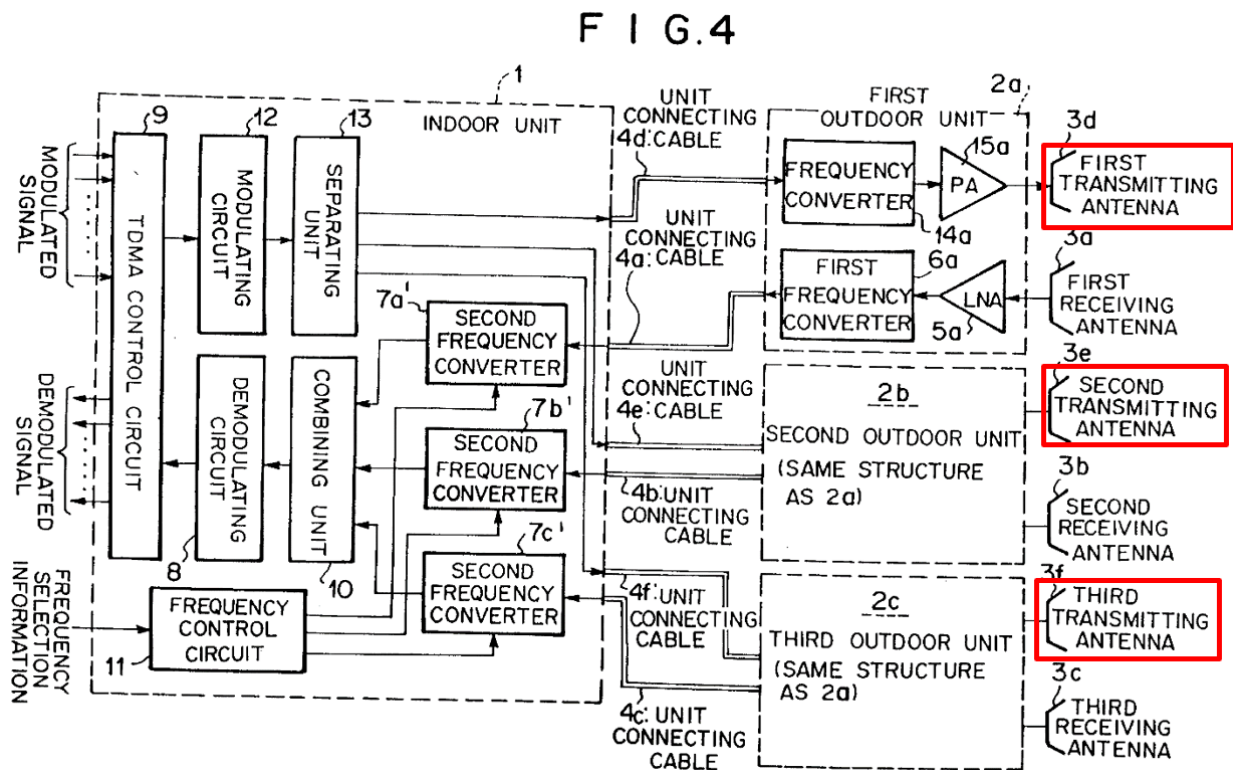
Regarding transmitting to “substantially only wireless access devices within an[]other of said sector using a second directed scanning beam signal,” Vornefeld describes using different antenna arrays (with different beams) for different sectors such that a second beam signal assigned to the different sector transmits to substantially only subscribers in a second sector. Ex. 1002, ¶107; Ex. 1004, 53 (explaining that different arrays “direct several beams to different positions conveying individual user signals”), 55 (“Forming directive beams ... to send different information to several locations”). In addition to there being different arrays for different sectors, the beams from one array are directed towards specific subscribers at their specific location. Ex. 1004, 52 (“multiple antenna beams that can be electronically directed to the mobile terminal (MT) locations adaptively”). This is the nature of beam forming, where an array targeting a particular sector can target the beam at a specific subscriber in that sector. Thus, Vornefeld transmits towards

“substantially only wireless devices” within that sector by, at least, using different arrays in different sectors for the first and second transmission and, under Patent Owner’s implied construction, aiming beams to different regions (regardless of the use of separate antenna arrays). Ex. 1002, ¶106; Ex. 1004, 53 (“steer the main beam pointing direction towards the estimated DoA of the desired MT”), Fig. 2.

Atsuta also describes directional antennas using beams to transmit to specific subscribers in specific sectors in which they are located. Ex. 1002, ¶107; 1005, 1:12-18 (“using a fan-shaped beam antenna for sectoring a service area”), 6:24-64 (“first to third transmission antennas that radiate the transmission frequency signals”), Fig. 4 (“first transmitting antenna,” “second transmitting antenna”). A POSA would have understood that such “directional” transmission would be transmitted to “substantially only wireless access devices” in the desired sector, as the same is the intent of a “fan-shaped beams” directed to a sector. Ex. 1002, ¶107; Ex. 1004, 52; Ex. 1005, 6:51-58.

Regarding transmitting “using an[]other of said directed scanning beam signals,” Atsuta describes sending downlink data to each sector using the directional transmitting antenna assigned to the respective sector. Ex. 1005, 6:31-64, Fig. 4 (“first transmitting antenna,” “second transmitting antenna”). Thus, the transmissions to different sectors in Atsuta use different antennas, with each having its own directed scanning beam signal. Ex. 1005, 1:12-18 (“using a fan-shaped beam

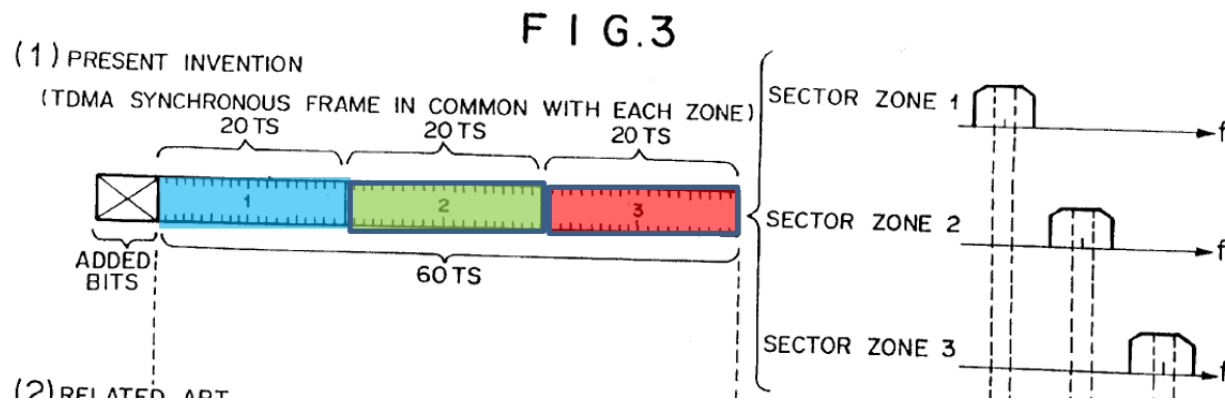
antenna for sectoring a service area”), 6:24-58 (“first to third transmission antennas that radiate the transmission frequency signals”). A POSA would understand that the use of a directional transmitting antenna to transmit data suggests a “directed scanning beam signal.” Ex. 1002, ¶107. Moreover, Vornefeld already describes using multiple beam signals to transmit to different sectors. Ex. 1004, 55 (“Forming directive beams ... to send different information to several locations”).



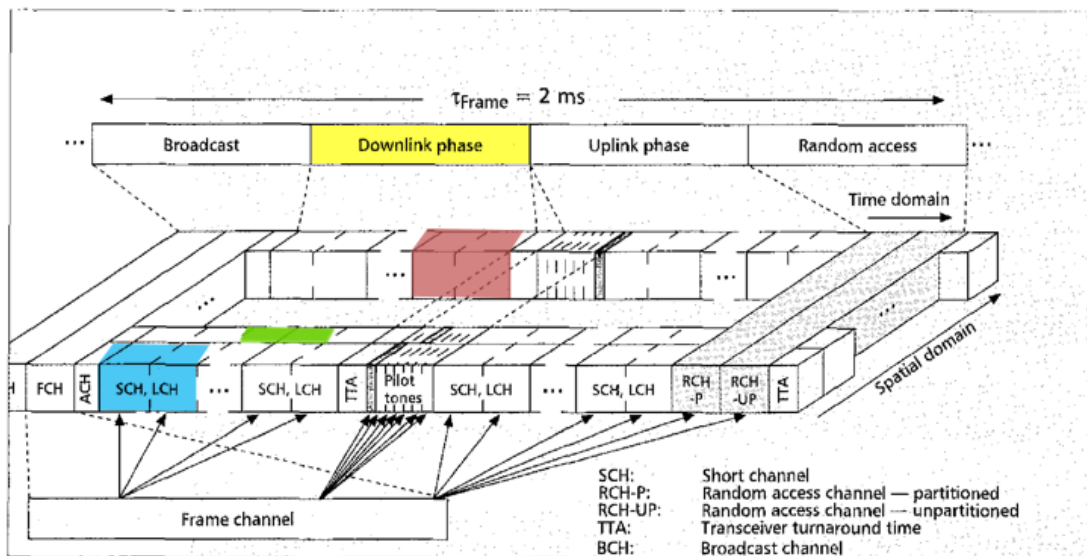
Ex. 1005, Fig. 4 (annotated).

A POSA would have readily understood how to incorporate Atsuta’s technique of transmitting to different subscribers (in different sectors) within a single TDD frame into Vornefeld’s system. Ex. 1002, ¶108. The equivalent downlink data

in Atsuta Fig. 3 and Vornefeld Fig. 3 are highlighted below. In Vornefeld's Fig. 3, each row is a transmission to a different portion of the cell site (as indicated on the "spatial domain" axis). Thus, the blue, green, and red downlink data in Vornefeld Fig. 3 show downlink data transmitted to subscribers in different sectors, and the same blue, green, and red downlink data are shown in Atsuta Fig. 3 all within a single frame.



Ex. 1005, Fig. 3 (annotated).



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

Ex. 1004, Fig. 3 (annotated).

Thus, the combination would use one known frame structure in place of another—specifically, Atsuta’s design that includes transmissions to multiple sectors in one frame. Ex. 1002, ¶¶109-111.

Vornefeld’s system is already capable of assigning time slots to different subscribers and directing beams to the subscriber locations. Ex. 1004, 53. Vornefeld recognizes that certain combinations of subscribers cannot be transmitted concurrently due to interference, so the transmissions must be split on the time axis. Ex. 1002, ¶112; Ex. 1004, 55-56. Atsuta describes this splitting on the time axis by transmitting to subscribers, in different sectors, in sequence in a single frame (which simplifies the hardware). Ex. 1005, 2:60-3:8, 6:31-58.

Because Vornefeld recognized the need to split up transmissions on the time axis, implementing Atsuta’s teachings of transmitting in sequential timeslots, where timeslots for different sectors are included within a single frame, would have been an obvious variation. Ex. 1002, ¶113.

2. Dependent Claim 29

Claim 29[p]: “The method as set forth in claim 19,”

As established above in Sec. V(A)(1), Vornefeld describes all of the features of claim 19.

Claim 29[a]: “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.”

For the reasons noted above for claim 28, this claim is also obvious over Vornefeld and Atsuta.

VI. Ground 2: Vornefeld in Combination with Goldberg

Vornefeld is prior art for the reasons already established above.

Goldburg was filed on December 10, 1997, making it prior art under at least 35 U.S.C. §§ 102(a) and 102(e) (pre-AIA). Goldburg was not previously considered by the USPTO.

As established above, Vornefeld describes all the features of claims 1 and 19 (*e.g.*, wireless communication system between a base station and subscribers using SDMA and TDMA techniques, TDD frame structure, etc.). Like Vornefeld, Goldburg is also directed to TDMA frame-based communication between a base station and subscribers. Ex. 1002, ¶117; Ex. 1006, Abstract, 2:13-33. These subscribers include fixed devices (“subscriber stations”). Ex. 1006, 1:16-22.

Goldburg describes transmitting to subscribers in different “regions” within a single TDD frame. Ex. 1006, 12:11-24. Goldburg uses the term “region” to mean a subdivision of the cell site. Ex. 1006, 20:8-39 (“Partition the parameter space into a finite number of regions whose union is the entire space”), 7:20-53, 27:30-35. Goldburg also uses the term “sector” in referring to the coverage area of an antenna

array. Ex. 1006, 4:6-18 (“the intended coverage region (i.e., the sector) of the antenna array”). Goldberg’s “regions” are created without regard to antenna array transmission area, and instead divide the area such that there are at least as many regions as subscribers. Ex. 1002, ¶117; Ex. 1006, 20:8-39 (“the number of regions is the number of co-channel users”). To the extent Patent Owner defines “sector” as simply a “portion of a cell site” (*see* Sec. IV(E) above), Goldberg’s “regions” describe these “sectors.” Nevertheless, Vornefeld in combination with Goldberg demonstrates that the Challenged Claims are obvious under any reasonable construction of “sector.”

By applying Goldberg’s technique to Vornefeld, each subscriber is assigned a separate region, and for each a region a weight vector is calculated based on the location of the subscriber relative to the base station. Ex. 1006, 20:8-39, 7:56-60 (“desirable weight vectors of the situation appropriate for the locations of the subscriber units”). The downlink signals to each region are then “weighted” using the weight vectors so that the signals are transmitted efficiently and a desired overall radiation pattern is achieved. Ex. 1006, abstract, 4:19-35. This technique enhances beamforming, such as that described in Vornefeld, by adjusting phase and amplitude to target individual subscribers and not interfere with nearby subscribers. Ex. 1002, ¶119. By using regions with just one subscriber, Goldberg’s weight vectors

(calculated for each region) allow for targeted, narrow beams, which reduce interference to nearby subscribers. Ex. 1002, ¶119.

Because Vornefeld provides the framework for using weight vectors but does not provide all the details of implementation (Ex. 1004, 56 (“weight vectors that control the beam pointing direction to maximize the amount of useful energy”)), a POSA would look at a variety of ways to implement this functionality, including Goldberg’s weight vectors for regions within the cell site. Ex. 1002, ¶134.

Vornefeld’s system already transmits to multiple subscribers within a single frame, while Goldberg allocates subscribers to different “regions” and calculates weight vectors to target those different regions. Ex. 1002, ¶119.

Goldberg’s base station sends downlink signals to subscribers using weight vectors to achieve the desired overall radiation pattern. Ex. 1006, Abstract, 6:6-7:53. The base station broadcasts common information (e.g., timing or synchronization data) to all subscribers using an omnidirectional radiated power pattern. Ex. 1002, ¶119; Ex. 1006, 1:17-47, 2:6-67.

Goldberg also transmits to subscribers in different regions using one frame as part of the TDMA protocol. Ex. 1002, ¶120; Ex. 1006, 3:47-4:18 (“timeslots may be used for [traffic channel] with one or more users”), 9:59-11:23. Goldberg describes eight timeslots, where one timeslot is reserved for common broadcast information (remaining slots are used to transmit directionally to specific subscribers). Ex. 1006,

3:47-4:18, 10:10-15, 12:11-24. This aligns with Vornefeld's teachings of using multiple timeslots for different users. Ex. 1004, 54.

A POSA would have been motivated to combine Goldberg's use of regions with Vornefeld's transmission system because the references are in the same field and address the same problems, *e.g.*, efficient broadcasting between a base station and subscribers using TDMA frame-structured communication that includes common broadcast information along with timeslots for specific subscribers. Ex. 1002, ¶121; Ex. 1004, 54-55 ("A MAC frame starts with two broadcast channels, the broadcast channel (BCH) and the frame channel (FCH)"); Ex. 1006, 1:48-2:12 "(It is especially applicable for [broadcast control channel] and [paging channel] that are used by a base station to simultaneously transmit common information to more than one subscriber").

Vornefeld recognizes that certain sets of subscribers are not suited for concurrent transmission due to signal interference constraints. Ex. 1004, 56. Thus, Vornefeld divides transmissions on the time axis. *Id.*, 55. Goldberg does the same, while also defining different regions for each subscriber to minimize interference, using weight vectors already disclosed in Vornefeld. Ex. 1002, ¶122; Ex. 1004, 53-54; Ex. 1006, 2:7-11, 6:20-8:45, 17:34-62.

Because both use a common channel for common information to all subscribers, transmit directed data to specific subscribers, and use weight vectors for

efficient transmission patterns this combination would not “result in a difference in function or give unexpected results.” *In re Rice*, 341 F.2d at 314; Ex. 1002, ¶123.

A POSA would have had a reasonable expectation of success in incorporating Goldberg’s regions into Vornefeld’s system. Ex. 1002, ¶124. Goldberg’s transmission to subscribers in different regions within a single frame matches Vornefeld’s MAC protocol, which transmits to different subscribers with “granularity.” Ex. 1006, 54. Also, Vornefeld’s antenna array allows the transmission beam to move for each time slot, so as to aim (using weight vectors) the different beams to different “regions,” which is what Goldberg describes. Ex. 1004, 53. And both references split up transmissions on the time axis to uses different beams to transmit to different subscribers in the same frame. Ex. 1002, ¶124.

A. Dependent Claim 28

Claim 28[p]: “The transceiver as set forth in claim 1”

Vornefeld teaches all the features of claim 1. *See* Sec. V(A)(1), *supra*.

Claim 28[a]: “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.”

Goldburg describes dividing an area into distinct regions and then transmitting to subscribers in those different regions within a single TDD frame. Ex. 1006, 12:11-18 (“Data destined for multiple mobiles and from multiple logical channels are put

together to form a GSM downlink frame. For example, time-slot 0 might contain a synchronization control channel (SCH) burst, time-slot 1 might contain TCH/F data for one mobile, . . . time-slot 6 might contain slow-associated control channel (SACCH) data for another mobile”). Ex. 1002, ¶127.

Regarding “transmit path circuitry,” Goldberg describes a “subsystem” for building TDD frames in a TDMA system. Ex. 1006, 12:25-13:13, Figs. 1(a), 1(b). This subsystem forms a frame with data to be sent to subscribers in different regions. Ex. 1002, ¶128; Ex. 1006, 12:11-33. Transmit path circuitry is also taught by Vornefeld, as established above.

Regarding the “transmit[ting], in said downlink portion of said TDD frame, second downlink data traffic to substantially only wireless devices within an[]other sector,” Goldberg describes how data “destined” for subscribers in different regions are put together in a single frame. Ex. 1002, ¶129; Ex. 1006, 12:11-33. Transmitting to subscribers in different regions is achieved through weight vectors, which are already used in Vornefeld.

Goldberg’s regions correspond to different sectors under Patent Owner’s construction because they are different portions of the cell site, each containing at most one subscriber. Ex. 1006, 7:24-29. Vornefeld also describes transmitting beams targeted to specific subscribers. Ex. 1004, 53 (“array antennas are able to simultaneously direct several beams to different positions conveying individual user

signals”), 55 (“Forming directive beams ... to send different information to several locations”). By targeting beams towards specific subscribers, the transmissions are directed towards “substantially only wireless devices” within the respective “region,” as taught by Golberg. Ex. 1002, ¶130; 1004, 53 (“steer the main beam pointing direction towards the estimated DoA of the desired MT”), Fig. 2.

While the Board found that Vornefeld did not explicitly describe transmitting to different sectors within a single frame, Goldberg makes clear that transmissions to different regions occur within a single frame. Goldberg’s “regions” are subdivisions of a cell site, defined without regard to antenna array transmission area, which matches Patent Owner’s implicit definition. Ex. 1006, 20:7-16; Ex. 1016, Ex. A, 34-35.

A POSA would understand that Goldberg transmission to subscribers in different regions within a single frame could be implemented in Vornefeld by simply partitioning the parameter space into regions such that each region includes at most one subscriber, thus causing Vornefeld to transmit to subscribers in different regions within a single frame. Ex. 1002, ¶131. Both Vornefeld and Goldberg utilize weight vectors to maintain efficient overall broadcasting patterns, with Goldberg’s technique of partitioning into regions furthering the goal of achieving a radiation pattern that facilitates efficient broadcasting (and in a single frame). Ex. 1002, ¶131.

Regarding “using an[]other of said directed scanning beam signals,” Goldberg and Vornefeld (*see* Sec. V(A)(1), *supra*) both describe using an antenna array to send different scanning beam signals to different subscribers. Ex. 1006, 5:25-58 (“beamformed so that the orthogonal signals are delivered to the different beams in the array antenna”), 8:57-65 (“form m complex valued (I, Q) signals for transmission by m antenna elements”), 13:34-63, Fig 1(d). A POSA would understand that antenna arrays transmit data to subscribers using different beams for each transmission because both describe separate transmissions to separate subscribers, where different weight vectors are used to target different users. Ex. 1001, 5:11-31 (“transmit forward channel (i.e., downstream) signals in directed beams”); Ex. 1002, ¶132; *see also* Ex. 1013, 22-23 (explaining Patent Owner’s position is that a scanning beam signal is just “beamformed signals directed to a portion of a cell site”).

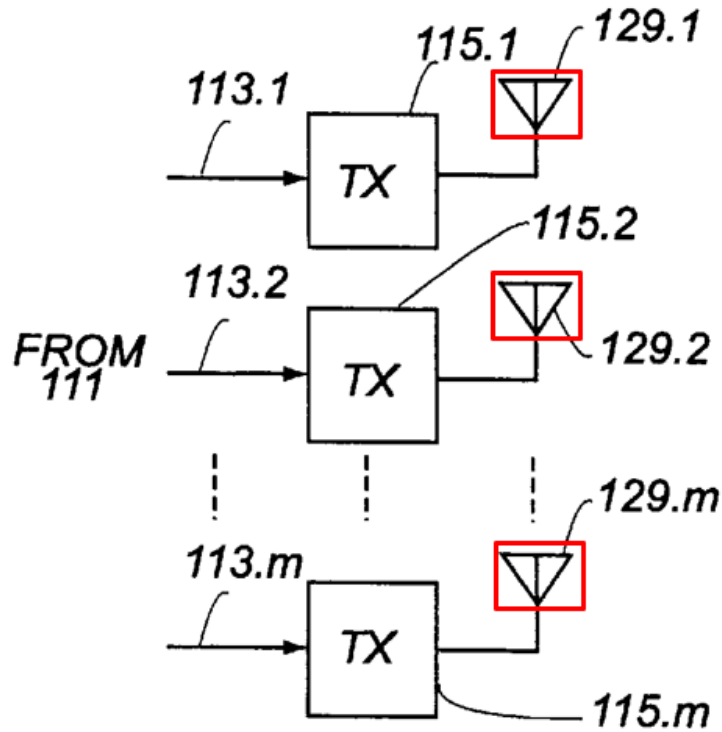


Figure 1(d)

Ex. 1006, Fig. 1(d) (annotated).

Also, the use of different scanning beam signals was already met by Vornefeld. Ex. 1002, ¶133; Ex. 1004, 55 (“Forming directive beams ... to send different information to several locations”).

For the reasons already discussed, a POSA would have understood how to incorporate Goldberg’s technique of transmitting to subscribers in different regions within a single frame into Vornefeld’s system. Ex. 1002, ¶¶134-135.

B. Dependent Claim 29

Claim 29[p]: “The method as set forth in claim 19,”

Vornefeld teaches all the features of Claim 19. *See* Sec. V(A)(1), *supra*.

Claim 29[a]: “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.”

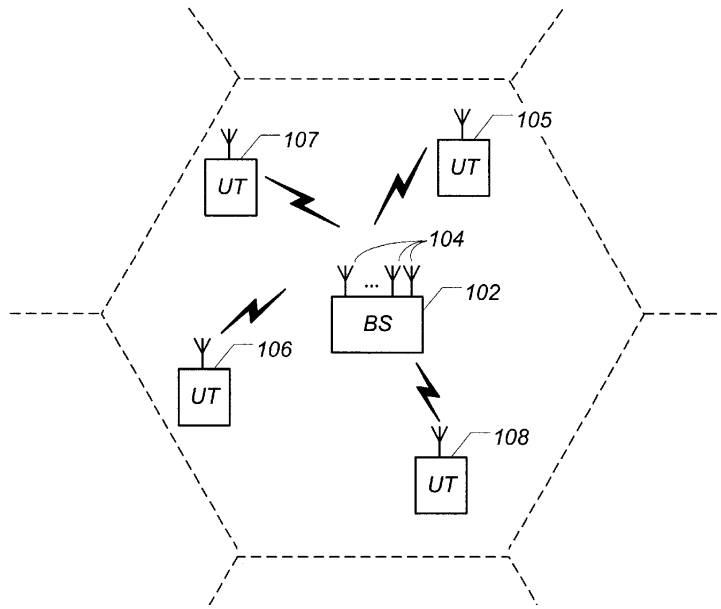
For the reasons discussed above with respect to claim 28, this claim is also obvious over Vornefeld and Goldberg.

VII. Ground 3: Claims 28 and 29 Are Obvious Over Youssefmir in Combination with Atsuta

Youssefmir was filed on September 29, 2000, making it prior art under at least 35 U.S.C. § 102(e) (pre-AIA). Youssefmir was not previously considered by the USPTO.

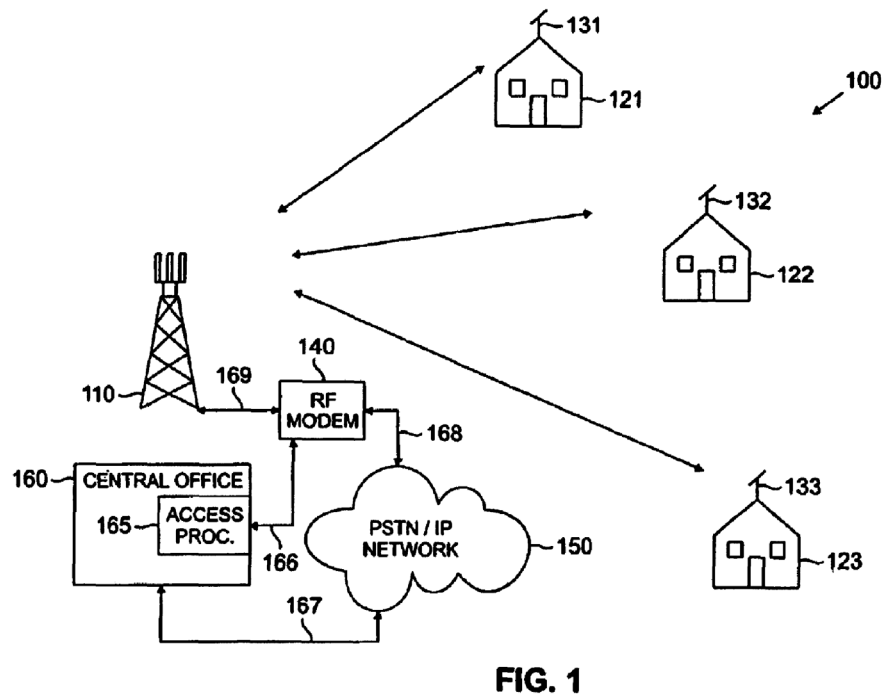
Atsuta is prior art for the reasons established above.

Youssefmir describes systems for wireless communication between a “base station having a smart antenna system” and “remote communication devices.” Ex. 1002, ¶139; Ex. 1007, Abstract. Youssefmir shows a system in which, in one cell site, a base station 102 has an array of antenna elements 104 that are used to communicate with user terminals 105-108 (which may be fixed), as shown below. Ex. 1007, 4:33-47; 1:29-34.



Ex. 1007, Fig. 1 (excerpt).

Youssefmir’s system may use a beamforming network 225. Ex. 1007, 7:33-61. A POSA would understand that Youssefmir describes that a sectorized cell site may be used, where different beams are transmitted to different sectors (and explains beams may be limited to a particular sector). Ex. 1002, ¶140; Ex. 1007, 14:5-19, 9:6-19 (“non-directional within the sector”); *see also* Ex. 1005, 1:13-24 (explaining that the conventional sector system uses different antenna apparatuses for different sectors to form a “fan-shaped beam antenna”). These features are similar to the design in the system in the ’931 Patent, which uses a base station 110 to communicate with various fixed user devices at premises 121-123 (see below). Ex. 1001, Abstract, 9:16-34; Ex. 1002, ¶¶140-141.

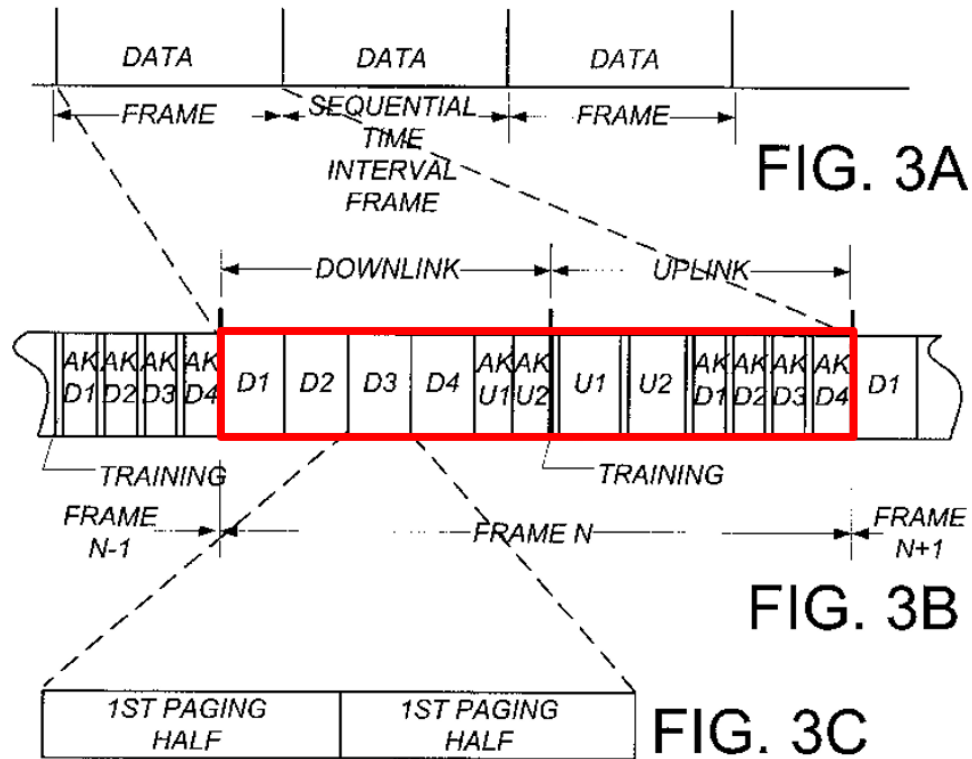


Ex. 1001, Fig. 1.

Youssefmir also describes that a TDMA-based system that uses TDD “so that the uplink and downlink frequency ... are the same.” Ex. 1002, ¶142; Ex. 1007, 7:1-7, 6:38-48 (also describing the use of SDMA). Youssefmir’s “directional signal pattern” design is intended to “enhance[]” the signal by, in part, “mitigating interference.” Ex. 1007, 6:38-48.

Youssefmir also details the structure of frames that may be used. Ex. 1002, ¶143. For instance, as shown in Fig. 3A-C, below, an example frame comprises a number of downlink slots (*e.g.*, D1, D2, etc.) and a number of uplink slots (*e.g.*, U1,

U2, etc.), which allow for transmission to multiple different user terminals in one frame. Ex. 1007, 18:15-19:8.



Ex. 1007, Fig. 3A-C (annotated).

Youssefmir does not explicitly state that the different downlink slots D1, D2 would be allocated to user terminals in different sectors; however, as discussed above, such a frame design was already taught by Atsuta (*see* Sec. V(B), *supra*). Ex. 1002, ¶144. Atsuta transmits to subscribers in different sectors within a single frame by employing a frame structure in which different slots are allocated to different subscribers across sectors. Ex. 1005, 6:24-58.

A POSA would have been motivated to combine Youssefmir and Atsuta for at least the reasons discussed above with respect to the combination of Vornefeld and Atsuta. Ex. 1002, ¶145. Notably, they are both directed to the same field and same problems, *e.g.*, efficient broadcasting between a base station and subscribers using TDMA frame-structured communication. *Id.* Moreover, Youssefmir describes transmitting downlink data to multiple subscribers in a single frame, and Atsuta provides additional detail by describing that the different subscribers may be in different sectors. Ex. 1007, 24:18-34; Ex. 1005, 6:24-58. Youssefmir recognizes sectorization of the cell site (Ex. 1007, 9:13-19, 14:5-19) such that implementing Atsuta's feature of transmission to different sectors within a single frame in Youssefmir's system of frame transmission would have been a simple and obvious design choice of the particular frame structure being used (particularly, given Atsuta's benefit of simplified hardware).

Atsuta's method also allows the signal processing circuitry to be simplified, reducing its size and power consumption. Ex. 1005, 2:60-64. Because Youssefmir's frame structure already describes transmission to different subscribers within a single frame, and Atsuta makes clear that the locations of those subscribers may be in different sectors, this combination would not change Youssefmir's function. *In re Rice*, 341 F.2d at 314; Ex. 1002, ¶146. Yousseffmir does not express a preference as to whether its subscribers transmitted to in one frame are in the same or different

sectors and Atsuta provides a known option on this point, making it a predictable variation. *Ball Aerosol*, 555 F.3d at 993 (“predictable variation” is obvious as a matter of law).

A POSA would have also had a reasonable expectation of success in combining Atsuta and Youssefmir. Ex. 1002, ¶147. Atsuta’s description of transmitting to multiple subscribers (in different sectors) within a single frame matches Youssefmir’s protocol, which already describes transmitting to multiple subscribers within a single frame. Ex. 1007, 24:18-34. Youssefmir recognizes the cell site may be sectorized, and describes directional transmitting antenna that can send downlink data to the desired subscribers in their respective sectors in the necessary timeslot. Ex. 1007, 1:35-40, 6:38-48, 9:13-19, 14:5-19; Ex. 1002, ¶147.

A. Independent Claim 1

Claim 1[a]: “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,”

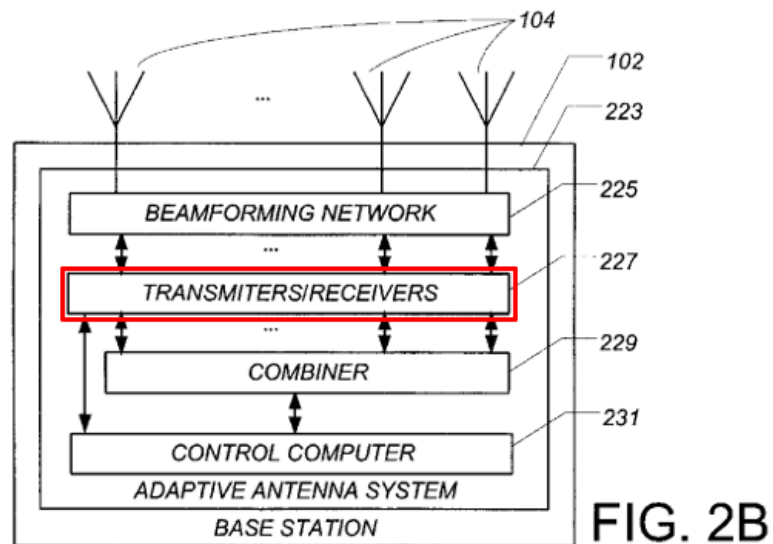
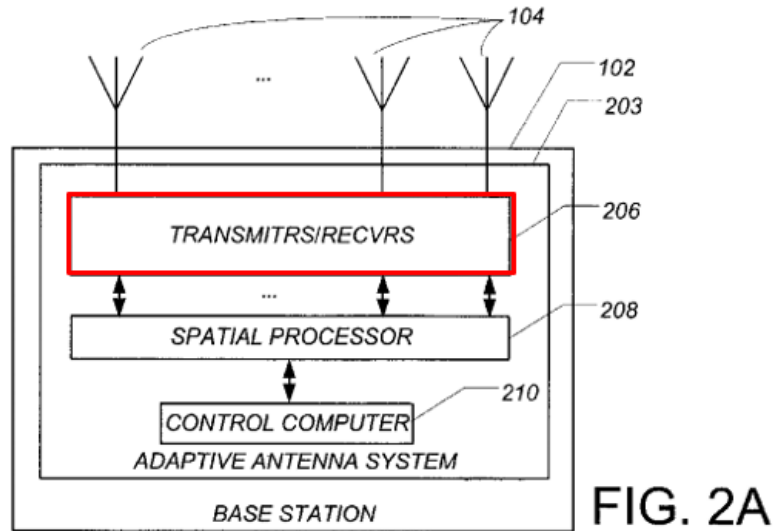
Youssefmir describes and/or suggests “a wireless access network comprising a plurality of base stations,” in that it describes a “cellular wireless communication system 100 having at least two base stations.” Ex. 1002, ¶149; Ex. 1007, Fig. 1, 4:33-47; *see also* Ex. 1005, 2:64-3:63, 4:44-5:30. Further, “each of said plurality of base stations [is] capable of bidirectional time division duplex (TDD) communication,”

because Youssefmir describes “time domain duplexing (TDD), so that the uplink and downlink frequency between a particular user terminal and its associated base station are the same.” Ex. 1007, 7:1-7, 23:36-39.

Further, Youssefmir suggests that its TDD design involves “communication with wireless access devices disposed at a plurality of subscriber premises” in the cell site. Youssefmir’s cell system has “a plurality of remote, possibly mobile user terminals” that conduct wireless TDD communication with the base station. Ex. 1007, Fig. 1, 4:33-47, 7:1-7, 26:36-39. These user terminals may also be stationary (*e.g.*, a “computer” or “video monitor”). Ex. 1007, 2:41-63, 4:33-48, 5:47-65. A POSA would understand that Youssefmir’s “user terminals” dispersed throughout a cell site qualify as “wireless access devices disposed at a plurality of subscriber premises in an associated cell site.” Ex. 1002, ¶150; Ex. 1007, Fig. 1.

Claim 1[b]: “a transceiver associated with a first of said plurality of base stations comprising:”

Youssefmir’s base stations each include at least one transceiver 206/227. Ex. 1007, 4:54-62 (“transceivers”), Fig. 1. Figures 2A and 2B illustrate embodiments of these transceivers. Ex. 1007, 1:29-35; *see also* Ex. 1005, 4:34-36, 6:54-46.



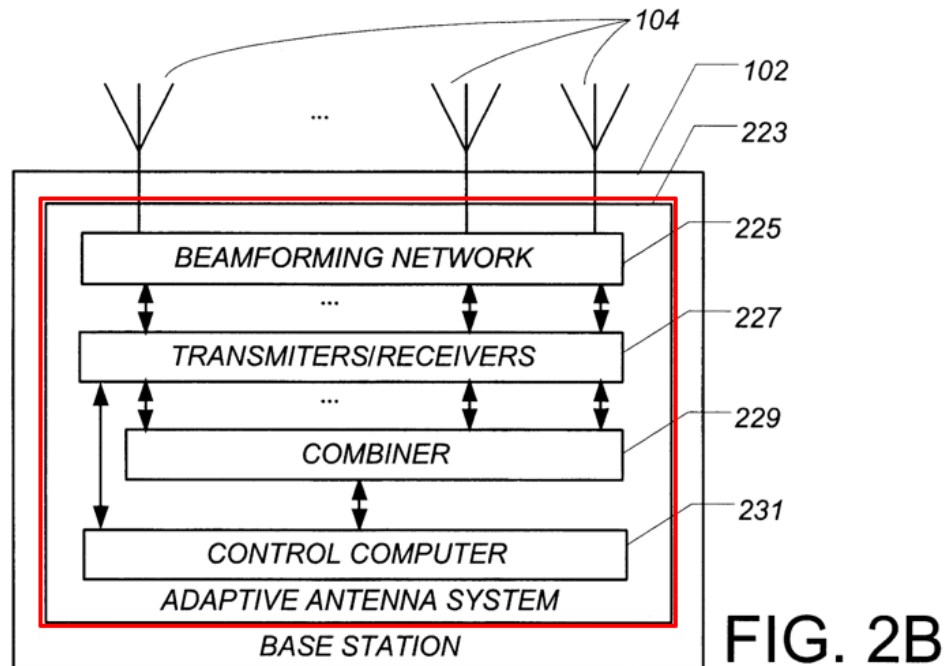
Ex. 1007, Figs. 2A, 2B.

Claim 1[c]: “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,”

Regarding “transmit path circuitry associated with a beam forming network,”

Youssefmir describes an adaptive antenna system with transceivers, a combiner, and

a control computer. Ex. 1007, Fig 2B, 7:33-60; *see also* Ex. 1005, 6:24-61. These elements comprise hardware components controlled by one or more processors. Ex. 1007, 28:39-29:12. A POSA would understand that this disclosure suggests “transmit path circuitry.” Ex. 1002, ¶152.



Ex. 1007, Fig. 2B.

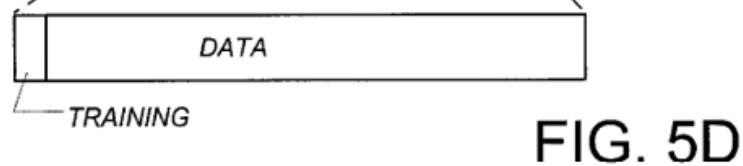
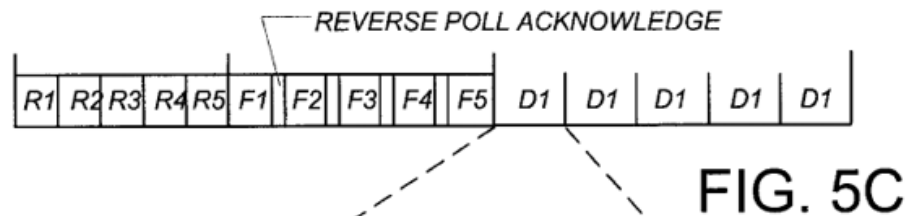
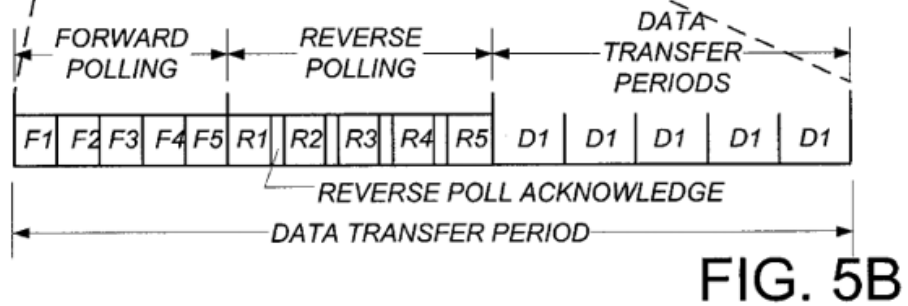
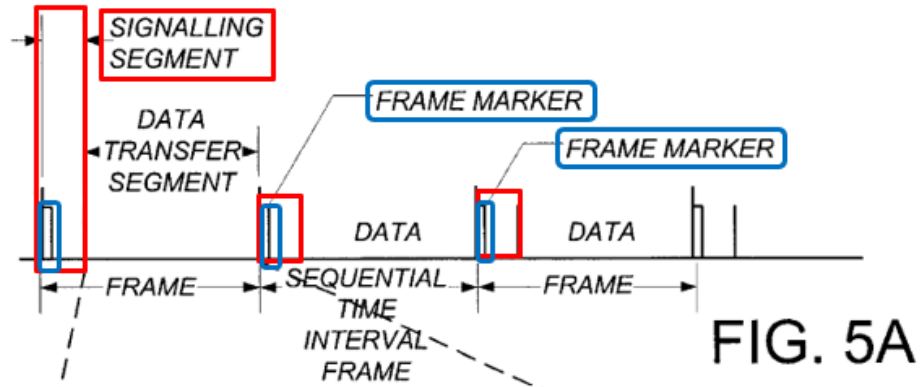
Regarding “a beam forming network capable of transmitting directed scanning beam signals each directed to substantially only wireless access devices within a different one of a plurality of sectors of a cell site,” Youssefmir’s base station transceiver transmits downlink data directionally to remote (wireless) user terminals. Ex. 1007, 5:31-40, 6:23-37, 1:40-51, 4:34-48 (“wireless communication”). Moreover, Youssefmir describes using an antenna array to

transmit different beams to different sectors of the cell site. Ex. 1002, ¶140; Ex. 1007, 5:31-40 (“smart antenna system has an array of antenna elements, a beamforming network that forms a set of fixed beams for the antenna elements”), 6:23-48 (“With SDMA, more than one user terminal associated with the first base station can communicate with the first base station on the uplink on the same “conventional” channel . . . so long as the co-channel remote users are spatially separated”), 9:13-19, 14:5-19. In particular, Youssefmir describes using the beams in a directional manner to mitigate interference. Ex. 1002, ¶¶140, 153; Ex. 1007, 7:62-8:4 (“directional signal pattern that enhances the signal link”), 14:5-19 (“sectorized system”), 9:13-19 (“sectorized system”). The base station antenna systems in Figs. 2A and 2B have directional antennas that transmit to different sectors. Ex. 1007, 7:33-61, 8:5-12.

In Youssefmir, each sector has a corresponding antenna array that uses beam forming within the sector. Ex. 1007, 4:55-57 (“smart antenna system”), 4:13-15. Furthermore, Atsuta makes clear that sectorized systems use different antenna arrays directed at different slices of the cell cite so as to transmit to substantially only subscribers within that sector. Ex. 1005, 1:13-18, 6:31-64, Fig. 4 (“first transmitting antenna,” “second transmitting antenna,” “third transmitting antenna”); Ex. 1002, ¶106.

Claim 1[d]: “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”

Regarding “transmit[ting], at a start of a TDD frame, a broadcast beam signal,” Youssefmir describes the use of TDD frames, as shown in Figs. 3-5. Ex. 1007, 17:50-59, 18:15-19:29, 23:35-50, 24:11-45, 25:52-26:11; *see also* Ex. 1005, Fig. 3 (“Added Bits”). Youssefmir uses a “signaling segment” and “frame marker” that is broadcast at the start of a TDD frame, as shown below with respect to Figs. 5A-C. Ex. 1007, Figs. 5A-5C, 18:23-33. The signaling segment and frame marker serve to synchronize all remote user terminals to the timing sequence of the base station. Ex. 1002, ¶154; Ex. 1007, 25:52-62.



Ex. 1007, Figs. 5A-5C (annotated); *see also* Figs. 3A-C.

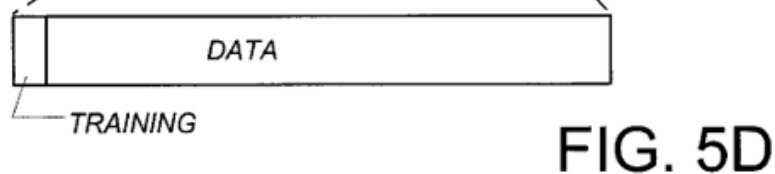
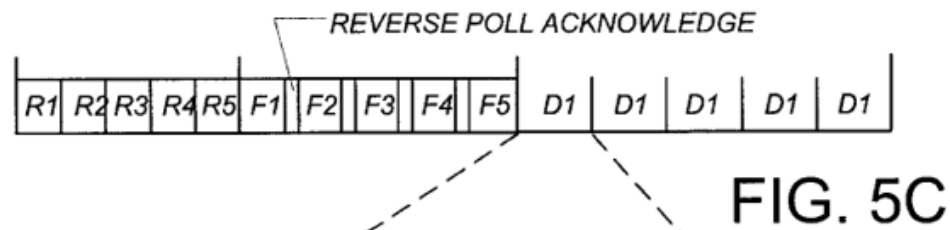
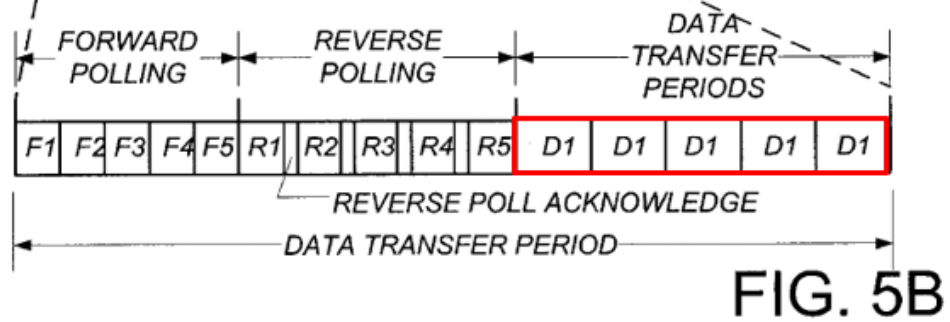
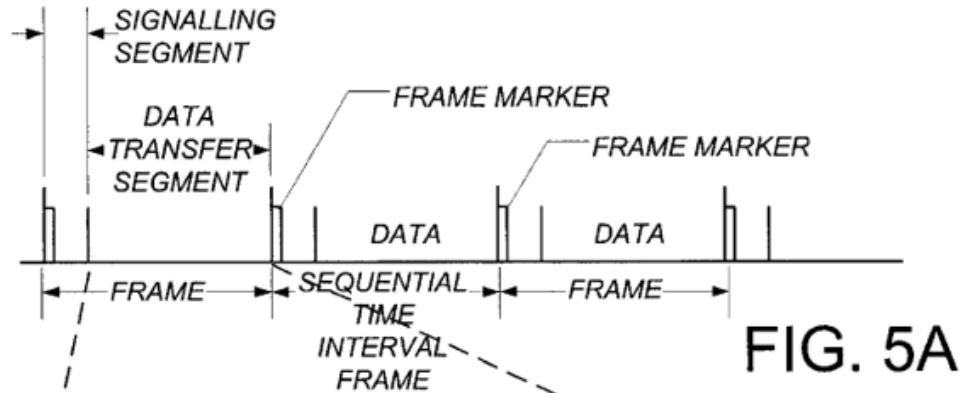
Further, this starting signal is sent to “wireless access devices within more than one of said sectors.” Youssefmir’s signaling segment and frame marker are sent to all users in the cell site to coordinate timing with the base station. Ex. 1007, Fig.

5A. As discussed, the cell site is sectorized such that the transmission to all users would be understood to be across sectors. Ex. 1002, ¶155.

Regarding “start of frame field,” as a POSA would appreciate, the “signaling segment” qualifies because, as shown above with respect to Fig. 5A, it appears at the start of the frame. Ex. 1002, ¶156; Ex. 1007, Fig. 5A.

Claim 1[e]: “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.”

Regarding “subsequently transmit[ting], in a downlink portion of said TDD frame, first downlink data traffic,” Youssefmir’s Fig. 5 illustrates that, subsequent to the signaling segment at the start of the TDD frame, multiple data slots are reserved for downlink data traffic, as shown below. Ex. 1002, ¶157; Ex. 1007, 13:12-24, 25:52-26:11, Figs. 3-5; *see also* Ex. 1005, 5:21-54, Fig. 3.



Ex. 1007, Figs. 5A-5D (annotated).

Regarding transmitting “to substantially only wireless access devices within one of said sectors,” Youssefmir describes using an antenna array “in a manner that effectively provides a directional signal pattern that enhances the signal link.” Ex.

1007, 7:33-8:39. By using a directional signal pattern to transmit to subscribers in a particular sector, Youssefmir's system is able to transmit downlink data to "substantially only wireless access devices within one of said sectors." Ex. 1002, ¶158.

Regarding "directed scanning beam signals," Youssefmir describes using a smart antenna system and a beamforming network that uses a fixed beam to transmit downlink data to a particular subscriber in a particular sector. Ex. 1007, 1:40-55 ("a "switched beam" system that includes a beamformer forming several fixed beams and a mechanism for combining one or more beams"), 5:31-40, 6:23-67, 7:33-61, Abstract. Youssefmir's smart antenna system transmits a "directional signal pattern" that enhances the signal from the base station to the user terminal. Ex. 1007, 6:38-48. A POSA would understand that the use of a smart antenna system and a beamforming network that uses a fixed beam to transmit data suggests the use of a "directed scanning beam signal." Ex. 1002, ¶159.

B. Dependent Claim 28

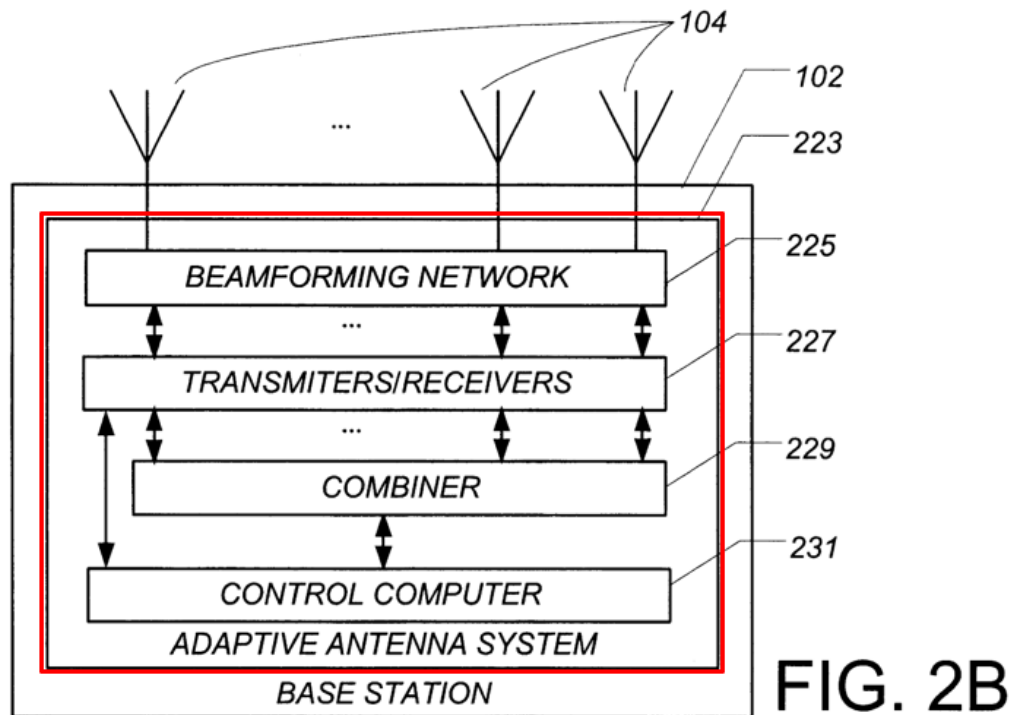
Claim 28[p]: "The transceiver as set forth in claim 1"

Claim 1 is obvious over Youssefmir in view of Atsuta. *See* Sec. VII(A), *supra*.

Claim 28[a]: "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."

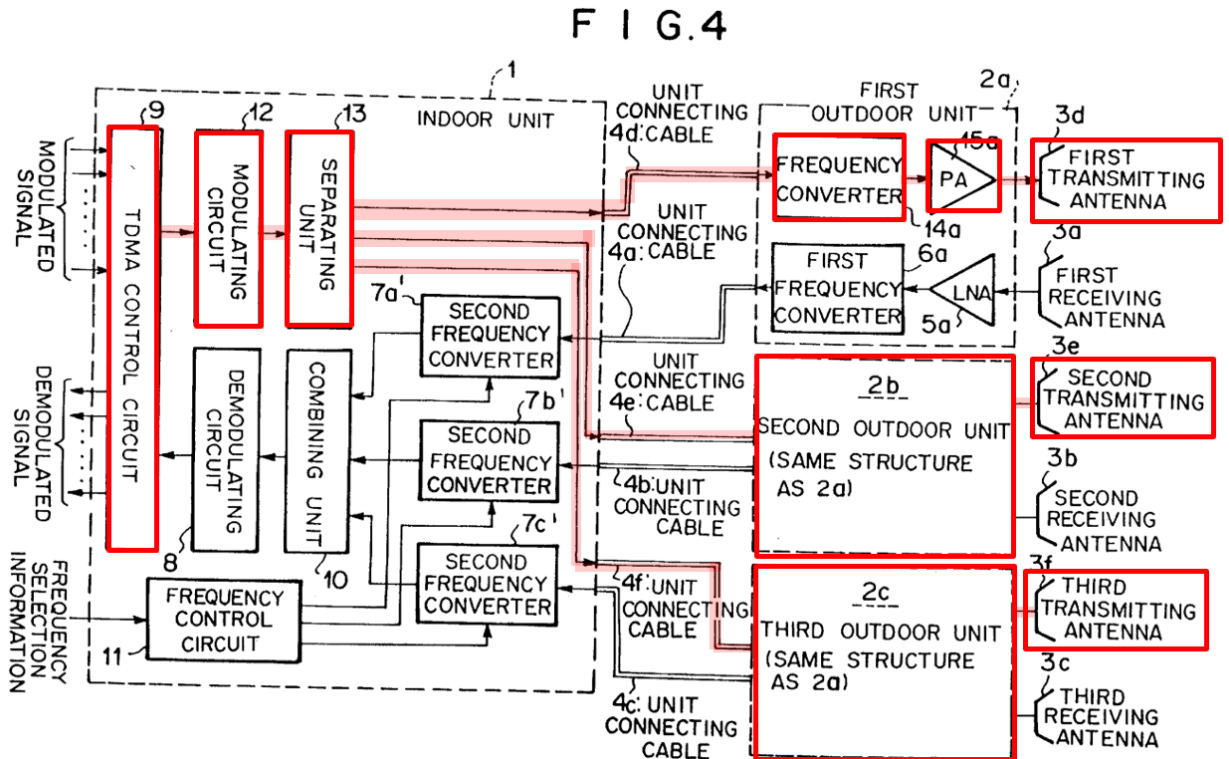
As discussed, Youssefmir describes transmitting downlink data from a base station to multiple remote users within a single TDD frame. Ex. 1007, 13:1-44, 18:66-19:8, 24:18-34. Youssefmir also makes clear that the cell site may be sectorized using directional antenna systems. Ex. 1002, ¶161; Ex. 1007, 1:35-65, 9:15-16. And Atsuta specifically describes transmitting downlink data to subscribers in different sectors within a single TDD frame. Ex. 1005, 6:24-61, Fig. 3.

Regarding “transmit path circuitry,” Youssefmir describes an adaptive antenna system with a beamforming network, transceivers, combiner, and control computer. *See* Sec. VII(A), *supra*; Ex. 1002, ¶162; Ex. 1007, Fig. 2b, 7:33-60.



Ex. 1007, Fig. 2B.

Atsuta also describes “transmit path circuitry” in the form of a control circuit, modulating circuit, separating unit, frequency converters, and power amplifiers. Ex. 1002, ¶163; Ex. 1005, 6:35-64, Fig 4.



Ex. 1005, Fig. 4.

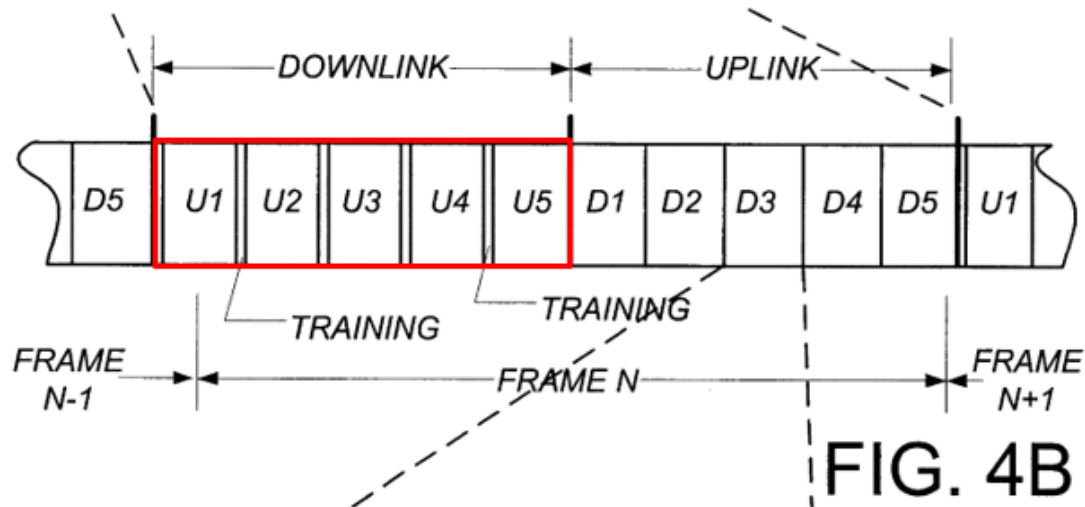
Both Youssefmir’s “adaptive antenna system” and Atsuta’s system are used to transmit downlink data from the base station to subscribers. Ex. 1007, 7:33-8:12, Abstract; Ex. 1005, 6:35-58. Both utilize a “control unit”— *e.g.*, a “control computer” in Youssefmir and a “control circuit” in Atsuta—to handle downlink data for all the subscribers and pass the downlink data through a “combining/separating unit”—*e.g.*, a “combiner” in Youssefmir and a “separating unit” in Atsuta—to

distribute the downlink data to the appropriate transmitting antenna. Ex. 1007, 6:49-8:12; Ex. 1005, 6:24-61. Thus, POSA would understand that both systems suggest “transmit path circuitry,” as claimed. Ex. 1002, ¶164.

Regarding “transmit[ting], in said downlink portion of said TDD frame,” Youssefmir describes a TDD frame system that sends both uplink and downlink signals. Ex. 1007, 7:1-22 (“TDD”), 13:11-24, 15:15-17, 23:35-50, Fig. 4B. Each frame includes “a selected number of downlink data transfer periods (timeslot),” to which different users are assigned. Ex. 1007, 13:11-24, 24:18-34, Fig. 4B. Similarly, Atsuta describes a “single synchronous frame,” within which downlink signals meant for transmission to subscriber stations in different zones are sequenced. Ex. 1005, 6:35-64. A POSA would have understood that the frames described by Atsuta are TDD frames, as claimed, for reasons already discussed above. Ex. 1002, ¶165.

Claim 1, discussed above, recites transmitting first downlink data to devices within one of the sectors. Claim 28 adds a transmission of “second downlink data to substantially only wireless access devices within an[]other of said sectors” in the same TDD frame. Youssefmir describes dividing the downlink portion of a TDD frame into “data transfer periods,” or timeslots. Ex. 1007, 13:12-41, 24:18-34, Fig. 4B. Figure 4B below is annotated to show the downlink “data transfer periods” or timeslots. Note Fig. 4B (perhaps erroneously) labels the “downlink” timeslots U1,

U2, U3, etc., and the “uplink” data timeslots D1, D2, D3, etc., but this does not affect the applicability of the information. Ex. 1002, ¶166.

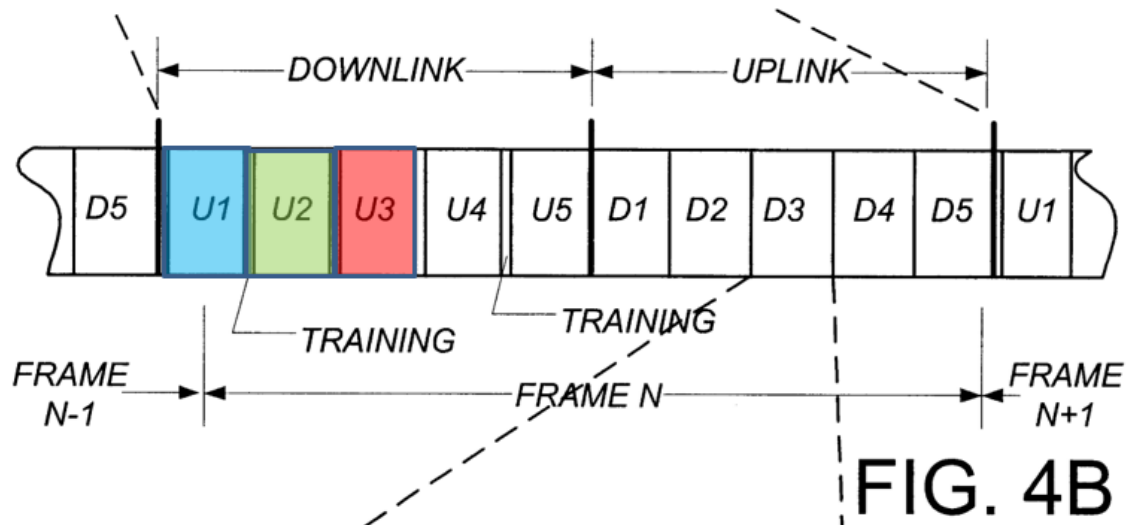


Ex. 1007, Fig. 2B.

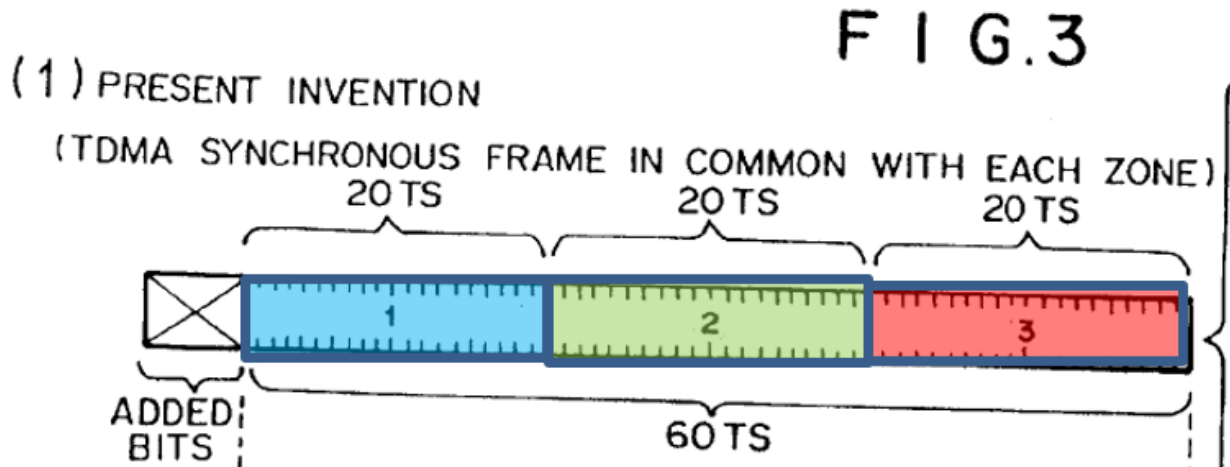
Youssefmir describes how each user is assigned to a downlink timeslot. Ex. 1007, 24:18-34. Thus, during timeslot U1, first downlink data is transmitted to a first user, and during timeslot U2, second downlink data is transmitted to a second user. This occurs in a single TDD frame (“Frame N”). Thus, Youssefmir describes transmitting “second downlink data.” Ex. 1002, ¶167. Youssefmir describes using a “beamforming network” that forms a set of fixed beams to transmit this data to each user. Ex. 1007, 33-61. 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; Ex. 1007, 9:13-19, 14:5-19. Atsuta describes how the users assigned to certain downlink slots in a single frame may be located in

different sectors. Ex. 1005, 6:24-58, Fig. 3. Atsuta's Fig. 3 illustrates data transmission to subscribers in different sectors within a single TDD frame. Ex. 1002, ¶168. The frame comprises 60 timeslots ("TS"), and every 20 TS is assigned to a different sector: first 20 TS to sector zone 1, second 20 TS to sector zone 2, and last 20 TS to sector zone 3.

The equivalent downlink data in Youssefmir Fig. 4B and Atsuta Fig. 3 are highlighted below.



Ex. 1007, Fig. 4B (annotated).



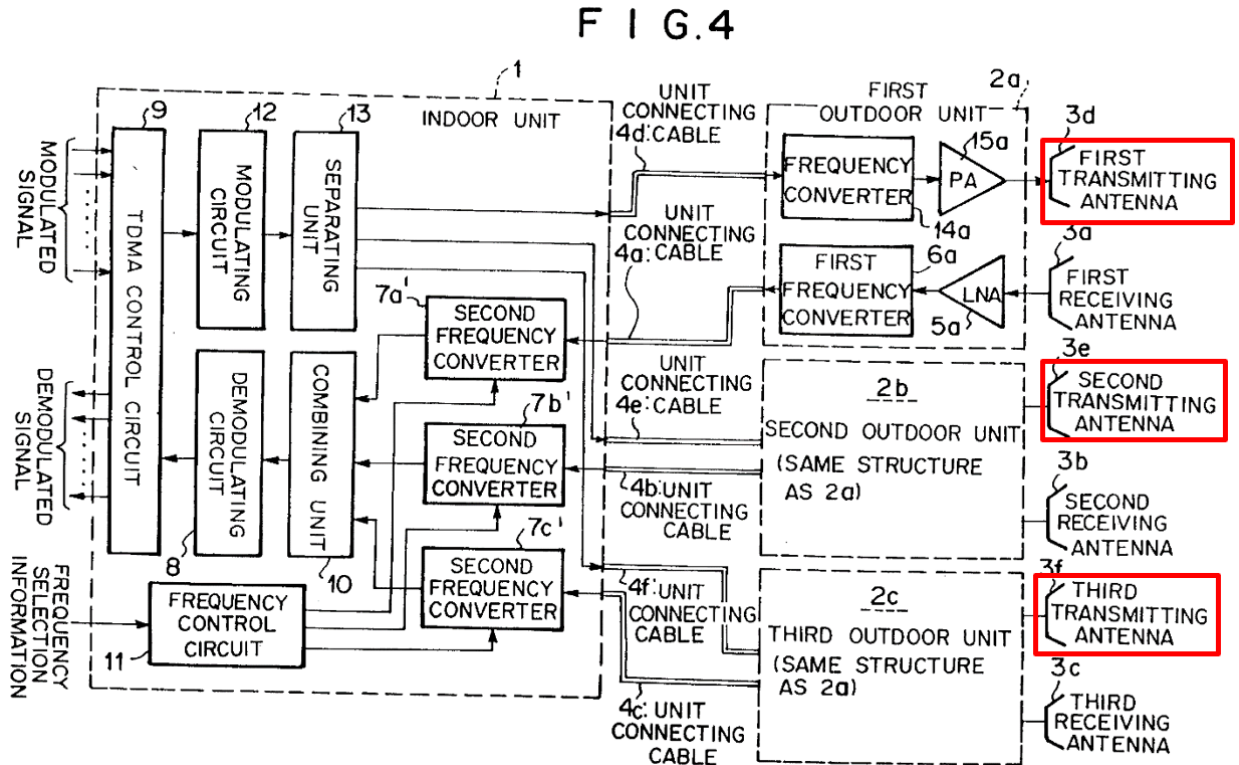
Ex. 1005, Fig. 3 (annotated).

A POSA would have understood that applying Atsuta's feature of transmitting downlink data to different sectors within a single frame allows for simplified hardware structure. Ex. 1002, ¶169. Moreover, Youssefmir describes that a single TDD frame is used to transmit to multiple user devices, with no limitation as to whether those user devices are located in the same or different sectors. As discussed above in Sec. V(B), Atsuta's use of single TDD frame across sectors allows for a reduction in the number of processing circuits down to a single circuit, reducing its size and power consumption. Ex. 1005, 2:46-3:8. Youssefmir recognizes that insufficient processing capabilities is a concern. Ex. 1007, 22:24-33 (suggesting "alternative embodiments" for scenarios where "the control computer does not have sufficient computational power"). Because Atsuta's single-frame structure alleviates computational limitation concerns contemplated in Youssefmir by reducing the

required number of functional circuits (and therefore the overall computational requirements), while still enjoying benefits of sectorization, a POSA would have had a logical reason for the combination. Ex. 1002, ¶169.

With respect to the second transmission “using an[]other of said directed scanning beam signals,” (*i.e.*, a beam different than that used to send the first traffic data to the “one sector”), directional beam antennas employ different beams to communicate with different sectors (and different users). Ex. 1002, ¶170; Ex. 1005, 1:13-18. Both Atsuta and Youssefmir describe such sectorized systems. Ex. 1005, 1:13-18; Ex. 1007, 9:13-19, 14:5-19. Youssefmir describes using a “directional” smart antenna system with an array of antenna elements and a beamforming network to transmit downlink data from the base station to remote units throughout the cell site. Ex. 1007, 1:35-56, 5:31-40, 6:23-67, 7:33-61. Youssefmir transmits a “directional signal pattern” from the base station to a particular user terminal in a particular location, and uses another beam for the next user. Ex. 1007, 6:38-48. Similarly, Atsuta describes sending downlink data to each sector using the directional transmitting beam antenna assigned to that sector. Ex. 1005, 6:31-64. In particular, Atsuta describes how downlink data meant for three sectors is arranged into a single frame, and then transmitted using “first to third transmission antennas that radiate the transmission frequency [beam] signals” to each respective sector. Ex.

1005, 6:31-64, Fig. 4 (“first transmitting antenna,” “second transmitting antenna,” “third transmitting antenna”).

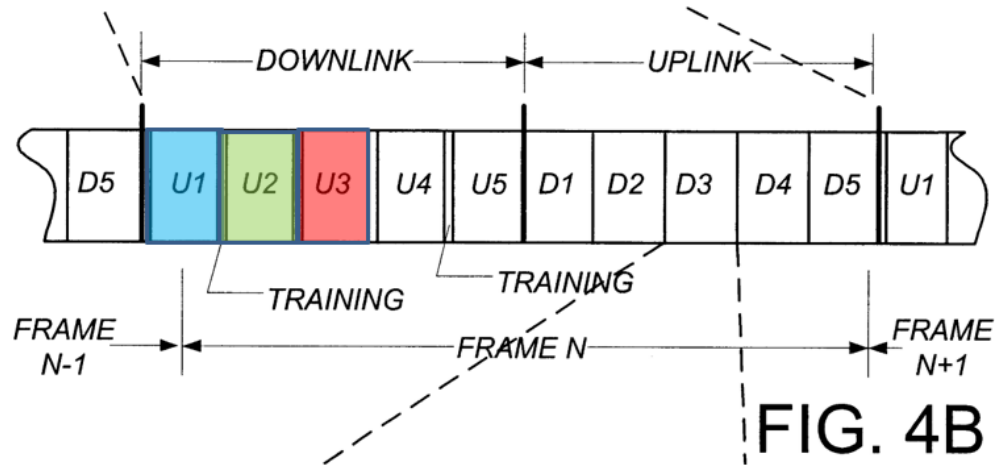


Ex. 1005, Fig. 4 (annotated).

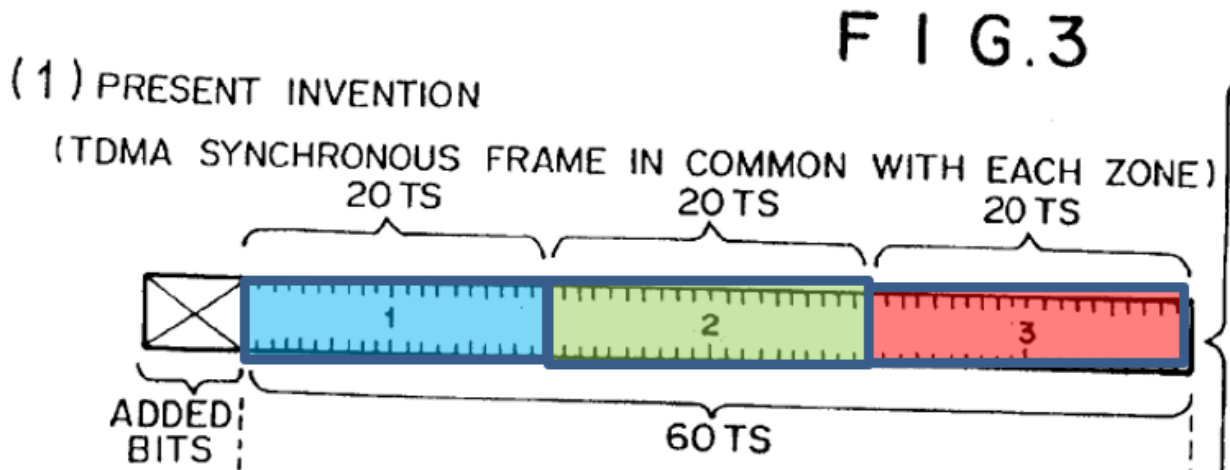
A POSA would have understood that the use of multiple directional transmitting antennas, each transmitting downlink data to different users in different sectors, suggests the use of “an[]other of said directed scanning beam signals.” Ex. 1002, ¶171.

In addition, a POSA would have readily understood how to incorporate Atsuta’s technique of transmitting to different subscribers (in different zones) within a single TDD frame into Youssefmir’s system because the downlink portions of the

frame are both comprised of timeslots that can be assigned to the desired subscribers.
 Ex. 1002, ¶172; Ex. 1007, 24:18-34, Ex. 1005, 5:35-54. The equivalent downlink portions of the frames in Youssefmir Fig. 4B and Atsuta Fig. 3 are highlighted below.



Ex. 1007, Fig. 4B (annotated).



Ex. 1005, Fig. 3 (annotated).

Thus, a POSA would understand that this combination would simply use similar timeslot assignment techniques, just that the timeslots spanned sectors. Ex. 1002, ¶173.

C. Independent Claim 19

Claim 19[a]: “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:”

For the reasons established above in Sec. VII(A), 1[a], this claim element is obvious over Youssefmir in view of Atsuta.

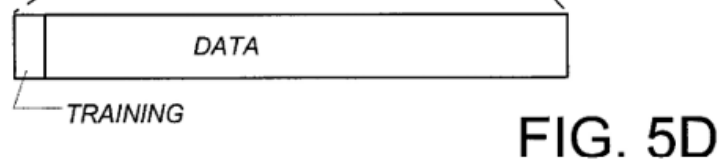
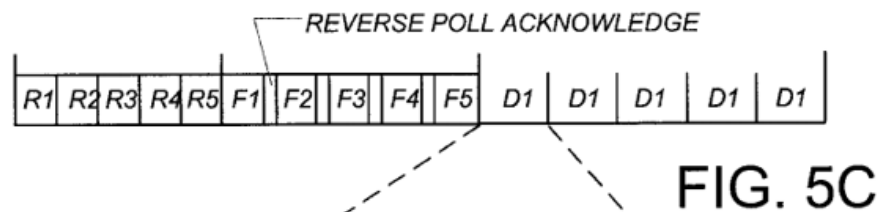
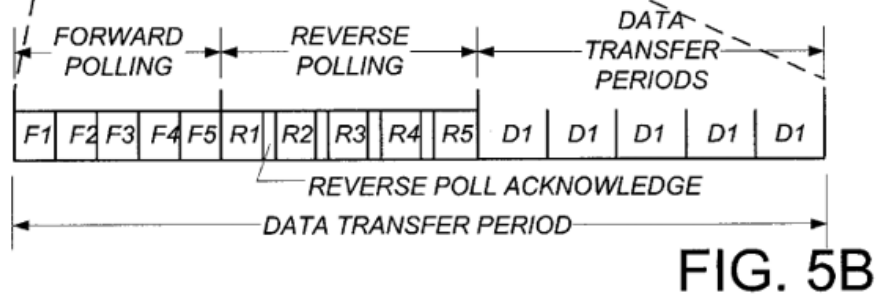
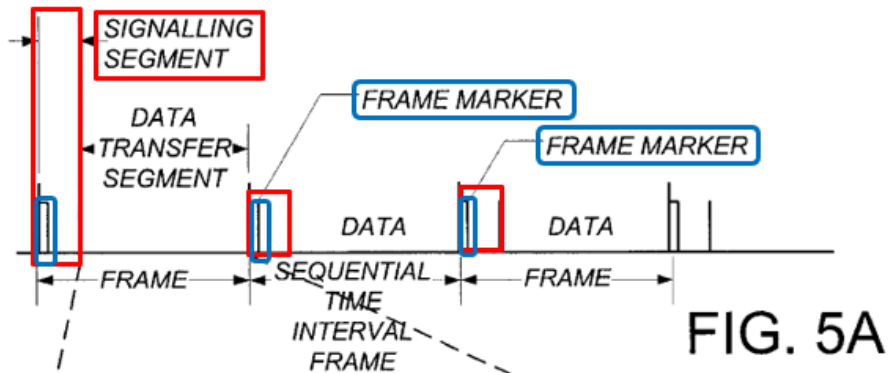
Claim 19[b]: “transmitting, at a start of a TDD frame, a broadcast beam signal to wireless access devices within more than one of a plurality of sectors within said associated cell site,”

For the reasons established above in Sec. VII(A), 1[d], this claim element is obvious over Youssefmir in view of Atsuta.

Claim 19[c]: “the broadcast beam signal comprising a start of frame field capable of synchronizing receivers in said wireless access devices; and”

Regarding a “broadcast beam signal comprising a start of frame field,” Youssefmir describes TDD frames, as shown in Figs. 3-5. Ex. 1007, 17:50-59, 18:15-19:29, 23:35-50, 24:11-45, 25:52-26:11; *see also* Ex. 1005, Fig. 3 (Added

Bits). Regarding the TDD frames, Youssefmir describes a “signaling segment” that is broadcast at the beginning of each frame from the base station to all remote users. Ex. 1002, ¶176; Ex. 1007, 25:52-52, Figs. 5A-5C. Indeed, as shown below with respect to Fig. 5A, the signaling segment appears at the start of the frame.



Ex. 1007, Fig. 5A (annotated).

Regarding the start of frame field being “capable of synchronizing receivers in said wireless access devices,” Youssefmir describes the signaling segment being sent from the base station to all the remote units to synchronize timing. Ex. 1007, 25:51-62. A POSA would have understood that synchronizing remote units to the timing sequence of the base station suggests “synchronizing receivers in wireless access devices.” Ex. 1002, ¶177.

For these reasons and the reasons established above in Sec. VII(A), 1[d], this claim element is obvious over Youssefmir in view of Atsuta.

Claim 19[d]: “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.”

For the reasons established above in Sec. VII(A), 1[e], this claim element is obvious over Youssefmir in view of Atsuta.

D. Dependent Claim 29

Claim 29[p]: “The method as set forth in claim 19,”

For the reasons established above with respect to claim 19, this element is obvious over Youssefmir in view of Atsuta.

Claim 29[a]: “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.”

For the reasons established above with respect to claim 28, this claim element is obvious over Youssefmir in view of Atsuta.

VIII. Grounds 4 and 5: The Challenged Claims are Obvious Over Vornefeld and Atsuta, in Further View of Tangemann, and Over Vornefeld and Goldberg, in Further View of Tangemann

Tangemann published in 1994, making it prior art under 35 U.S.C. § 102(b) (pre-AIA). Ex. 1019, ¶¶49-56.

As discussed above, in the Related Litigation, Patent Owner uses the term “sector” to mean a “geographic portion of the cell site.” Ex. 1016, Ex. A at 35. Tangeman describes “sectors” as used by Patent Owner. Thus, the Challenged Claims are also obvious based on Vornefeld and Atsuta in further view of Tangemann and Vornefeld and Goldberg in further view of Tangemann.

Like the '931 Patent, Tangemann describes a one-to-many wireless communication system, with a base station communicating with subscribers in a cell site. Ex. 1002, ¶185; Ex. 1008, 745. Tangemann describes dividing a cell site into “minisectors,” each “minisector” being a “slice” of the total cell site. Ex. 1008, 746, Fig. 2.

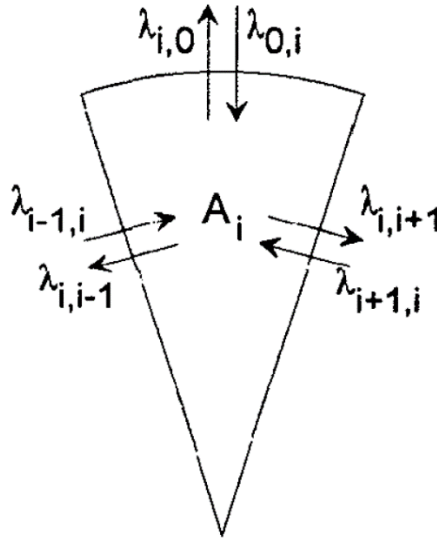


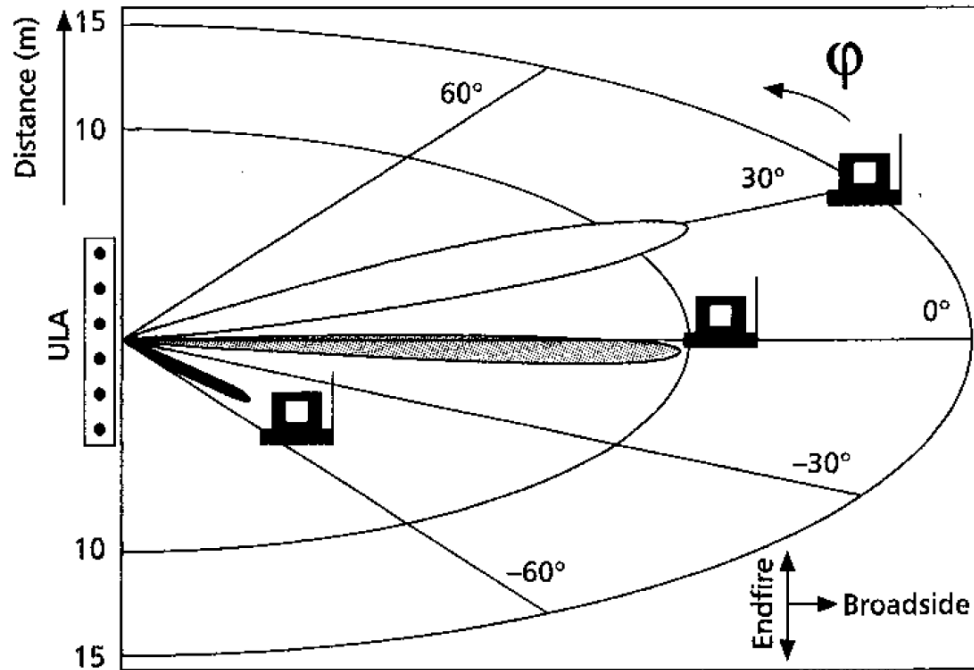
Fig. 2: Flow model for a minisector

Ex. 1008, Fig. 2.

Dividing the cell site into minisectors allows a more precise calculation of angular user density—where users are located in the cell site—by applying a user mobility model that tracks the movement of subscribers into and out of each minisector. By gaining more precise information about subscribers’ locations, the method allows for more precise beam transmission from the base station to the subscriber. Ex. 1002, ¶186; Ex. 1008, 746-747. Narrower, more precise beam transmission allows frequency channels to be re-used and reduces interference between channels. Ex. 1008, 745. Tangemann’s minisectors are defined slices of the cell site served by “independent beams” from an “adaptive array antenna.” *Id.*; *see id.*, 746 (“different angular positions”), 749 (“multiple independent beams”).

Tangemann's minisectors divide the cell site as needed, without regard to the transmission area of an antenna array. Ex. 1002, ¶187; Ex. 1008, 746. This matches Patent Owner's desired definition of sector. Ex. 1016, Ex. A, 34-35. Thus, these additional grounds are provided out of an abundance of caution and without assenting to Patent Owner's infringement theory.

A POSA would have been motivated to combine Tangemann's minisectors with Vornefeld's system because both describe beamformed wireless communication between a base station and subscribers, with the goal of efficiently utilizing transmission resources and minimizing interference between transmissions. Ex. 1002, ¶188. Both Vornefeld and Tangemann utilize SDMA techniques to send transmissions throughout the cell site. Ex. 1004, Fig. 2; Ex. 1008, Fig. 1. And both use beamforming to target subscribers. Ex. 1004, 52; Ex. 1008, 745.



Ex. 1004, Fig. 2.

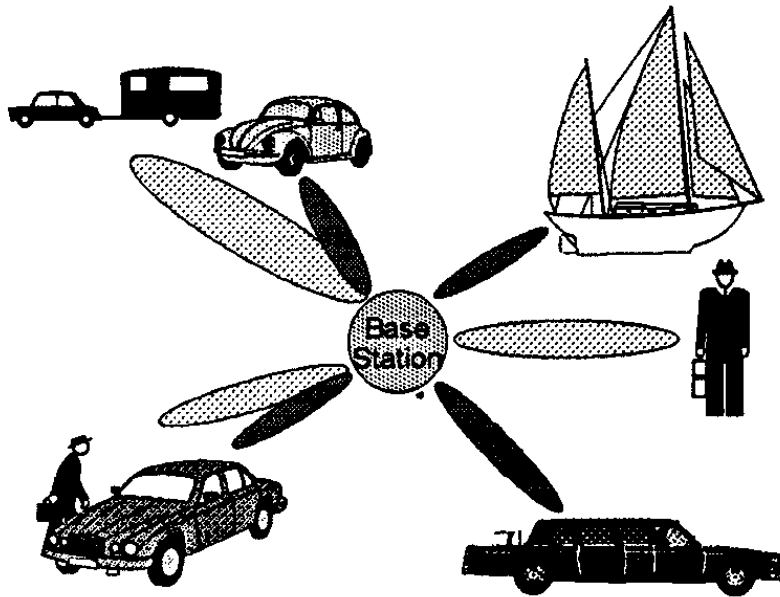


Fig. 1: Typical scenario for A-SDMA application

Ex. 1008, Fig. 1.

Vornefeld provides a framework for using “spatial information” of subscribers in order to direct beams to specific subscribers in specific timeslots, but does not provide all the details of implementation. Ex. 1004, 52 (“algorithms make use of the spatial information in the [spatial covariance matrix]”). A POSA would look at a variety of ways to implement this functionality, including Tangemann’s user mobility model using minisectors. Ex 1002, ¶188. By dividing the cell site into smaller minisectors to define subscriber locations, Tangemann uses a beamforming system to utilize targeted, narrower beams, which reduces interference to nearby subscribers, and allow the beams to transmit to substantially only subscribers within the targeted minisector. Ex. 1002, ¶188.

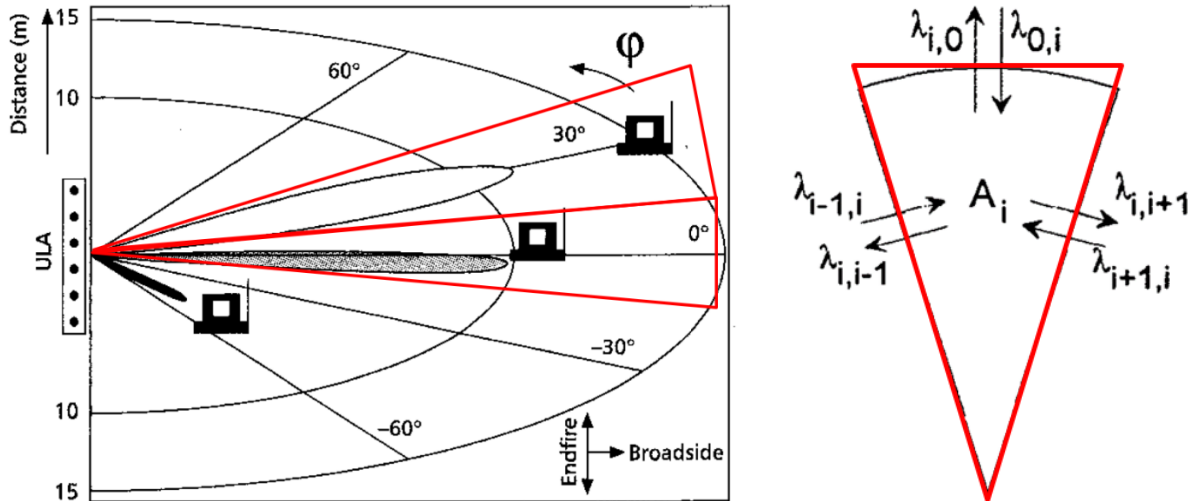
Vornefeld identifies efficient use of the available frequency bandwidth as a “crucial issue,” (Ex. 1004, 52), and Tangemann’s minisector and queueing model allow frequencies to be re-used, increasing efficiency. Ex. 1002, ¶189; Ex. 1008, 745-746. Vornefeld also seeks to minimize interference between transmissions (Ex. 1004, 57), a goal addressed by Tangemann’s method of using minisectors to calculate angular user density and reduce overlapping transmission. Ex. 1008, 745-746.

Because Vornefeld recognized the need for efficient usage of available frequency resources, and Tangemann describes a way to maximize those frequency resources using minisectors, a POSA would readily understand the benefit of using

Tangemann's teachings. Ex. 1002, ¶190. Tangemann's minisectorization method also provides for reduction in interference between transmissions, by calculating angular user density, and putting that information through a queueing model to determine efficient transmission patterns. Ex. 1008, 745-746.

Also, Tangemann's details about calculating subscriber locations are already suggested by Vornefeld's system. Ex. 1004, 52 (estimating the "directions of arrival" of each user), 55 (using "spatial input parameters" of users to schedule transmission and reception). Because of the fit between these technologies, this combination would not "result in a difference in function or give unexpected results." *In re Rice*, 341 F.2d at 314; *see also Wyers*, 616 F.3d at 1245; Ex. 1002, ¶191.

A POSA would also have a reasonable expectation of success in combining Vornefeld and Tangemann. Ex. 1002, ¶192. Tangemann's minisector technique to calculate angular user density matches Vornefeld's system which already considers subscriber location. Ex. 1004, 52-53. And Vornefeld contemplates applying "spatial signal processing algorithms" to calculate transmission patterns; such algorithms could include Tangemann's queueing model. Ex. 1004, 52; Ex. 1008, 746. An annotated version of Vornefeld's Fig. 2 (below left) shows 2 minisectors (shown in Tangemann's Fig. 2, below right) overlaid over the cell site in Vornefeld.



Ex. 1004, Fig. 2 (annotated); Ex. 1008, Fig. 2 (annotated).

With respect to the combination already set forth in Ground 1 (Sec. V(B)), Tangemann's minisectors are also compatible with the sectorization described in Atsuta. Ex. 1002, ¶193. Atsuta describes a sector as the area corresponding to a fan-shaped beam antenna. Ex. 1005, 1:13-18. Atsuta also describes tracking the density of subscribers within each sector. Ex. 1005, 3:9-13. Tangemann's technique of dividing the cell site into minisectors of desired width to calculate angular user density aligns with this goal. Ex. 1008, 746. Tangemann's description of locating and counting users is separate from the predefined coverage patterns of the base station antennas. Ex. 1008, 746. Vornefeld's antenna arrays already direct beams towards specific subscribers, which allows for transmitting downlink data to substantially only the subscriber(s) within each minisector. Ex. 1004, 52, 53, 55. Combining Tangemann with Vornefeld and Atsuta results in transmission to

subscribers in different minisectors (equivalent to the “sectors” as implicitly defined by Patent Owner) within a single TDD frame. *See* Ex. 1013, 22-23 (explaining that Patent Owner’s position is that the beams need only be sent to “a portion of a cell site”).

With respect to the combination already set forth in Ground 2 (Sec. VI), Tangemann’s minisectors are also compatible with Goldberg’s “regions.” Ex. 1002, ¶194. Goldberg describes a region as the subdivision of the cell site. Ex. 1006, 20:12-16. Goldberg also describes using the location data of subscribers to calculate broadcast patterns. Ex. 1006, 6:66-7:53. This fits Tangemann’s system locating and counting users by minisector. Ex. 1008, 746. To the extent Patent Owner argues Goldberg’s “regions” are not “sectors,” Tangemann describes that specific “minisectors” may be used to subdivide the cell site. Ex. 1008, 746. Combining Tangemann with Vornefeld and Goldberg results in transmission to subscribers in different minisectors (equivalent to “sectors” as implicitly defined by Patent Owner) within a single TDD frame.

Adding Tangemann’s minisectors to the combinations of (1) Vornefeld and Atsuta, and (2) Vornefeld and Goldberg would result in a system that a POSA would understand to transmit to subscribers in different sectors within a single TDD frame. Ex. 1002, ¶195.

IX. Secondary Considerations

There are no secondary considerations known to Petitioner that affect this strong case of obviousness.

X. Discretionary Denial Is Unwarranted Under *Fintiv*

In view of the Director’s recent guidance on *Fintiv*, the time to trial is not a dominating factor in the *Fintiv* analysis. *Memorandum for the Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation*, at 8 (June 21, 2022). Instead, a “compelling unpatentability challenge” is a more important consideration. *Id.* at 4. Such compelling evidence refers to a high likelihood of success on the merits for at least one claim. *Commscope Tech. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 at 3-4 (PTAB Feb. 27, 2023) (precedential).

For the reasons set forth above, this case presents a compelling unpatentability challenge. In particular, Patent Owner has *conceded* that the majority of the claimed elements are unpatentable over applied art.

Should GAS present a *Fintiv* challenge based on the developments in the trial subsequent to the filing of this Petition, Verizon will seek to address the developments.

XI. Conclusion

Verizon requests *inter partes* review of claims 28 and 29.

DATED: May 26, 2023

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. § 42.24

I hereby certify that this petition complies with the word count limitation of 37 C.F.R. § 42.24(a)(1)(i) because the petition contains a total of 13,957 words. This total excludes the cover page, signature block, and the parts of the petition exempted by 37 C.F.R. § 42.24(a)(1).

DATED: May 26, 2023

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CERTIFICATE OF SERVICE

The undersigned certifies that a complete copy of this Petition for *Inter Partes* Review of U.S. Patent No. 7,230,931 and all Exhibits and other documents filed together with this Petition were served on the official correspondence address for the patent shown in PAIR via FEDERAL EXPRESS next business day delivery, on this date:

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