

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

REPLY DECLARATION OF DR. KEVIN C. ALMEROOTH

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I. Introduction

1. I have been retained by Cellco Partnership d/b/a Verizon Wireless (“Petitioner”) to provide my opinion concerning the claimed subject matter of U.S. Patent No. 7,230,931 (Ex. 1001 and henceforth referred to as “the ’931 patent”).

2. In a prior declaration submitted in this case, I have set forth my opinions concerning claims 28 and 29 of the ’931 patent. Ex. 1002 (“Original Declaration”).

3. I have considered the following:

- Materials listed in my Original Declaration (Ex. 1002, ¶38), particularly the ’931 patent (Ex. 1001), Vornfeld (Ex. 1004), Atsuta (Ex. 1005), Goldberg (Ex. 1006), and Youssefmir (Ex. 1007);
- The Patent Owner’s Response;
- Theodore S. Rappaport, WIRELESS COMMUNICATIONS, PRINCIPLES & PRACTICE (1996) (excerpts) (Ex. 2022);
- Bernard Sklar, Digital Communications – Fundamentals and Applications (1988) (Ex. 2023);
- Claim Construction Order (Ex. 2027);
- Declaration of Douglas A. Chrissan, Ph.D (Ex. 2028);
- 3GPP Ts 36.221 (Ex. 2030);
- Ed Oswald, “Is Clearwire the savior of global LTE,” Extremetech, May 9, 2012 (Ex. 2031);

- Harry Newton, Newton's Telecom Dictionary, 16th ed. (2000) (Ex. 1021);
- Walter H.W. Tuttlebe, CORDLESS TELECOMMUNICATIONS WORLDWIDE (1997) (excerpts) (Ex. 1022);
- Theodore S. Rappaport, WIRELESS COMMUNICATIONS, PRINCIPLES & PRACTICE (1996) (excerpts) (Ex. 1023);
- Deposition Transcript of Dr. Douglas A. Chrissan (Ex. 1024);
- Holma, et al., "Evaluation of interference Between Uplink and Downlink in Ultra/TDD," IEEE, VCT (1999) (Ex. 1026); and
- 5 FCC Red No. 14, FCC 90-233, 4123-30 (1990) (Ex. 1031).

4. My understanding of the legal principles at issue are set forth in my Original Declaration. Ex. 1002, ¶¶30-37.

II. Ground 1 (Vornefeld and Atsuta)

A. Frames

5. Dr. Chrissan attempts to create a divide between a "TDMA frame" and a "TDD frame." Ex. 2028, ¶¶42-43, 109. In particular, Dr. Chrissan asserts that "use of TDMA does not disclose" a TDD frame (Ex. 2028, ¶91) and that "a POSA would not understand that any given TDMA frame that might be implied or described by Atsuta is 'compatible with a TDD frame'" (Ex. 2028, ¶109). This argument is used to allege that Atsuta's frame (which Dr. Chrissan wants to limit to a TDMA/FDD

design) would not be applicable to the TDD frame of Vornefeld or the claims. This frame argument (1) has no real impact on the opinions expressed in my Original Declaration concerning the combination of Vornefeld and Atsuta, (ii) misrepresents a POSA's understanding of frames and upstream/downstream transmission, and (iii) misrepresents what Atsuta teaches to a POSA.

6. On the first point—namely, the impact on my opinions—Dr. Chrissan's arguments confuse the simplicity of the combination. The proposed combination of Vornefeld and Atsuta, as discussed in my Original Declaration, (i) accepts that Vornefeld is already a TDMA/TDD frame (Ex. 1002, ¶¶73-80, 86-87, 91-92, 94-96, 105), (ii) acknowledges that the prior ruling by the Board in the Sprint IPR left open the mere question of whether a POSA would have understood that the TDMA/TDD frame in Vornefeld could be structured to include communications (in the downlink portion of the frame) to user devices in different sectors (Ex. 1002, ¶¶68, 87), and (iii) explains how Atsuta teaches structuring a single frame to include transmissions to devices in different sectors (Ex. 1002, ¶¶65, 88). There is no dispute that Vornefeld already teaches a TDMA/TDD frame with a downlink portion that has timeslots for different user devices or that Atsuta's frame is also a TDMA design. Ex. 1024, 69:22-70:9, 79:7-10, 90:22-1:5, 136:14-20. Thus, the only question relevant to the Vornefeld-Atsuta combination is whether Atsuta suggests that Vornefeld's downlink timeslots could be assigned to devices in different sectors.

That is exactly what Atsuta describes, as discussed in more detail in later sections below.

7. For context, because Atsuta describes how to structure a frame with respect to communications to *different devices* in different sectors, Atsuta is addressing a multiplexing issue (specifically a TDMA operation). *See* Ex. 1002, ¶ 88. Consequently, the TDMA methodology forms the most relevant consideration (which both references use). And, notably, while claims 28 and 29 refer to a “TDD frame,” which simply indicates the duplexing scheme already used in Vornefeld, the specific recitations pertain to the manner of communicating with *different devices* (namely, that communications to devices in different sectors are addressed in the same frame). Thus, any analysis of what was known in the field on that point would be a question of known multiplexing structures for frames.

8. On the second point—namely, the POSA’s understanding of frames—a POSA would have understood that frames are simply hierarchical data structures. *See* Ex. 1002, ¶¶50, 57-61; Ex. 1021, pp. 372-73. A POSA would understand that frames could be constructed in any number of known ways so as to divide up the available capacity for communications, both to and from a particular device (i.e., duplexing) and among multiple devices (i.e., multiplexing).

9. The structure of a frame, including the header and the payload are largely independent of *how* the data is transmitted. In general, frames have been defined in

the telecommunications context as “[o]ne complete cycle of events in time division multiplexing. When transmissions for different stations are divided up by time, the frame usually includes a sequence of time slots for the various sub channels as well as extra bits for control, calibration, etc. T-Carrier makes use of such a framing convention for packaging data. Channelized T-1, for instance, frames 24 time slots with a framing bit which precludes each set of sampled data.” Ex. 1021, p.372-73 (entry 3). Numerous other ways of dividing up the data portion of a frame were well understood to a POSA, not least of all because the numerous existing, standardized protocols used different structures, including choices about the design of the structure best suited for their intended use.

10. Multiplexing (or multiple access) addresses the manner in which, e.g., a base station communicates with multiple user devices. The division among different users can be through TDMA methodology, which divides users into different timeslots. Ex. 1021, pp. 876; Ex. 2022, pp. 400-01. For contrast, FDMA divides users into different frequency bands. Ex. 1021, pp. 349-50. Other options exist, such as SDMA (discussed below), which use spatial distances to separate transmissions to and from user devices. These options are not mutually exclusive. There exist examples where available spectrum is divided using all three techniques, e.g., radio or television transmissions that divide the spectrum into frequency ranges (i.e., channels) and in each channel there are slots of programming and advertising

and different geographic regions can reuse the same spectrum. The techniques to flexibly and efficiently use a given spectrum have been well known for decades and techniques that predate the computer age have been applied for data communication.

11. Independently, duplexing defines the methodology for sending and receiving signals in both directions (e.g., the way uplink and downlink transmissions are arranged between, for instance, a base station and a particular user device). Duplexing is an additional concept incorporated into multiplexing. Indeed, the Rappaport book cited by Dr. Chrissan has a chapter on multiple access techniques, including TDMA, with the discussion of duplexing (e.g., TDD) being included within that chapter as part of the discussion of, e.g., “TDMA frames.” Ex. 2022, pp. 395-402; *see id.* p. 398, Table 8.1 (including the particular duplexing method in the “Multiple Access Technique” column). TDD divides uplink and downlink based on time and FDD divides uplink and downlink based on frequency. Ex. 1021, pp. 349, 876.

12. Dr. Chrissan acknowledges that a POSA seeing the term “TDMA frame” would picture both the TDD and FDD versions of that frame, such that the use of “either” of the two would be expected. Ex. 2028, ¶¶44, 145; Ex. 1024, 27:9-11. Thus, TDMA and TDD methodologies in a frame structure are not incompatible with each other—and as described above, Vornefeld already describes a TDMA/TDD frame structure. Consequently, I disagree with Dr. Chrissan’s statement that “a POSA

would not understand that any given TDMA frame that might be implied or described by Atsuta is ‘compatible with a TDD frame.’” Ex. 2028, ¶109.¹

13. That the idea of TDD operations (as well as FDD operations) go part and parcel with TDMA (and thus the methodologies are compatible and combinable) is supported by the record. First, Vornefeld already uses a TDMA/TDD frame, as discussed in my Original Declaration. Ex. 1002, ¶¶73-80, 86-87, 91, 94, 105; *see* Ex. 1004, p. 53. Dr. Chrissan agrees. Ex. 1024, 69:22-70:9, 79:7-10, 90:22-1:5. Second, the Rappaport book cited by Dr. Chrissan describes the frame structure for TDMA/TDD systems (Ex. 2022, pp. 400-401 (“[i]n a TDMA/TDD system, half of the timeslots in the frame information message would be used for the forward link channels and half would be used for reverse link channels”) and notes that such systems were in operation before the ’931 patent’s filing date (Ex. 1023, pp. 538-544). Third, the ’931 patent itself refers to a “time division duplex (TDD) time division multiple access (TDMA) frame.” Ex. 1001, 10:59-61, 14:28-33.

14. I also note that Dr. Chrissan asserts that the relative timing between the uplink and downlink transmissions in the TDD operation is described as a “key aspect” described in the ’931 patent. Ex. 2028, ¶48. First, I see nowhere in claims

¹ Dr. Chrissan seems to acknowledge that a POSA would have wide latitude in designing a frame. Ex. 1024, 14:19-15:16.

28 and 29 where any timing is required. In fact, the claims do not mention the uplink portion. Second, the '931 patent does not appear to dispute that TDMA/TDD designs and interference issues were known. *See* Sec. III.B.3, below. The timing for such designs was also already known. Third, in any event, Dr. Chrissan acknowledged during his deposition that any timing between the uplink and downlink would simply be that implicit in the understanding of “TDD.” Ex. 1024, 48:1-17. In that regard, the idea that the uplink and downlink communications should be timed to not overlap interference has long been known. Ex. 1024, 108:15-110:22; Ex. 1026, Abstract, 2617 (Sec. 4), 2619 (Secs. 9-10). Thus, this argument seems to have no bearing on the claims or the combination.

15. For these reasons, I disagree with Dr. Chrissan’s position and belief that a POSA would readily understand Atsuta’s frame structure relating to TDMA design to be applicable to Vornefeld’s TDMA/TDD frame structure. In fact, even if one were to accept (incorrectly) that Atsuta taught only an FDD operation (addressed later in Declaration), that duplexing arrangement would have no impact on the fact that Atsuta teaches combining in one frame downlink transmissions to devices in different sectors—a multiplexing issue.

16. Moreover, I have been informed that, in the related District Court trial, representatives of GAS explained TDD frames as follows:

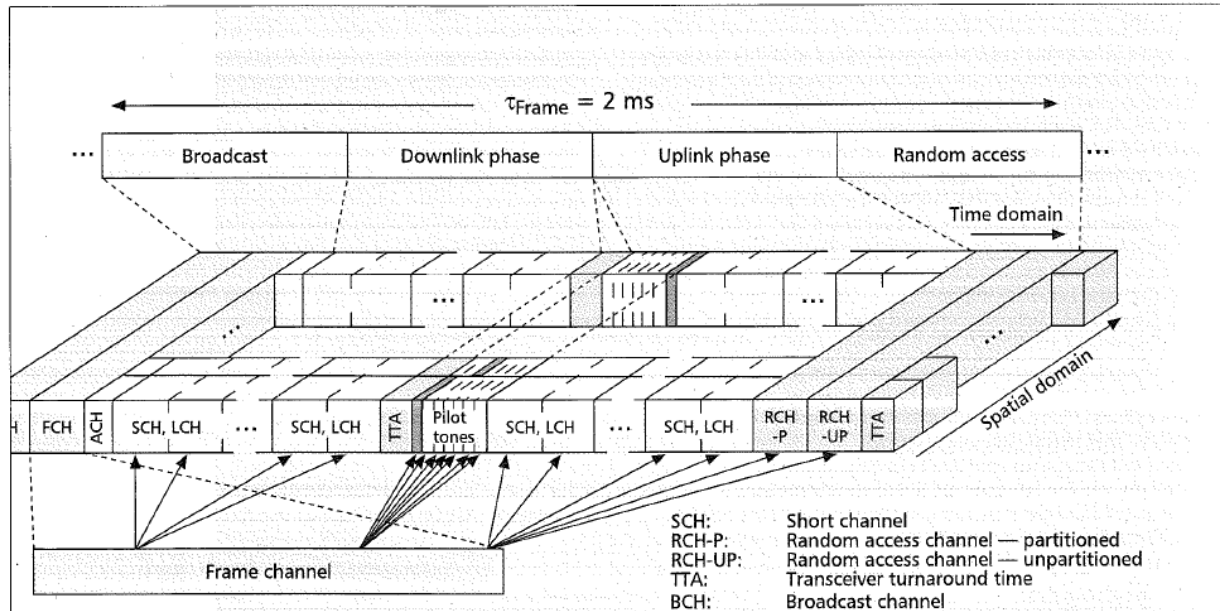
- “TDD frame is just a schedule”; and

- “the TDD frame, which is the schedule of common timetable that is carried out by the base station across all sectors.”

17. With that understanding of a TDD frame, the total schedule of transmissions across sectors would be considered the frame. A POSA would have understood that setting the schedule across sectors would be an expected function of a base station in a sectorized system, a concept well known before the '931 patent, such that GAS's understanding of a TDD frame would clearly encompass the prior art discussed herein.

B. Vornefeld

18. As indicated above, Vornefeld's system used both TDMA and TDD methods in its frame structure. In fact, Vornefeld's system also used SDMA (which allows for simultaneous transmissions to different devices in addition to the sequential transmissions provide by TDMA). As shown in Fig. 3, each frame included an uplink portion and a downlink portion, separated based on time, which makes it a TDD frame. Ex. 1024, 79:7-14.



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

Ex. 1004, Fig. 3.

19. Additionally, within each of the uplink and downlink portions, there are multiple timeslots (e.g., Long Channel Header (LCH)) that are assigned to different user devices, which makes the frame a TDMA frame. Ex. 1004, Fig. 3, p. 53 (cols. 1-2). Dr. Chrissan agrees. Ex. 1024, 107:8-108:9. Vornfeld also uses beamforming to provide SDMA operability wherein the beams allow for simultaneous transmission to different devices based on their spatial separation. Ex. 1004, p. 52 (col. 2), p. 53 (col. 1), p. 55 (col. 1). Thus, Vornfeld uses both simultaneous transmissions and transmissions separated into different time slots to communicate with various user devices. As Vornfeld explains, the system uses the different timeslots to separate communications to different user devices and, when possible, also uses simultaneous transmissions. Ex. 1004, p. 55 (col. 2), p. 56 (col. 1).

20. In this regard, Fig. 3 shows a frame arrangement substantially the same as that shown in Fig. 3 of the '931 patent.

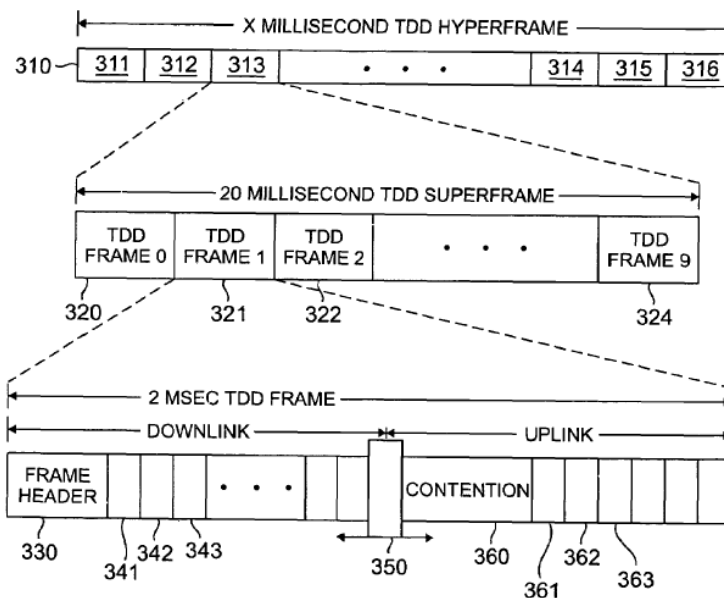


FIG. 3

Ex. 1001, Fig. 3.

21. As discussed in my original declaration, the prior assertion of Vornefeld in the Sprint IPR left open the simple question of whether the transmissions to devices *in different sectors* would be included in the same frame.² Again, there is no dispute that Vornefeld uses a TDMA/TDD frame that provides downlink communications to different users in different timeslots. Ex. 1002, ¶¶68, 87; Ex.

² While I believe the same would be obvious from Vornefeld, I relied upon Atsuta to more specifically address that element.

1024, 69:9-70:17. The only material issue addressed by Atsuta is whether a POSA would understand that Vornefeld's different time slots could be assigned to devices in different sectors. This is a simple question of how to organize the information pertaining to TDMA transmissions.

C. Atsuta

22. As discussed in my Original Declaration, Atsuta describes a manner of simplifying hardware and reducing energy consumption. In particular, Atsuta describes combining (i) prior art circuitry provided for different antennas (and thus different sectors) into one centralized circuitry design and (ii) the communications for those different antennas/sectors into one frame. Ex. 1002, ¶90. In particular, Atsuta describes using one frame for the transmissions to various sectors. Ex. 1005, Fig. 3, 5:21-43, 6:13-41, 3:1-5, 1:53-55 (comparing the conventional multi-frame option). That is all the information a POSA would need to determine that it would be obvious that a single frame in Vornefeld could include downlink transmissions to different sectors. That would be true regardless of Atsuta's duplexing method (e.g., FDD or TDD). When asked about this frame structure in Atsuta, Dr. Chrissan admitted that a POSA would not find the inclusion of transmissions to devices in multiple sectors in the same frame odd. Ex. 1024, 192:14-193:15

23. In any event, I address Dr. Chrissan's strawman arguments below, which incorrectly allege that Atsuta is an FDD teaching only, that Atsuta does not describe

the downlink portion of a frame, and that Atsuta is so complex that a POSA would never rely upon it.

1. TDD

24. Dr. Chrissan asserts that Atsuta describes an FDD frame, rather than a TDD frame. Ex. 2028, ¶¶78-79. As discussed above, this argument misdirects from the point. Nevertheless, I disagree with Dr. Chrissan's characterization of Atsuta.

25. As discussed in my Original Declaration (Ex. 1002, ¶105), Atsuta's system calls for an asymmetric design. Ex. 1005, 5:66-6:12. Interestingly, while the portion of Dr. Chrissan's declaration discussing Atsuta alleges that asymmetry indicates an FDD method (Ex. 2028, ¶¶103, 104), other portions of his declaration explains that a POSA would have understood asymmetry indicates a TDD operation (Ex. 2028, ¶¶152, 44). In any event, during his deposition, Dr. Chrissan confirmed that a POSA would understand asymmetry to suggest a TDD operation and relied on references supporting this point. Ex. 1024, 41:12-16, 44:15-45:14. Dr. Chrissan's admissions and relied upon references are in line with my position. In particular, the dictionary definitions of TDD and FDD state that TDD is suited for asymmetric communications and that FDD is appropriate for symmetric communications. Ex. 1021, 349 (defining FDD as "appropriate for symmetrical services"), 876 (defining TDD as "best suited for asymmetrical applications"). TDD is suitable for asymmetric communications because time slots can be easily reassigned so that there

are more slots given to uplink as compared to downlink (or vice versa). In FDD, frequency bands are often dictated by predetermined standards that do not allow for reassignment to create an asymmetry. Ex. 1023, p. 506 (stating reverse and forward channel assignments for GSM). Also, reassigning frequency bands would require retuning the radios used, a complicated undertaking. Thus, Atsuta's discussion of asymmetry would suggest to a POSA a TDD methodology.

26. Dr. Chrissan's argument for Atsuta being an FDD disclosure relies upon Atsuta's mention of "frequency band." Ex. 2028, ¶104. As an aside, I note that Dr. Chrissan's declaration refers to the reallocation of timeslots in a TDD system to provide for asymmetry to be a shifting of "bandwidth." Ex. 2028, ¶41. Despite using that term for discussion of timeslots, when asked about that paragraph during his deposition, he explained that "capacity" would be a better term to describe the reallocation of timeslots in providing the asymmetry allowed by TDD methods. Ex. 1024, 31:20-34:1, 40:13-17, 42:1-6, 43:15-44:5; *see* Ex. 1004, 57 (discussing "capacity improvement" through sectorization). Notably, the relevant section of Atsuta refers to "transmission capacity." Ex. 1005, 5:57-6:12. Despite acknowledging that "capacity" is the terminology a POSA often uses to describe the reallocation of timeslots in an asymmetrical TDD arrangement, Dr. Chrissan does not address the discussion of capacity in Atsuta's discussion of asymmetry. In general, a POSA would understand asymmetry to more easily be implemented

through a TDD operation. Even viewing Atsuta's mention of "frequency band and transmission capacity" in a light favorable to Dr. Chrissan's viewpoint, a POSA would at most view the discussion as being agnostic to FDD and TDD such that a POSA would understand both options.

27. In any event, a POSA would understand that Atsuta's description of a TDMA frame would indicate to a POSA a methodology that would incorporate one or more of TDD and FDD, such that a POSA would immediately picture both options. Dr. Chrissan appears to acknowledge this fact. Ex. 2028, ¶¶44, 145. And, either way, Atsuta's frame structure would still be compatible with Vornefeld regardless of the duplexing method.

28. For these reasons, a POSA would understand Atsuta to teach that its TDMA frame would use TDD methodology and that it could also use FDD methodology if a POSA preferred to take up that more difficult task of reallocating frequency (Ex. 1024, 34:18-35:11 ("it was not easy to dynamically change bandwidth"))).

2. Downlink

29. Dr. Chrissan's declaration asserts that Atsuta is primarily directed or "only" directed to uplink transmissions. Ex. 2028, ¶¶84, 93 ("focused on the uplink"), 105 ("uplink direction *only*"). That is not correct. First, Fig. 3 of Atsuta

does not provide any restrictions regarding whether the design may be used for uplink or downlink transmissions. Dr. Chrissan agrees. Ex. 1024, 174:6-9.

30. Second, while Dr. Chrissan focuses on Fig. 1 of Atsuta showing receiving antennas, Fig. 4 shows transmission antennas, as discussed in my Original Declaration. Ex. 1005, Fig. 4, 6:35-64; Ex. 1002, ¶103. Moreover, Atsuta explicitly states that the TDMA circuit in Fig. 4 “receives a plurality modulated signals to be transmitted to the subscriber stations, arranges these signals into *one signal sequence as a predetermined synchronous frame* in the TDMA method, and outputs the resultant signal sequence to the modulating circuit 12.” Ex. 1005, 6:35-44. Those signals within the same frame are sent to the various sector antennas. *Id.* Thus, the downlink signals for different sectors are combined into a single frame. During his deposition, Dr. Chrissan did not dispute these disclosures in Atsuta or that Atsuta’s description of “a” frame in the quote above indicates a single frame. Ex. 1024, 173:5-174:1.

31. Thus, while Vornefeld already discloses a downlink portion of a TDD frame, Atsuta also describes that a downlink portion of a single frame and further describes that the same may include communications to devices in different sectors.

3. Alleged Complexity

32. Dr. Chrissan asserts that Atsuta’s design adds complexity by requiring more expensive/complex circuitry, the purchase of additional frequency spectrum,

and a more complex clock. Ex. 2028, ¶¶128-129. On this basis he asserts that a POSA would not rely upon Atsuta. In fact, his opinion is that a POSA would never rely upon Atsuta for any of its teachings. Ex. 1024, 149:12-13. I disagree.

33. With respect to the circuitry, Dr. Chrissan confirmed during his deposition that his basis for asserting that, e.g., Atsuta's TDMA modulation circuit 9 in Fig. 3 would be more expensive/complicated as compared to the prior art circuitry shown in Atsuta's Fig. 1 involves comparing the one TDMA modulation circuit 9 in Fig. 3 to *one* TDMA modulation circuit 9a in Fig. 1. However, TDMA modulation circuit 9 in Fig. 3 replaces *three* such circuits in the prior art design. Ex. 1005, 1:53-2:57, 4:44-5:16, 6:25-57. Dr. Chrissan acknowledged that the one TDMA modulation circuit 9 in Fig. 3 would not be 3 times as complex as the aggregate of the three circuits it replaces. Ex. 1024, 158:8-16 (Dr. Chrissan appears to equate complexity and expense in his response). In fact, Dr. Chrissan admitted that the TDMA modulation circuit 9 in Fig. 3 would likely be only 2-2.5 times more complex than any one of the three prior circuits shown in Fig. 1. Ex. 1024, 158:8-16. Thus, there is no dispute that a POSA would have understood that Atsuta's design would be, in the aggregate, less expensive/complicated as compared to the prior art system.

34. Similarly, while Dr. Chrissan also stated that part of the "complexity" in Atsuta's system would be additional outputs in the inventive circuit (Ex. 2028, ¶129), this again fails to account for the aggregate, where the new TDMA

modulation circuit 9 would be taking the place of three prior circuits. Ex. 1024, 150:10-18. In the aggregate, the outputs would match.

35. With respect to the allegation of Atsuta's design requiring three times the frequency spectrum, that statement mischaracterizes Atsuta. As shown and discussed in Atsuta (see Fig. 3), in both the prior art design and the inventive embodiment, the center wavelengths of frequency bands f1-f3 are the same. Ex. 1005, Fig. 3, 5:39-46. Thus, the frequency spectrum from f1 to f3 is the same in Atsuta's inventive embodiment as that in the comparative prior art design. Dr. Chrissan agrees with this understanding. Ex. 1024, 151:16-153:21. Consequently, Atsuta simply utilizes more of the intervening spectrum at issue. *See* Ex. 1005, 4:1-12 ("fully realized"). Specifically, Atsuta describes using the intermediate frequencies previously left unused as a buffer to avoid cross-sector interference. In the prior art design, the communications to different sectors are taking place simultaneously, such that there is a concern with crosstalk. To mitigate crosstalk, the prior art design provides a gap between e.g., frequency bands f1 and f2. In Atsuta's inventive design, the transmissions to different sectors are spaced apart in time, which avoids the crosstalk issue and, thus, allows for more of the intervening spectrum to be used, which might otherwise "collid[e]" (i.e., interfere). Ex. 1005, 5:21-46, 3:64-4:12. Put another way, less buffer is needed in the sequential transmissions as compared to the simultaneous transmissions.

36. In Dr. Chrissan's view, a party would need to purchase the intervening frequency spectrum between, e.g., f_1 and f_2 . I disagree. First, a POSA would expect that the entire block would be dedicated (or licensed) for a particular purpose (otherwise crosstalk would still be a problem from another's use of that intervening spectrum). Ex. 1024, 154:16-155:2. Atsuta is simply utilizing more of the dedicated spectrum. Moreover, even if one were to entertain Dr. Chrissan's characterization, a POSA would have understood that parts of the radio spectrum are dedicated for public use without any license. Ex. 1031, 4123 ("non-licensed spread spectrum"). Thus, the assumption that there would be an additional cost for spectrum licensing is not correct.

37. In any event, a simple matter of cost would not render the concepts in Atsuta uncomparable with Vornefeld. A POSA would recognize the applicability of useful technological innovations even where those innovations incur a cost. A POSA would have realized that there are benefits to Atsuta's system, including those stated in Atsuta (Ex. 1005, 5:65-6:23), regardless of possible tradeoffs.

38. With respect to Dr. Chrissan's clock argument, as discussed above, Atsuta's design consolidates the number of circuits previously used for control of the various antennas. In doing so, it can use a fraction of the clocks used in the prior art design. Dr. Chrissan himself admits that each of blocks 1a-1c in the prior art design in Atsuta's would use at least one clock (Ex. 1024, 162:19-164:5), such that

Atsuta's inventive circuitry would be expected to use fewer total clocks, mitigating any increased complexity in the clock.

39. Furthermore, I do not agree that the clock used in Atsuta's inventive design would need to be more complex. Dr. Chrissan's argument assumes that the inventive frame design in Atsuta would have to use timeslots shorter in duration. Ex. 1024, 159:8-15. However, a POSA would understand that a POSA could divide his/her timeslots in any manner preferred (at least when operating outside of a specific standard that has requirements on this point) and, as Dr. Chrissan acknowledges, existing standards often dictate the size of the timeslots such that a POSA would not alter the timeslots. Ex. 1024, 161:17-162:12; Ex. 1023, pp. 506, 543. Regardless, any addition in complexity of the single clock would be a tradeoff relative to using, e.g., one clock instead of three.

40. Finally, I note that Dr. Chrissan has not stated or otherwise documented the alleged increases in cost/complexity, in the aggregate, so as to provide any useful comparison of the costs and benefits. Instead, he simply assumes that Atsuta would not be relied upon for any of its teachings. Ex. 1024, 149:12-13. In contrast, however, Dr. Chrissan admits that "Atsuta discloses a basic, conventional TDMA method." Ex. 2028, ¶ 77. I agree with that declaration statement and believe that it is a reason why a POSA would have understood that Atsuta's frame structure could

be combined with Vornefeld. Also, a POSA would have had ordinary creativity and would have understood new designs often involve benefits and costs.

D. Combining Vornefeld and Atsuta

41. Dr. Chrissan makes other arguments against the combinability of Vornefeld and Atsuta. While I again believe that the arguments create strawman that distract from the simple mechanism of the combination discussed above, I address the arguments below.

1. Interference

42. Dr. Chrissan appears to assert that a POSA would have understood the interference problem addressed by Vornefeld to be limited to beamforming and to be solved such a that a POSA would not consider any other references that also address interference. Ex. 2028, ¶¶114-15. Again, a POSA would have ordinary creativity and would not have viewed interference as myopically as Dr. Chrissan suggests. The interference in Vornefeld involves interference occurring with communications to different devices. Specifically, Vornefeld uses simultaneous transmissions through beamforming/SDMA when possible but uses TDMA when such simultaneous transmissions would lead to interference. Ex. 1004, p. 55 (col. 2), p 56 (col. 1). Similarly, Atsuta addresses interference (which it refers to as collisions) in communications to different devices and addresses the problem by spacing transmissions to different sectors along the time axis and putting that information in

one frame. Ex. 1005, 3:66-4:5. Both references describe sectorized systems. Thus, both references address interference issues related to transmissions to different devices in TDMA systems. TDMA itself is a method of avoiding interference. In trying to distinguish interference between device transmissions occurring within a sector or across sectors, Dr. Chrissan does not recognize that a POSA would approach the question of interference holistically. Indeed, a POSA would understand that Atsuta and Vornefeld both implicate generally similar interference issues, regardless of the fact that Vornefeld uses beamforming. Ex. 1024, 90:22-91:5 (admitting that TDMA can aid in preventing interference), 134:3-8 (same). Ultimately, the question a POSA would consider is not whether Atsuta solves a specific beamforming issue, but whether it would be obvious to combine aspects of Atsuta's frame structure into Vornefeld's existing frame structure. Both are TDMA designs and Vornefeld already combines TDMA and SDMA aspects such that combination would not affect Vornefeld's beamforming. That Atsuta addresses interference occurring between sectors would make it useful for Vornefeld, which also addresses interference issues, even if not focusing on interference across sectors. Dr. Chrissan even acknowledged that, when using SDMA, there is risk of interference between devices in different sectors. Ex. 92, 11:17. He also acknowledged that "it's no secret that a person of skill knows about intracell interference. Ex. 1024, 119:5-14, 121:11-20.

E. Simultaneous Transmissions

43. Dr. Chrissan argues that Atsuta “specifically precludes” simultaneous transmission. Ex. 2028, ¶111. This mischaracterizes Atsuta and fails to account for what Vornefeld already teaches. For context, Dr. Chrissan agrees that the claims at issue do not require simultaneous transmission, making this argument a straw man. Ex. 2028, ¶¶61, 66.

44. To begin, Atsuta is simply silent on simultaneous transmissions. What Atsuta describes in Fig. 3, is a TDMA arrangement in which transmissions to different devices in different sectors occurs in different timeslots. Vornefeld already describes a TDMA operation in which transmissions to and from devices occur in different timeslots. Vornefeld additionally describes simultaneous transmissions to different devices in the same sector using beamforming (SDMA), thus combining SDMA and TDMA operations, as Dr. Chrissan acknowledges. Ex. 1024, 78:2-19. Consequently, any argument that Atsuta’s TDMA operation would somehow preclude SDMA operations is belied by the fact that Vornefeld already combines both methods. One simply does not preclude the other.

45. Separate from his “precluding” argument, Dr. Chrissan also asserts that Atsuta “teaches away” from simultaneous transmission is predicated on silence as to beamforming. Ex. 2028, ¶¶68, 111, 125; Ex. 1024, 59:4-60:13. However, I have been informed that a “teaching away” requires that the reference “criticize, discredit,

or otherwise discourage investigation into” an option. Nothing in Atsuta disparages simultaneous transmissions. Again, as discussed above, TDMA operations, such as used in Atsuta, were known to be combined with simultaneous transmission methods such as provided in SDMA, with both Vornefeld and Goldberg describing joint TDMA/SDMA systems. Ex. 1004, p. 52; Ex. 1006, 2:21-33, 3:47-4:5. In the combination, a POSA would continue to use Vornefeld’s joint TDMA/SDMA operations. Again, the combination of Ground 1 simply combines aspects of Atsuta’s frame for TDMA operations with the existing TDMA/TDD frame of Vornefeld, where Vornefeld’s timeslots are simply assigned to devices in different sectors in the manner describe in Atsuta. Doing so would not change the SDMA operations in Vornefeld at all.

III. Ground 2 (Vornefeld and Goldberg)

A. Vornefeld

46. My discussion of Vornefeld above applies equally to Ground 2.

B. Goldberg

1. TDMA and TDD

47. My discussion as to the interrelatedness of TDMA and TDD above applies equally to Golburg. Specifically, there is no dispute that Vornefeld and Goldberg both describe TDMA operations for the multiplexing method and that Vornefeld already teaches that its frame is of the TDD variety with a specific downlink portion containing timeslots for transmissions to different user devices. Because Goldberg

describes including, in one frame, transmissions to devices throughout the cell, it describes transmissions to different sectors being included in one frame. *See* Ex. 1002, ¶¶120, 127-129.

48. With that understanding, the combination of features would have been obvious to a POSA regardless of the duplexing method used in Goldberg. Dr. Chrissan, however, predicates the bulk of his argument to trying to assert that Goldberg is limited to FDD duplexing. Dr. Chrissan states that Goldberg is limited to only FDD frames. Ex. 2028, ¶¶138, 140, 143, 145. I disagree.

49. To begin, Dr. Chrissan attempts to limit Goldberg's design to use with the GSM standard only (which utilizes a TDMA/FDD design). Ex. 2028, ¶¶138, 143. Goldberg is not so limited. Goldberg provides a list of "examples of a cellular system to which the present invention can be applied are systems using variants of" a number of different options. Ex. 1006, 1:48-65. The first listed option is the Personal Handyphone System (PHS). Ex. 1006, 1:48-52. PHS is a TDMA/TDD design. Ex. 1022, pp. 429-430. In fact, the Rappaport book cited by Dr. Chrissan acknowledges the same. Ex. 1023, 544. However, Dr. Chrissan admitted he was unaware of this. Ex. 1024, 177:11-14.

50. In addition, Goldberg explains that its "invention is applicable to all downlink broadcast and transmissions." Ex. 1006, 2:6-33, 6:61-62. In fact, the Detailed Description in Goldberg identifies different preferred implementations,

where the first two are PHS standards (with the third being a GSM option). While the example discussion that follows uses a GSM example, Goldberg makes clear that “[h]ow to adapt these for other air interfaces and for other multiplexing schemes would be clear to one of ordinary skill in the art.” Ex. 1006, 6:58-65, 9:50-58, 11:12-23.

51. Thus, a POSA would clearly understand that Goldberg is not limited to FDD operations. Instead, a POSA would see that the commonality in the PHS and GSM standards identified by Goldberg is that they are both TDMA systems, regardless of the duplexing methods. The fact that Goldberg discloses a method applicable to both TDD and FDD would confirm a POSA’s understanding of the flexibility in using different TDMA framing structures independent of TDD or FDD. As already discussed above, Vornefeld is also a TDMA system and the question addressed by the references relates to multiplexing questions. In fact, both Vornefeld and Goldberg address using TDMA and SDMA together in a sectorized system such that a POSA would have immediately understood their compatibility. Ex. 1006, 2:21-33, 3:47-4:18, 10:10-13, 20:7-35; Ex. 1004, 52.

52. Again, the relevant frame structure being taken from Goldberg and applied to Vornefeld is the idea of providing transmissions to devices in different sectors in the same frame—an issue of multiplexing (e.g., TDMA).

2. Goldberg's Frame

53. Dr. Chrissan did not appear to rebut that Goldberg's frame design includes (in one frame) downlink transmissions to different devices regardless of their position throughout the cell site (i.e., across sectors). *See* Ex. 1002, ¶¶117 (“Goldburg[’s] ‘regions’ are created without any regard to antenna array transmission area, and instead divide the area such that there are at least as many regions as subscribers.”), 120 (“Goldburg transmits to multiple subscribers within the same frame as part of the TDMA protocol.”), 121, 130.

54. Dr. Chrissan's Declaration does assert that “there is nothing in Goldberg that teaches ‘transmit[ting] to multiple subscribers within the same frame.’” Ex. 2028, ¶143. However, that statement is not correct. Goldberg describes a single “downlink frame” in which timeslots are assigned to different mobile devices. EX1006, 12:11-24 (“time-slot 1 might contain [] data for one mobile ... and time-slot 7 might contain [] data for yet another mobile”; “[a]ll of this data ... is assembled into a 1250 bit frame”). Dr. Chrissan did not dispute this disclosure in this deposition. Ex. 1024, 186:14-187:7.

55. Dr. Chrissan also asserts that Goldberg does not address the “unique challenge associated with ... [transmitting] to multiple users, located in multiple sectors, *in the same TDD frame.*” Ex. 2028, ¶146 (emphasis in the original). However, the claims of the '931 patent do not identify any particular way of

transmitting to multiple sectors in the same frame that would overcome any alleged challenge of doing so. Instead, claims 28 and 29 simply state that the information is contained in the same frame, which is a simple question of the preferred data structure. I do not believe a POSA would view any challenge in using such a structure and Dr. Chrissan does not identify one. Thus, Dr. Chrissan seems to want Goldberg to solve an unidentified problem not relevant to what is actually recited in the claims. A POSA would recognize that all that would be required with this combination is assigning the existing timeslots in Vornefeld's downlink portion of its TDMA frame to devices in different sectors. That is just how a POSA would choose to arrange information and Goldberg describes a single "downlink frame" where timeslots are assigned to different mobile devices. Ex. 1006, 12:11-24 (time-slot 1 might contain [] data for one mobile ... and time-slot 7 might contain [] data for yet another mobile"; "[a]ll of this data ... is assembled into a 1250 bit frame"). To the extent that Dr. Chrissan is asserting that his alleged challenge is putting those transmissions into one "TDD" frame, based on his belief that Goldberg is limited to FDD frames, Dr. Chrissan's attempt to limit Goldberg to FDD frames is flawed for the reasons discussed above.

3. Interference

56. Dr. Chrissan states that Goldberg does not disclose any issues relating to interference at sector boundaries. Again, Dr. Chrissan views interference myopically

and I disagree with his positions for reasons stated above. Interference among transmissions to different devices is an interference issue regardless of whether it occurs with devices at sector boundaries or devices in the middle of sectors. A POSA would understand that multiplex and duplexing methods aid in avoiding interference within and across sectors, with TDMA designs splitting transmissions to different users in different locations across the time domain. Also, to suggest that a POSA would not have an appreciation of the various solutions to avoiding interference severely under-represents the knowledge of the POSA and the POSA's ordinary creativity in being able to select options from different references.

IV. Ground 3 (Youssefmir and Atsuta)

57. Dr. Chrissan asserts that Youssefmir lacks claim element 1[d] because it does not specifically state that broadcast beam ("frame marker" in Youssefmir) is sent to more than one sector. Ex. 2028, ¶¶160-162. Youssefmir states that the base station sends, at the beginning of a frame, the broadcast beam ("frame marker") to "*all* remote user terminals" in the cell. Ex. 1007, 18:30-33; 25:52-62, Figs. 1, 5A; *see* Ex. 1002, ¶¶155-56. Youssefmir also teaches that the system may be sectorized. Ex. 1007, 9:13-19. Dr. Chrissan does not appear to dispute these points.

58. As explained in my Original Declaration, a POSA would understand that a frame could contain transmissions to multiple sectors. Ex. 1002, ¶¶144-47. Because Youssefmir teaches that the frame marker goes to all devices in the cell and

a POSA would understand that the frame may contain transmissions to different sectors, it naturally follows that a POSA would understand that the frame marker would be sent across sectors. Dr. Chrissan seems to look for an explicit statement by Youssefmir on this point, but that fails to account for the full scope of knowledge of a POSA.

59. I also note that GAS, by conceding the application of Vornefeld against claims 1 and 19, acknowledged that this claim element was known in the field. Vornefeld's and Youssefmir's teachings on the broadcast transmissions at a start of a frame are similar. *See* Ex. 1004, Fig. 3, Ex. 1007, Fig. 5A. Thus, Dr. Chrissan's argument seems to contradict what was conceded in the Sprint IPR.

60. Dr. Chrissan's argument concerning claim element 1[e] essentially repeats his argument for claim element 1[d]. Ex. 2028, ¶163. I disagree with that position for reasons stated above.

61. Dr. Chrissan's arguments against the combination of Youssefmir and Atsuta largely repeat the attacks on Atsuta addressed above. Ex. 2028, ¶¶165-175. I disagree for reasons already stated.

V. Conclusion

62. For the reasons stated above, I maintain my positions in my Original Declaration with respect to the obviousness of claims 28 and 29.

63. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, I am aware that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 12, 2024



Dr. Kevin C. Almeroth