

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC.
NOKIA OF AMERICA CORPORATION
Petitioners,

v.

XR COMMUNICATIONS LLC
Patent Owner.

U.S. PATENT NO. 10,715,235
Title: DIRECTED WIRELESS COMMUNICATION

Inter Partes Review No.: IPR2024-00613

PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 10,715,235

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Petitioners' Exhibit List

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 10,715,235 (the “‘235 Patent”)
1002	Select portions of prosecution history of the ‘235 Patent (“File History”)
1003	Declaration of Petitioners’ Expert Dr. Mark Mahon
1004	U.S. Pat. No. 7,248,841 (“Agee”)
1005	U.S. Pat. No. 3,255,450 (“Butler”)
1006	[This exhibit number intentionally omitted]
1007	[This exhibit number intentionally omitted]
1008	U.S. Pat. App. 2002/0158801 (“Crilly”)
1009	U.S. Provisional Application No. 60/423,660 (includes “Beamforming for Littlejoe” priority document at page 134)
1010	Preliminary Patent Owners Response, IPR2022-00367, Paper 7, 04/19, 2022
1011	Patent Owner’s Sur-Reply To Petitioner’s Reply, IPR2022-00367, Paper 9, 6/16/2022
1012	Patent Owner’s Response, IPR2022-00367, Paper 14, October 20, 2022.
1013	[This exhibit number intentionally omitted]
1014	Comparison of Crilly language vs ‘235 patent language
1015	XR Claim Construction Brief, <i>XR Comm'ns LLC v. Cisco Sys.</i> , No. 6:21-cv-00623-ADA, Dkt. No. 44 (W.D. Tex. May 6, 2022)
1016	XR Sur-Reply Claim Construction Brief, <i>XR Comm'ns LLC v. Cisco Sys.</i> , No. 6:21-cv-00623-ADA, Dkt. No. 47 (W.D. Tex. June 3, 2022)
1017	Claim Construction Order, <i>XR Comm'ns LLC v. Cisco Sys.</i> , No. 6:21-cv-00623-ADA, Dkt. No. 56 (W.D. Tex. September 30, 2022)

I. INTRODUCTION

Pursuant to 35 U.S.C. §§ 311 *et seq.* and 37 C.F.R. §§ 42.1 *et seq.*, Ericsson Inc. and Nokia of America Corporation (collectively “Petitioners”) hereby petition for an *inter partes* review (“IPR”) of U.S. Patent No. 10,715,235 (the “‘235 Patent”). Petitioners respectfully submit that claims 1-5, 8-12, and 15-19 (the “Challenged Claims”) of the ‘235 Patent are unpatentable under 35 U.S.C. §103 over the prior art herein – none of which was considered during prosecution or any previously-filed IPR petition.

II. OVERVIEW

Most of the Challenged Claims focus on “simultaneously” receiving signal transmissions via multiple antennas from a remote station; determining different “signal informations” from those transmissions; and calculating beam-forming weights from those “signal informations.” During prosecution and before this Board, PO repeatedly sought to evade prior art based on two of these claim elements.

First, PO argued that the prior art did not disclose signal transmissions received “simultaneously” from the *same* remote station. Second, PO argued that certain prior art did not show “different signal informations” were determined, as required in elements 1.4-1.5, *infra*. Notably, neither the ‘235 patent specification nor priority documents expressly recite these allegedly-novel concepts anywhere

and PO has never identified any excerpt or figure in the specification that expressly recites these elements. Instead, as PO has argued repeatedly to the Examiner and this Board, it is the operation of a “Butler matrix” beamformer that provides implicit written description support for these claim elements. In fact, the Butler matrix has been front and center since the initial prosecution of the ’235 Patent and citation to its operation was the distinction that allowed for patentability during prosecution. Section V.F, *infra*.

A “Butler matrix” is a long-known concept patented in 1960 that uses signals that are received (or transmitted) simultaneously on multiple antennas to form beams. Section 0, *infra*. Butler’s U.S. Pat. No. 3,255,450 teaches the “Butler matrix” functionality. According to PO, “Butler matrix” connected to an antenna array implicitly discloses simultaneous reception of signal transmissions from the remote station:

Document C [Littlejoe] describes that the “searcher” receivers use a **“Butler matrix”** with “N = 16 array elements to form N beams.” EX-1009, 137. ... This **design enables the searcher receiver to receive multiple signals simultaneously via the receive beams.**

EX-1010 at 000019, *see also* EX-1011 at 000007-000008.¹ Referenced

¹ *See also* EX-1010, POPR at 000023 (“as a matter of law, the scope of the

“Document C” is a priority document for the ‘235 patent called “Beamforming for Littlejoe” (referenced herein as “Littlejoe”) (EX-1009, at 0134). Like the ‘235 specification, Littlejoe shows a “Butler matrix” attached to an antenna array with its outputs used for determining beamforming weights. While Littlejoe discloses a Butler matrix, it does not explicitly recite “simultaneously” receiving transmissions from the same station.

Consistent with PO’s argument, using a Butler matrix for beamforming based on signal measurements was well known; such as disclosed in the primary prior art reference herein -- U.S. Pat. No. 7,248,841 (“Agee”). Agee discloses: (1) using a Butler matrix to receiving signal transmissions on different antennas from the same remote station simultaneously; (2) using different “signal informations” from the different antennas’ receptions; and (3) calculated “weights” that are used for beamformed receptions and transmissions. There is no light between Agee’s disclosure and the Challenged Claims’ scope in view of the Butler matrix on which PO relies for written description support. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed. Cir. 1996) (excluding the preferred embodiment from the

challenged element must include the disclosures in Document C [Littlejoe] cited by Applicant for this element during patent prosecution”). Also, unless otherwise noted, all emphases and annotations herein are added.

claim scope “rarely, if ever, [is] correct and would require highly persuasive evidentiary support.”). Agee teaches a Butler matrix, used for the same purpose that PO cited in prosecution and before the Board, along with all other claim limitations, and therefore, Petitioners respectfully request that the Board institute IPR and cancel the Challenged Claims. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

III. GROUNDS FOR STANDING (37 C.F.R. §42.104(A))

Petitioners certify that the ‘235 Patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR on the grounds identified herein. 37 C.F.R. §42.104(a).

IV. REASONS FOR THE REQUESTED RELIEF

As explained below and in the attached Declaration of Petitioners’ Expert (EX-1003), the Challenged Claim were obvious over the prior art to a person of ordinary skill in the art (“POSITA”) at the invention time.

V. BACKGROUND

A. Previous IPR Proceedings

Two distinct IPRs were filed against the ‘235 patent. Neither prior IPR included the prior art or arguments made herein.

In IPR2022-00367,² PO submitted numerous arguments regarding the scope

² IPR2022-01398, IPR2022-01362, and IPR2022-01353 were joined with

of the disputed claim terms in its Patent Owner’s Preliminary Response (“POPR”) (EX-1010) and sur-reply to the POPR (EX-1011). Section V.F, *infra*.

Substantively, PO argued primarily that the prior art did not disclose receiving two signals “simultaneously.” Patent Owner’s Response, 14-33; Patent Owner’s Sur-Reply, 2-15. Following institution, further briefing and an oral argument, PO settled with petitioners and IPR2022-00367 was dismissed.

The Board declined to institute IPR2022-01155. There, the Board accepted PO’s arguments that the prior art in IPR2022-01155 did not disclose simultaneously receiving two signal transmissions. IPR2022-01155, Institution Decision, 27-32. Importantly, the Board was not presented with, and did not analyze, the following compelling arguments made herein:

- the known Butler matrix operation discloses the “simultaneously” receiving elements;
- PO extensively relied upon this known Butler matrix operation during prosecution and in IPR2022-00367 to disclose the “simultaneously” receiving elements;
- the Applicant argued that the Butler matrix operation was the feature allowing the Applicant to predate the largely verbatim prior art cited

IPR2022-00367.

by the Examiner for all elements except the “simultaneously” elements; and

- different “signal informations” can include “signal strengths” on different antennas; not just the content of signals argued in IPR2022-01155; and
- Agee’s OFDM tones simultaneously are received by each antenna element.

B. Prosecution History

The ‘235 Patent issued from U.S. Pat. App. No. 15/495,539 filed April 24, 2017 claiming priority through continuation applications to U.S. Provisional Pat. App. No.60/423,660 filed on November 2, 2002. Section V.F details the relevant prosecution history exchanges.

C. Claim Construction

For this Petition’s purposes, Petitioners propose that each claim term be given its plain and ordinary meaning. The prior art herein meets each claim limitation under any reasonable construction.

D. Person of Ordinary Skill in the Art (“POSITA”)

A POSITA in November 2002 would have been familiar with wireless communications networks, including the design of beamforming using multiple antennas. A POSITA would have at least a Bachelor’s degree in Electrical

Engineering or equivalent, and at least two years of work experience. A more advanced degree can substitute for some work experience. EX-1003, ¶¶37-39.

E. Using A Butler Matrix To Receive Information From Multiple Antenna Array Elements Simultaneously Has Been Well-Known Since 1960.

By 2002 (when the ‘235 inventors used this old technology in Littlejoe), the Butler matrix was well known and referenced in hundreds of patents throughout the world. EX-1003, ¶¶284-291. Figures 3 and 4 of Butler’s patent (EX-1005) show the Butler matrix. “FIGURE 4 shows the relative orientation of the eight beam patterns for the circuit of FIGURE 3.” EX-1005, 2:13-14.

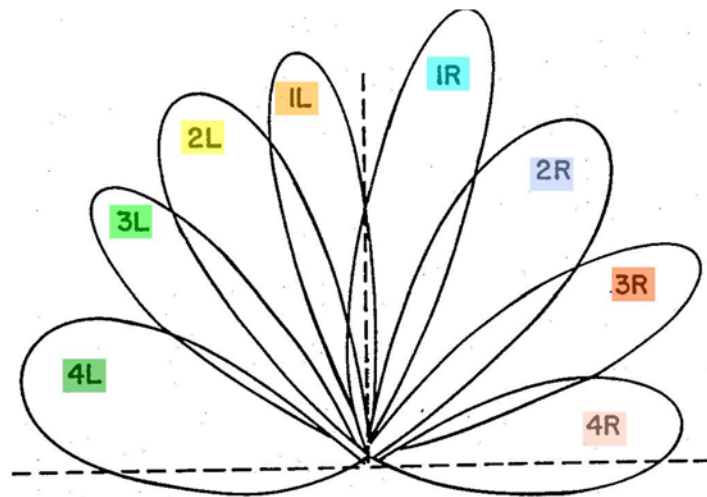


Fig.4

EX-1005, Fig. 4. “FIGURE 3 ... show[s] schematically the feed structure for an eight element array with eight independent feed terminals and designed to produce eight patterns.” EX-1005, 3:16-20. Circuitry connects the two sets of

input/outputs. The top “antenna ports” in Fig. 3 connect to a set of antennas (“a”-“h”). *E.g.*, EX-1005, 3:28-29.

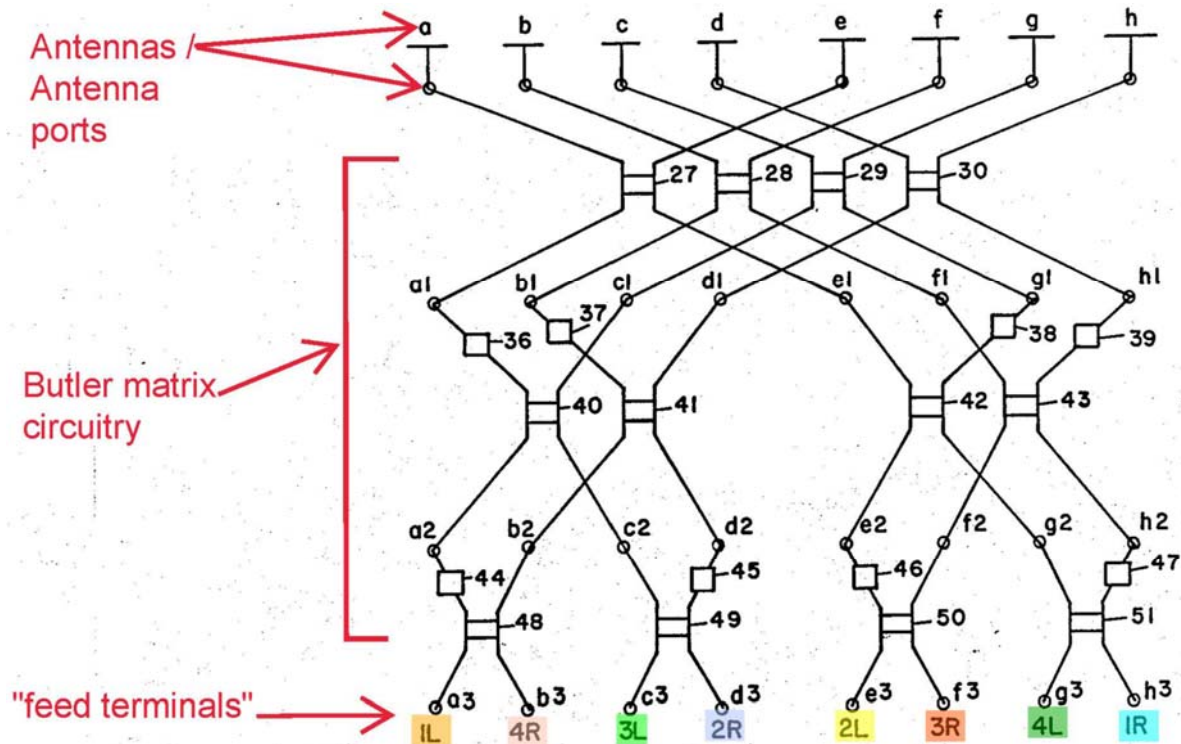


Fig.3

At the bottom are “feed terminals” that correspond to the beams (1L, 1R, 2L, 2R, 3L, 3R, 4L, 4R) transmitted (or received) by the antennas based on the signals of the antennas connected to those “feed terminals” through the circuitry. The feed terminals can be referenced as:

- (a) “combiner” feeds for reception because they output the “combined” signals from multiple antennas being received and aggregated to form each reception beam; or
- (b) “distributer” feeds for transmissions because the signals applied to these

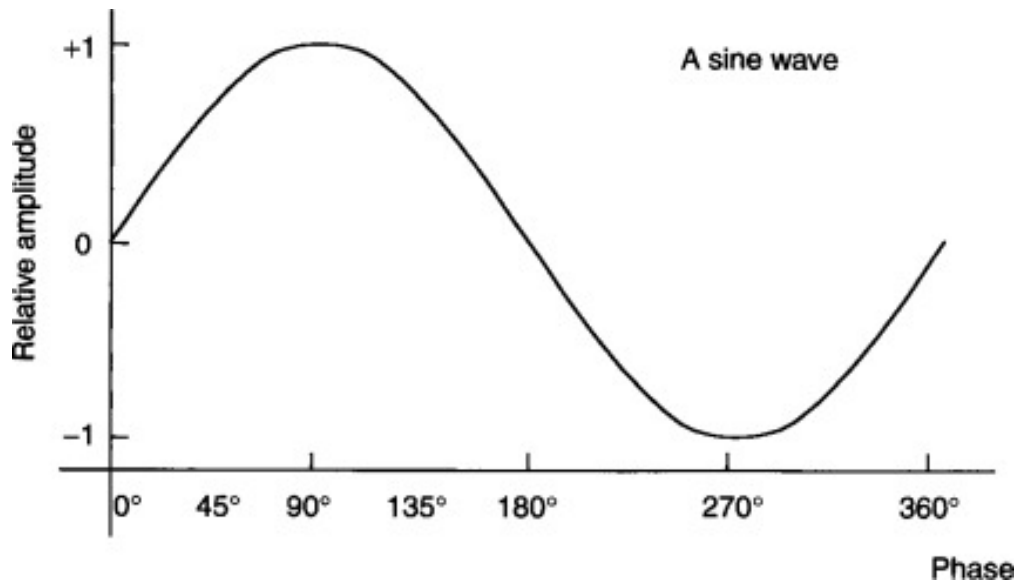
terminals are distributed to various antennas to form a transmission beam.

E.g., EX-1005, 3:70-73 (“Connections a3 and h3 form the input connections for energy sources to produce the various beam patterns ... in FIGURE 3.”).

The circuitry between the antenna ports at the top and the “feeds” at the bottom is configured such that the different collection of signals to / from one or more antennas forms each beam. This circuitry includes dividers (which divide the signals) and phase shifters (which shift the phase of signals). EX-1005, 3:28-73. EX-1003, ¶¶321-329.

The beams can be formed for transmission or reception. In one Butler embodiment, the same Butler matrix is used both to receive signals using the beams and then re-transmit those same signals back along the original beam. *E.g.* EX-1005, 4:16-37, Fig. 6.

The antennas receive “signal transmissions” in the form of continuous radio waves, as exemplified in the sine wave below which represents using a single frequency.



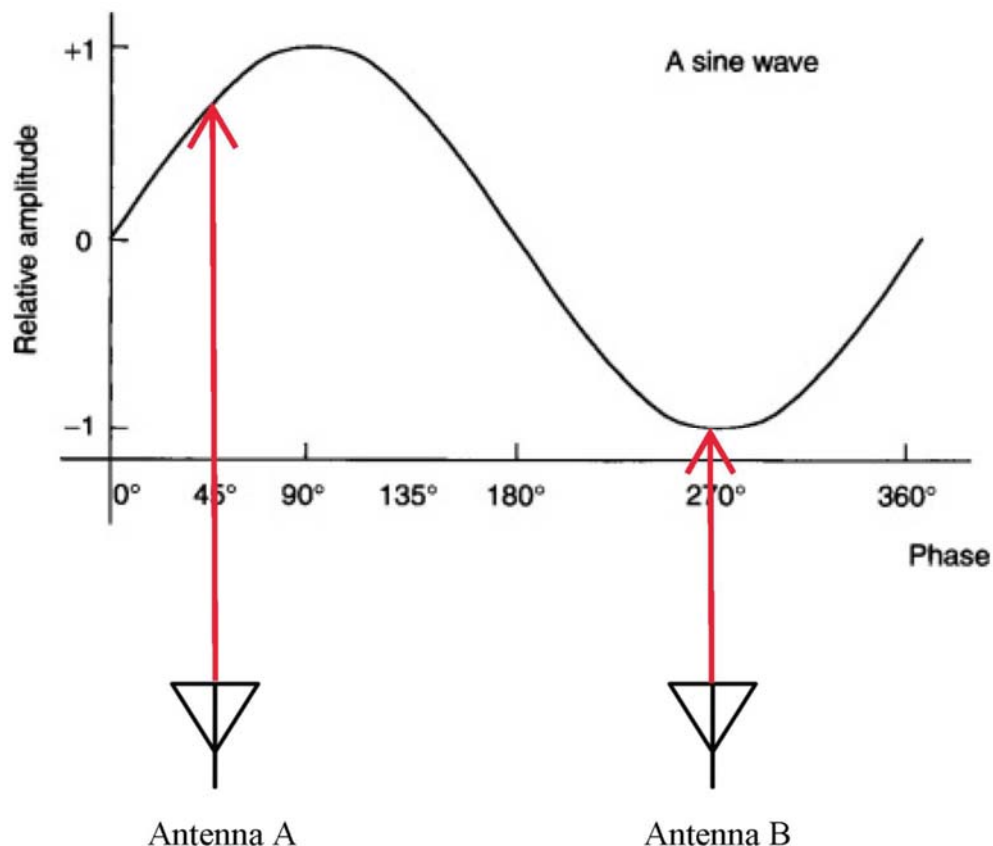
The relative amplitude of the signal wave is the “signal strength” which, as shown in this diagram, can be represented as going from -1 at the bottom to 1 at the top. The wave’s amplitude (*i.e.*, signal strength) varies depending on the “phase” of the wave; in this example, the amplitude is 0 at a phase angle 0 degrees, and is 1 at phase angle 90 degrees. EX-1003, ¶¶330-335.

While the received signal’s amplitude and signal strength vary over time, the signal wave is continuous and is “sampled” by the receiver(s) at particular times; rather than being discrete and limited to one point in time.

Furthermore, because the wave is traveling spatially from the transmitter to an antenna, it has a “phase front” (similar to a weather front moving geographically) associated with directionality and which determines the signal’s “path.” Accordingly, circuitry sampling the signal (wave) at each antenna element of an antenna array at the same time will detect different “amplitudes” (or signal

strengths) depending upon the angle of arrival of the signal's phase front with respect to the relative orientation of the antenna elements in the array. EX-1003, ¶¶335-336.

To illustrate this point, two antenna elements are depicted below and the wave is sampled simultaneously. Because of the physical separation of the antennas, each sample reflects a different “phase” (*i.e.*, at a different location which translate directly into a different phase value for the propagating wave), and the circuitry, which samples the wave received at each antenna, detects and measures a different signal strength (amplitude) for the same received signal.



In other words, at a given sampling instance, the wave is in the process of propagating across the antenna array and antenna A detects the signal when it is at phase 45 degrees and detects a signal strength of around 0.7. Antenna B is physically located such that (sampling at the same time as Antenna A) it detects the same signal at phase 270 degrees and will measure a received signal strength of -1.0. EX-1003, ¶337.

The Butler matrix purposefully uses these different phases detected simultaneously by the antennas. The Butler matrix has “phase shifters” that account for the physical separation of the antennas (based on a fixed mathematical relationship between phase, frequency and distance for a propagating). These phase shifters (and later combiners) generate the beams:

Through suitable wavelength spacing of the antennas from each other and phasing of the signal paths, the directional patterns can be varied as desired. The phase shifters 25 may preferably be an extra length of transmission line to cause signals therethrough to lag those signals going through the parallel paths.

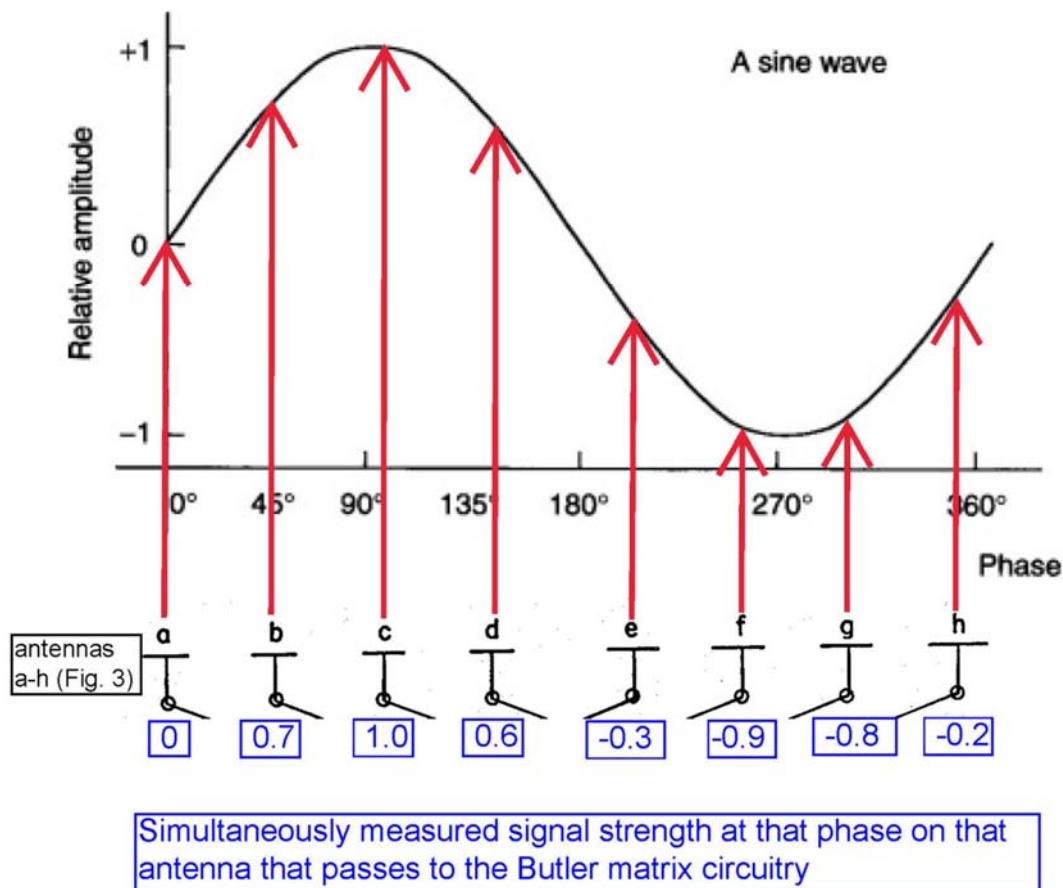
EX-1005, 35-37.

The amount of phase shifting of the signals depends upon the desired direction of the beam to be received or transmitted. This system is equally adaptable to reception as well as transmission of signals.

EX-1005, 17-20.

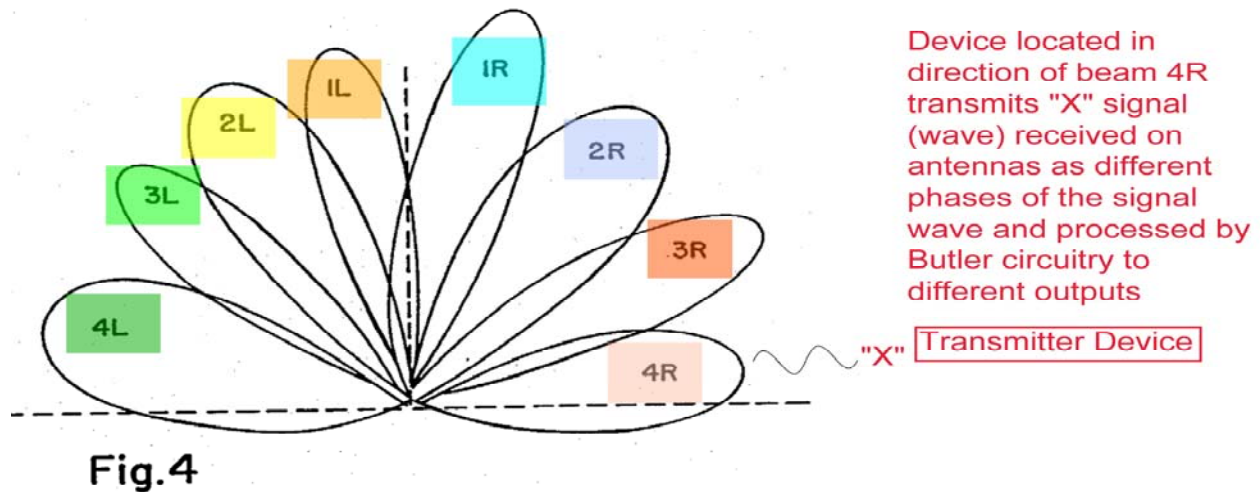
For a transmit beam, the use of the phase shifters and simultaneous transmission from the antennas facilitate the purpose of a Butler matrix, which is to create beams using antennas that are physically spaced apart. For a “receive” beam, the inverse is true: the simultaneously received signals on multiple antennas are shifted and combined to form receive “beams” on the feed outputs. In doing so, the Butler matrix takes advantage of the signal wave being at different phases when measured simultaneously at the differently located antennas. EX-1003, ¶¶338-340.

The Butler matrix can use this same approach and provide more specific results when more antenna elements receive the signal wave to be sampled. As shown below the signal wave is simultaneously detected on each of the Butler matrix antennas “a” through “h” as shown in Figure 3:



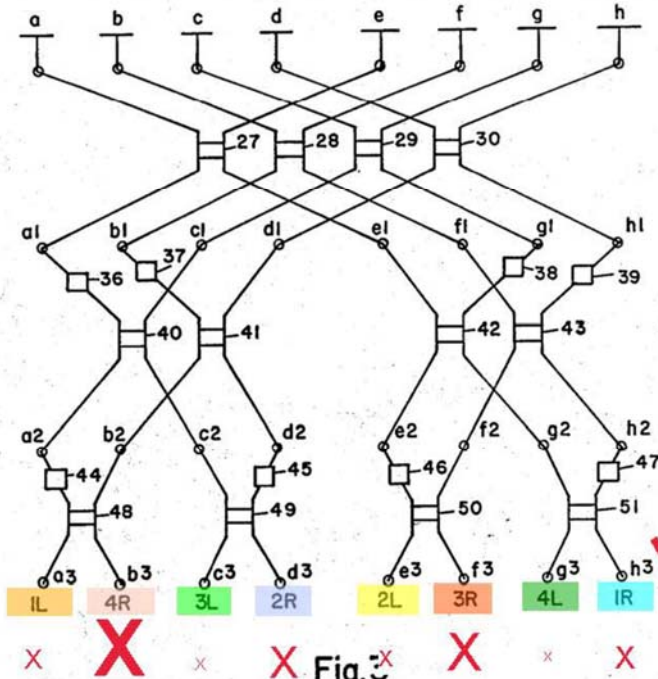
Each antenna receives simultaneously its own signal strength (amplitude) which in the example above, is different (from other antennas). These measurements are passed into the circuitry of shifters and dividers / combiners. EX-1003, ¶¶341-342.

The following annotated figures from EX-1005 show using the Butler matrix for beamforming based on its processing of simultaneously received signals. In this example, there is a “transmitter device” in the direction of beam 4R that transmits a signal transmission on wave “X.”



Each antenna receives that transmission at different phases, which are detected through sampling, each representing different informations associated with signal strengths, which the Butler matrix circuitry processes as shown below:

a("x") b("x") c("x") d("x") e("x") f("x") g("x") h("x")



Because the “transmitter device” is located in the direction of beam “4R”, the Butler circuitry processing results in a strong combined signal being output at the “4R” feed terminal at the bottom. The other feed terminals output progressively weaker signals as the formed beams move away from the transmitter’s location. Thus, beam “4L” will have the smallest reported combined signal strength (possibly 0) because the beam resulting from the circuitry associated with the 4L feed is “pointed” that beam away from the transmitter device. EX-1003, ¶¶343-345.

Note that, the signal measurements for each antenna $[a(x), b(x) \dots h(x)]$ are different (*i.e.*, different portions of the continuous wave) with different signal informations (phase and amplitudes) because the wave is being measured at different points.³

The different signals (measured at different phases and amplitudes) allow the Butler matrix to “form” the beam. The Butler matrix circuitry is taking the signal measurements of multiple antennas and combining those measurements in a manner such that the aggregated measurements are either increased or decreased based on the “direction” of the beam in comparison to the direction of the

³ In addition to phase difference, the signal strengths differ due to different distances from the antenna. EX-1003, ¶¶346-347.

transmitter – as reflected in the different phase / amplitude measurements. The point of the Butler matrix is to receive, and use, the different signals being received on different antennas simultaneously. EX-1003, ¶¶348-349. If the measured signals were the same, it would be effectively the same as using only a single antenna – which would not allow for beamforming through leveraging the information implicitly contained in the different phases and amplitude.

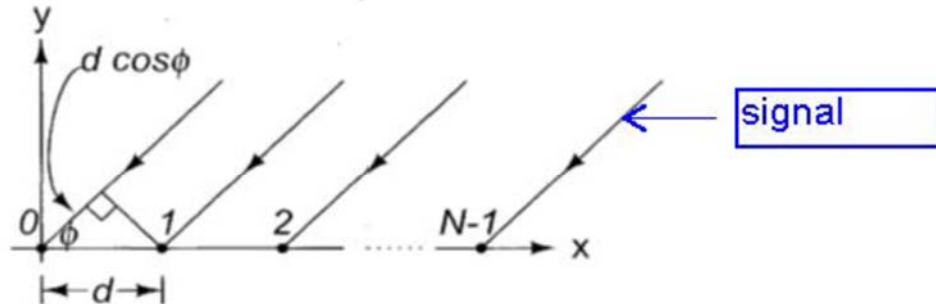
The beamforming criteria determined by the Butler matrix circuitry in response to the simultaneous receipt of signal informations then is used to determine the orientation of beams. As a signal to be transmitted is applied on the feed(s) corresponding to the desired beam(s) (*see* bottom of Butler Fig. 3), the circuitry then divides, shifts and distributes the signal and weights to the antennas used to form desire beam(s). EX-1003, ¶350.

Littlejoe explains the Butler matrix consistently with the above, but using a different diagram to represent the wave with the transmitter in the upper right and the signal wave arriving from the upper right.

Appendix A - Butler Matrix Beamforming

transmitter

Consider a uniformly-spaced linear antenna array with N elements spaced a distance d along the x -axis.



A unit-amplitude signal at a distance ($\gg d$) arriving at an angle ϕ relative to the x axis undergoes a phase shift per element of $\frac{2\pi}{\lambda} d \cos \phi$. The signal at the n 'th element is:

$$v(n) = e^{j(\frac{2\pi}{\lambda} d n \cos \phi)} \quad (1)$$

EX-1009, 0134. Littlejoe discloses antenna elements (on the X axis) detect different phases because the “signal ... undergoes a phase shift” that depends on the distance between antennas. The circuitry sampling each antenna measures a different phase of received signals and determines a different signal information. Then, the Butler matrix circuitry combines the different antennas’ receptions to form the beams. EX-1003, ¶¶351-352.

F. Based on the Intrinsic Record, PO Is Estopped from Arguing that a Butler Matrix Does Not Satisfy the Elements Related to “Receiving ... Simultaneously” and “Different Signal Informations.”

PO has repeatedly distinguished prior art on the “receiving simultaneously from the same remote station” and “different signal informations” recited in elements 1.3-1.7 below. Likewise, the prosecution history and PO statements made during IPRs demonstrate conclusively that PO argued that Littlejoe’s disclosure of a Butler matrix necessarily satisfies the claim elements related to receiving signal transmissions simultaneously and using the signal informations within each signal transmission to calculate beamforming weights (elements 1.3-1.7 in Section VII.A.3.a). Indeed, PO argued during IPR2022-00367 that:

[A]s a matter of law, the scope of the challenged element must include the disclosures in Document C [Littlejoe] cited by Applicant for this element during patent prosecution.

EX-1010, 000023. The only “disclosures in Document C cited by Applicant for this element during patent prosecution” were to the operation of Littlejoe’s Butler matrix. Furthermore, PO’s statements are consistent with the Butler matrix operation shown in Section 0.

PO’s statements taken together (as part of the intrinsic record) are overwhelming evidence that using a Butler matrix satisfies these elements. The ‘235 specification (and priority documents) do not ever expressly recite this

claimed activity, but as PO repeatedly argued to the Examiner and the Board, it is the long-known operation of a Butler matrix that provides implicit support for these elements. Here, PO is estopped from arguing otherwise.

1. THE PROSECUTION HISTORY SHOWS THAT THE BUTLER MATRIX DISCLOSES THESE ELEMENTS.

During prosecution: (1) the Examiner repeatedly ruled that U.S. Pat. App. 2002/0158801 (“Crilly,” EX-1008) – which is identical to the ‘235 in material respect except for the Butler matrix in the ‘235 patent -- teaches the independent claims except for the “simultaneously” received limitation; and (2) to pre-date (and overcome) Crilly, the PO cited extensively to the known Butler matrix operation in Littlejoe.

a. The Butler Matrix Operation Is the Only Alleged Distinction over Crilly.

Crilly uses almost verbatim language as the ‘235 patent uses – including the same Figure – to describe calculating beam-forming weights from signal transmissions. Unsurprisingly, the Examiner determined that Crilly taught the independent claims of the ‘235 Patent, except for the “simultaneously” received limitation. EX-1002, 000202-0225. The Examiner focused on Crilly’s Fig. 4 (copied in the ‘235 patent’s Fig. 12):

- receive a first signal transmission from a remote station via the antenna and a second signal transmission via the antenna (**see Crilly FIG. 4, paragraph [0091]; These signals, both desired and undesired, are collected by receiving elements within antenna array 110 and are eventually provided to control logic 110.**);

EX-1002, 000204. However, the Examiner eventually concluded:

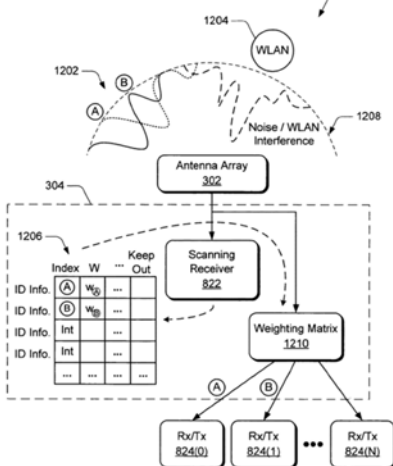
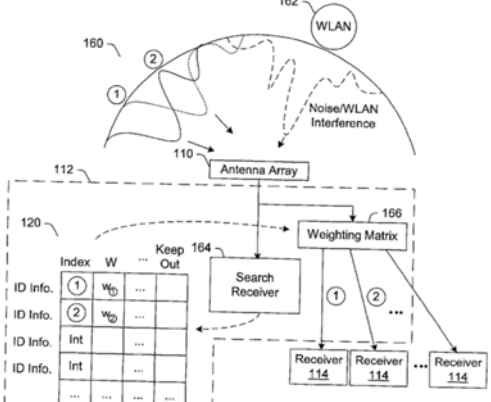
Crilly does not specifically disclose “receive a first signal transmission from a remote station via the antenna and a second signal transmission from the remote station via the antenna simultaneously.”

EX-1002, 000205.

For that reason, the Examiner cited a secondary reference (Ishii) for the “simultaneously” limitation. EX-1002, 000206. The applicant did not challenge the Examiner’s determination the Crilly disclosed all elements except “from the remote station ... simultaneously” but instead (unsuccessfully) challenged the secondary reference, Ishii, on the basis that it did not show the “simultaneously” element. EX-1002, 000190-0192. The Final Rejection repeated the determination that Crilly disclosed all claim elements except the “simultaneously” limitation. EX-1002, 000148-0150.

For convenience, EX-1014 contains a comparison of relevant Crilly passages and the corresponding passages in the ‘235 specification discussing

creating “weights” for beamforming (EX-1001, 24:25-27:67, Figs 12-14, “‘235 Weight Embodiment”)), which is summarized below:

‘235 Weight Embodiment (EX-1001, 24:24-25:30)	Corresponding Discussion in Crilly (EX-1008, ¶¶87-94)
 <i>Fig. 12</i>	 <i>Fig. 4</i>
EX-1001, 24:25-33	Crilly, ¶90
EX-1001, 24:34-38	Crilly, ¶91
EX-1001, 24:38-53	Crilly, ¶92
EX-1001, 24:54-67	Crilly, ¶87
EX-1001, 25:1-15	Crilly, ¶88
EX-1001, 25:16-22	Crilly, ¶93
EX-1001, 25:22-30.	Crilly, ¶94
EX-1001, 25:31-27:67, Figs. 13-15 (describing Butler matrix operation)	Not in Crilly.

The only reasonable conclusion that can be drawn from this comparison and the Examiner’s findings is that a Butler matrix discloses the scope of the “simultaneously” elements – which is consistent with the Butler matrix operation in Section 0.

b. **To Overcome Crilly, the Applicant Cited To the Butler Matrix Operation in Littlejoe.**

In response to the Final Rejection, PO sought to pre-date Crilly by arguing that Littlejoe (“Document C”) predated Crilly and cited to the Butler matrix operation missing from Crilly. EX-1002, 000130-0134 (citing to Littlejoe, EX-1009, 0134).

Figure 1 in Littlejoe depicts the “Butler Matrix BF”

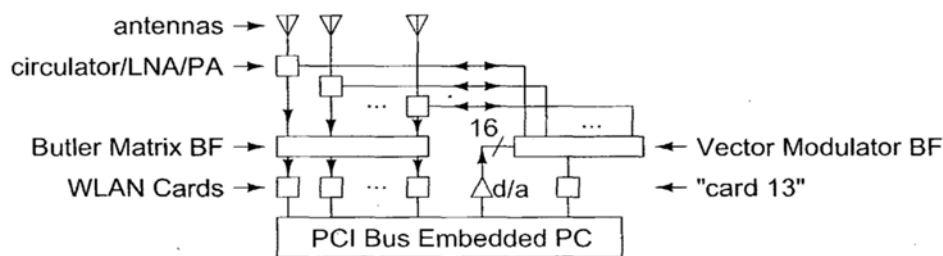


Figure 1: *Little Joe* block diagram.

EX-1009, 0135. Littlejoe further describes a Butler matrix to calculate the weights for performing beamforming:

Little Joe ... us[es] a 16-element linear antenna array to increase range and performance.

... The first beamformer, the “searcher,” is for receiving only and **uses a 16-port Butler matrix** whose outputs are connected to 16 standard WLAN cards installed in a PC. An application on the PC obtains the received signal levels for each received packet.

This signal level information is used to compute the complex weights

for a second RF beam former.

EX-1009, 0134. The inputs to the “Butler Matrix BF” are the signals received from the “16-element linear antenna array.” EX-1009, 0134. Also, Littlejoe’s “Butler Matrix BF” has 16 outputs to “WLAN Cards.” Each output represents the composite signal strength levels for multiple antennas connected to that output. See in Section 0, *supra* (explaining a Butler matrix’s operation).

The Applicant argued that the operation of a Butler Matrix BF corresponded to multiple claim elements in the following passages. For the “receive a first signal transmission element...”, PO argued it was disclosed by

C-3: “The signal received by the array elements will be the vector **sum of signals** arriving by many paths.” C-3 also refers to the “arrival of signals from the desired and undesired users”.⁴

For the “determine first signal information” and “determine second signal information” elements, PO argued they were both disclosed by:

C-4: “The beamforming application uses the **signal strength information** derived from packet receptions by the ‘searcher’

⁴The Examiner cited Crilly’s similar statement for this “receiving element.” EX-1002, 000146, 000204 (rejections citing to “0091 These signals, both desired and undesired, are collected by the receiving elements....”)

receivers.”

EX-1002, 000130-0131. The PO mirrored these arguments for the other claims.

EX-1002, 000132-0134. The Examiner accepted these arguments as “persuasive” and withdrew the Crilly rejection. EX-1002, 000091.

Thus, Littlejoe used the Butler matrix to “sum” the “signals” arriving on each antenna – reflecting how a Butler matrix works. Littlejoe used the known Butler matrix beamformer for its intended and known purpose of combining multiple different transmissions (of different phases and amplitudes) received simultaneously – just as Butler matrix beamformers had been known and used since 1960. Section 0.

Therefore, the scope of elements 1.3-1.7 below encompasses the operation of a Butler matrix beamformer. EX-1003, ¶¶187-249.

2. PO AFFIRMED THE APPLICANT’S ARGUMENTS THAT A BUTLER MATRIX MEETS THE SIMULTANEOUSLY RECEIVING ELEMENTS.

PO’s arguments during prior IPRs are consistent with the Applicant’s arguments during prosecution of the ’235 patent, *i.e.*, the Butler Matrix beamformer in Littlejoe disclosed claim elements 1.3 – 1.7. For example, “Patent Owner respectfully submits that Document C [Littlejoe] discloses each of the challenged claim elements of Challenged Claim 8[.]” EX-1010 at 000012 (IPR2022-00367, Preliminary Patent Owners Response (“POPR”)). PO detailed

arguments that Littlejoe's "Butler matrix" corresponded to the claim elements reciting reception of signal information. EX-1010 at 000017-000021.

PO repeatedly argued that the (known) Butler matrix disclosed the claimed receiving actions:

Document C [Littlejoe] describes that the "searcher" receivers use a "Butler matrix" with "N = 16 array elements to form N beams." EX-1009, 137. ... This design enables the searcher receiver to receive multiple signals simultaneously via the receive beams.

EX-1010 at 000019. The POPR spent pages arguing that the known operation of a Butler matrix disclosed the claim elements:

Petitioner only disputes the portion of this element requiring "simultaneous" receipt of a first and second signal transmission from the same remote station. ... However, these elements are disclosed in Document C [Littlejoe]. As Petitioners note, the "searcher" "comprises a 16-port Butler matrix coupled to 16 different WLAN wireless cards." *Id.* As will be shown below, Document C describes methods by which multiple signals are received simultaneously. EX-1009, 134 [C-1] ("The first beamformer, the 'searcher,' is for receiving only and uses a 16-port Butler matrix")....

EX-1010, 000018.

PO reiterated these arguments in its sur-reply in opposition to the Petition: Petitioners dispute Doc. C discloses “simultaneous” reception. But Doc. C discloses a “16-element linear antenna array” ... with “a Butler matrix to support the beamforming function”

Petitioners dispute the Examiner’s understanding that sixteen antenna elements coupled to sixteen “searcher” receivers (i.e., WLAN radios) will receive signals simultaneously. But an ordinary artisan would recognize that each WLAN radio on each **Butler matrix port** will “listen simultaneously,” It would be clear to an ordinary artisan from Document C alone that Little Joe’s sixteen antenna elements with sixteen receivers results in simultaneous reception.

EX-1011 at 000007-000008 (IPR2022-00365, PO’s sur-reply to the POPR).

Again, PO argued that it was the known Butler matrix operation that was “clear to an ordinary artisan.”

3. THE ‘235 SPECIFICATION INCLUDES A BUTLER MATRIX AND DOES NOT EXPLICITLY TEACH THE “SIMULTANEOUSLY” ELEMENTS.

The ‘235 specification includes only one example of creating “weights” for beamforming – the ‘235 Weight Embodiment. EX-1001, 24:25-27:67, Figs 12-14. Most of the ‘235 Weight Embodiment is virtually identical to Crilly’s language cited by the Examiner – including substantively the same Figure. But, the

Examiner determined that Crilly did not disclose the “receiving ... simultaneously” element. *See* section V.F.1, *supra*.

Likewise, the ‘235 specification does not ever explicitly discuss two signals being received simultaneously from the same remote unit. At most, the ‘235 patent states:

FIG. 12 illustrates an exemplary implementation 1200 of the multi-beam directed signal system 206 that weighs signals received via antenna array 302. Communication and/or data transfer signals are received from sources 1202 (e.g., sources A and B). The signals received from sources 1202 are considered desired signals because they are from nodes within the wireless routing network. Further, signals such as noise and WLAN interference associated with another external wireless system 1204 are not desired.

EX-1001, 24:25-33. This paragraph discusses “signals are received from sources” twice – both in the plural. It does not discuss signals received simultaneously from the same source. Crilly discloses substantively the same language as above:

Reference is now made to FIG. 4, which illustratively depicts signals received by a wireless routing device 102 from different sources. Here, for example, it is assumed that signals received from sources 160 are desired signals as they are from other nodes within wireless routing

network 100 and that signals such as the noise and WLAN interference associated with another external wireless system 162, are not desired. EX-1008, ¶0090 (Crilly). Thus, because Crilly and the ‘235 patent contain the same discussion of “desired” signals, and because the Examiner determined that Crilly did not disclose “simultaneously” (Section V.F.1, *supra*), this passage cannot be said to disclose the “simultaneously” claim elements.

The ‘235 Weight Embodiment then discusses the calculation of “weights” (EX-1001, 24:35-25:30), but there is no discussion of receiving “simultaneously.” Again, the discussion is largely the same as Crilly, with the only substantive difference being the ‘235 specification adding a Butler matrix. EX-1001, 25:31-27:67. But rather than explicitly describe a “receiver” that receives two signals simultaneously from the same remote unit, the ‘235 specification only uses the already-known operation of a Butler matrix – using language similar to Butler’s 1960 patent discussed in Section 0. EX-1003, ¶¶238-248.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

This Petition challenges claims 1-5, 8-12 and 15-19 of the ‘235 Patent.

B. Statutory Ground for Challenges

The Challenges are detailed below and summarized as follows:

Ground	Claims	Basis	Reference
1	1-5, 8-12, 15-19	§ 103	U.S. Pat. No. 7,248,841 alone or in

			combination with U.S. Pat. No. 3,255,450
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The references asserted herein were not considered during prosecution or a prior IPR.

Ground 1:

U.S. Pat. No. 7,248,841 (Agee) was filed on June 10, 2001, issued on July 24, 2007, and claims priority to U.S. Provisional Application Nos. 60/211,462 and 60/243,831. Agee is prior art under 102(a)(e)(g). If PO attempts to predate Agee's non-provisional date, Petitioners intend to establish that Agee is entitled to one or both provisional's dates.

U.S. Pat. No. 3,255,450 was filed on June 15, 1960 and issued on June 7, 1966 ("Butler"). Butler is prior art under 102(a)(b)(e) and (g).

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

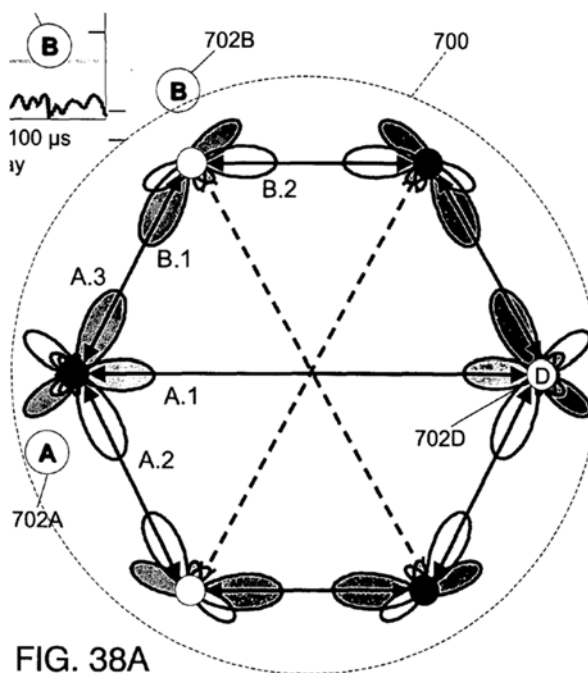
A. Ground 1: The Challenged Claims are unpatentable over Agee alone or in combination with Butler.

Ground 1 is that Agee alone, or in combination with Butler, renders the identified claims obvious.⁵ Butler explains how a POSITA would understand Agee's discussion of a Butler matrix.

⁵ This Ground is in view of the knowledge of a POSITA including a POSITA's understanding about well-known concepts such as a Butler matrix.

1. Overview of Agee

Agee teaches a wireless system in which base stations (“BS”) communicate with other BS’s and subscriber units (“SU”) using beam-formed transmissions:



EX-1004, Fig. 38A.

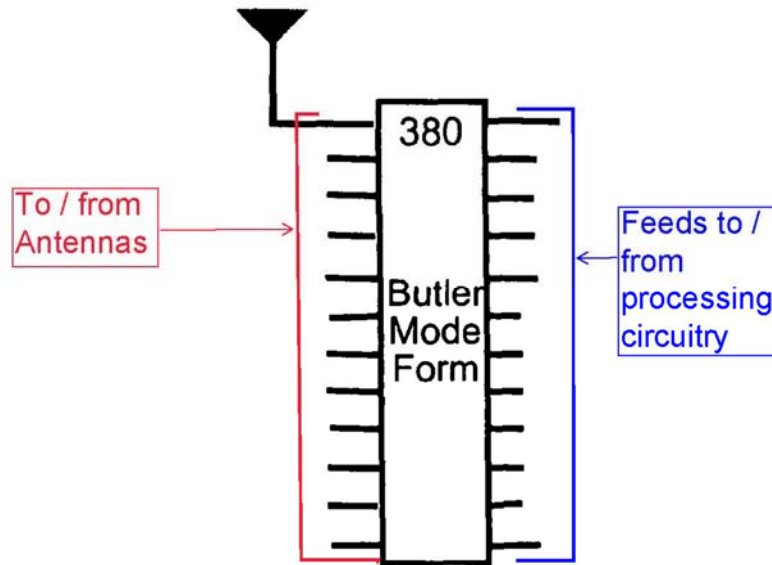
Agee’s BSs include an antenna array (EX-1004, 45:43-54) and radios that receive signals on the antennas in the arrays and use those signals to calculate adaptive “weights” to form a “receive beam.” Using the principle of reciprocity, Agee’s BS then uses the “receive weights” to form “transmit weights.”

Exploiting the substantive reciprocity of internode channel responses through dynamic, adaptive modification of receive and transmit weights...

EX-1004, Abstract.

Agee’s BS uses a “Butler” matrix to simultaneously receive different signals

on the different antennas in the array and output those signals received on the feeds to the BS processing units. Section 0, *supra*. Agee references the Butler matrix as the “Butler Mode Form” in Fig. 25:



EX-1004, Fig. 25.

A POSITA would recognize this “Butler mode form” as implementing the long-known Butler matrix. EX-1003, ¶¶277-301. First, the Butler matrix is pervasively well known having been cited by hundreds of patents and using “Butler” in this context would be recognized by a POSITA as the Butler matrix – particularly in the context of being used with an antenna array. EX-1003, ¶¶277-291, 316-350. Second, Agee identifies the operations performed by the “Butler Mode Form” as those operations that the known Butler matrix would perform. EX-1004, 45:55-46:50, 48:19-46, claims 40, 180. EX-1003, ¶¶291-301. The “transmission reciprocally formed with the shared Receiver feeds” reflects that

Butler matrices form beams for both transmission and reception as explained in Section V.E. The “spatial signal separation,” “link separation,” and “link detection” reflect beamforming. EX-1004, 20:22-21:28, 3:51-4:23. Agee specifically states that its Butler matrix (Mode Form) “enables steering ... beams and nulls...” EX-1004, 46:43-45. See also EX-1004, Fig. 38A (showing beams), 36:59-60, 46:65-47:3, 46:21-27, Fig. 25.

The BS uses the “feeds” from the Butler matrix (with the different signal information from different antennas) to adaptively determine “weights” using Agee’s “Multilink Rx Weight Adaptation Algorithm” depicted in Fig. 24:

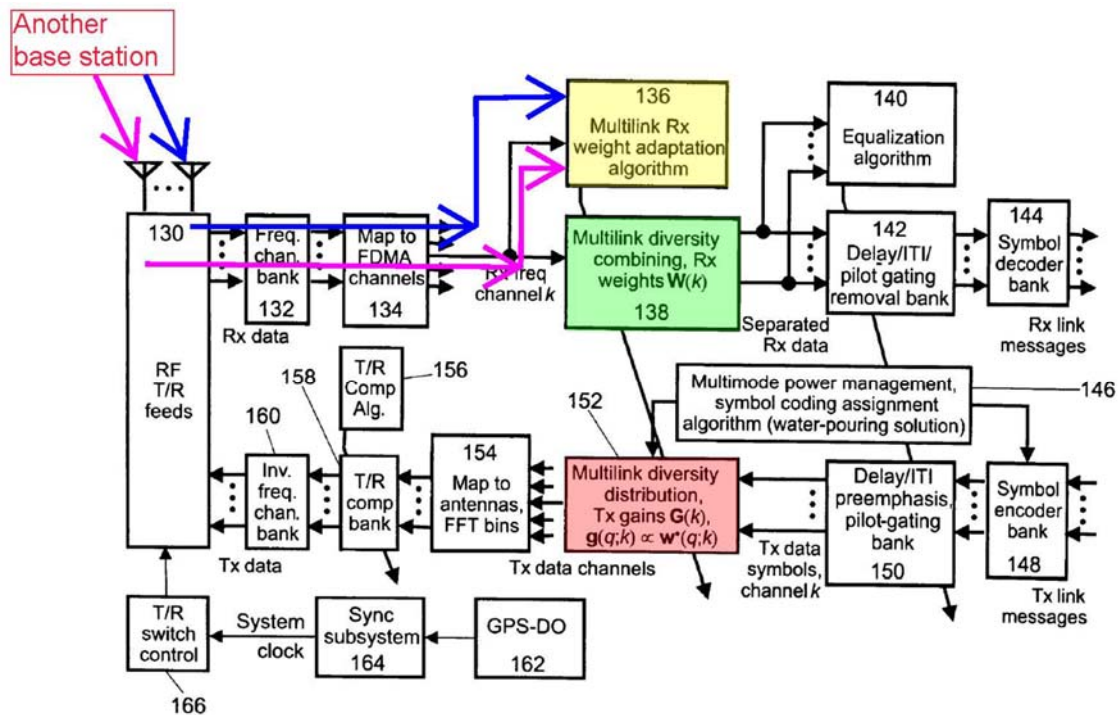


FIG. 24

EX-1004, Fig. 24. The “Multilink RX weight adaptation algorithm” adaptively calculates the “receiver weights” for each link:

substantively nulling combiner weights are formed using [] algorithms that adapt [weights] to values that minimize the mean-square error (MSE) between the combiner output data and a known segment of transmitted pilot data.

EX-1004, 64:43-48.

The adapted “combiner weights”: (a) receive beam-formed transmissions in the “Multilink Diversity combining 138” block; and (b) transmit beam-formed transmissions as “distribution weights” in block 152. Effectively, by using the weights for transmit (and receive), Agee is constructing/adapting beams of beams from the existing beams created by the Butler matrix. EX-1003, ¶¶303-307.

Thus, Agee uses a Butler matrix to receive different signal informations on different antennas simultaneously – in the same manner as PO argued is taught and claimed in the ‘235 patent. Agee uses those signal informations to determine weights used to construct beam-formed transmission signals and transmits signals based on those weights – as claimed in the ‘235 patent.

Agee teaches all the Challenged Claims’ elements– using the same technology relied upon by the ‘235 specification and priority documents.

2. Overview of Butler

PO argued that the receiving simultaneously element “would be clear to an ordinary artisan” from the operation of a Butler matrix. *See* Section 0. The same

knowledge that PO relied upon for the Butler matrix operation applies to a POSITA understanding Agee's disclosure. Thus, Agee in view of a POSITA's knowledge provides the requisite disclosure of a Butler matrix. Nevertheless and to foreclose any argument about the Butler matrix operation, Butler (described in Section 0) is cited as a secondary reference. A POSITA would have been motivated to combine Butler with Agee because Agee expressly references that Butler matrix technology that Butler disclosed (and invented) and which has been well-known for 40+ years before Agee's 2000 priority dates. The POSITA would have a reasonable expectation of success because Agee is using the Butler technique for its well-known and intended purpose. EX-1003, ¶¶355-366.

3. Detailed Application of Agee alone or in combination with Butler

a. Claim 1

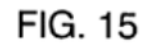
[1.0] A receiver for use in a wireless communications system, the receiver comprising: an antenna, wherein the antenna comprises a first antenna element and a second antenna element;

Agee, alone or in combination with Butler, discloses⁶ these elements as part of Agee's BS's. EX-1003, ¶¶368-382. Agee's BS's all include a MIMO transceiver that include an antenna array comprised of multiple elements that

⁶ As used throughout this Petition, "discloses" encompasses what a reference would teach, suggest, or render obvious to a POSITA.

Each node of the network incorporates a MIMO transceiver. ... Each MIMO transceiver possesses an antennae array ... (FIG. 15, Item 110). This provides 1-to-M modes (RF feeds) for the signals to be transmitted or received over, ...

Agee's Figures show the antenna arrays (elements 110, 125) with antenna elements:



36

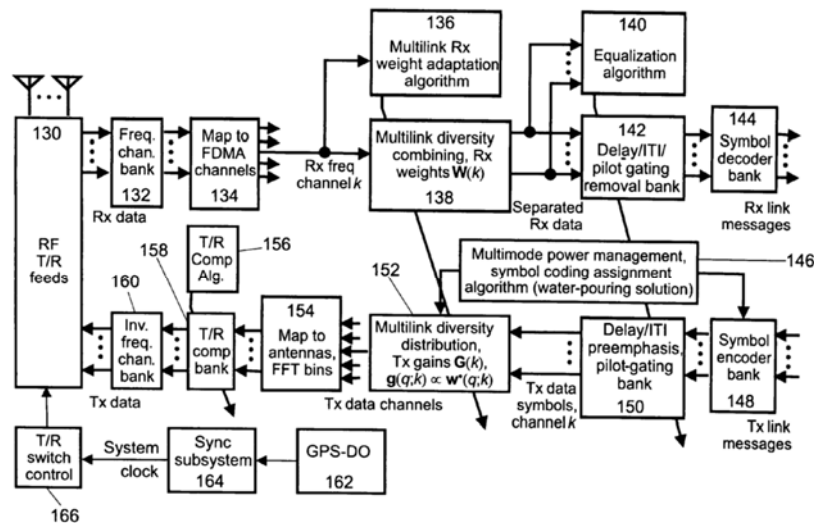


FIG. 24

EX-1004, Fig. 24. See also EX-1004, Figs. 16-18, 20, 25, 31.

The “1-to-M modes (RF feeds) for the signals to be transmitted or received” (EX-1004, 45:52-54) are received (as shown above) from the Butler matrix to a “Multilink Weight Adaptation Algorithm” that calculates receive / transmit weights discussed below for elements 1.4 – 1.7.

Agee’s BS has “a spatially diverse antennae array of M antennae, where $M \geq \text{one [two]}$ ” and “a transceiver for each antenna.” EX-1004, claims 1, 2, 40, 98, 105, 110, 180.

[1.1] a transceiver operatively coupled to the antenna and configured to transmit and receive electromagnetic signals using the antenna;

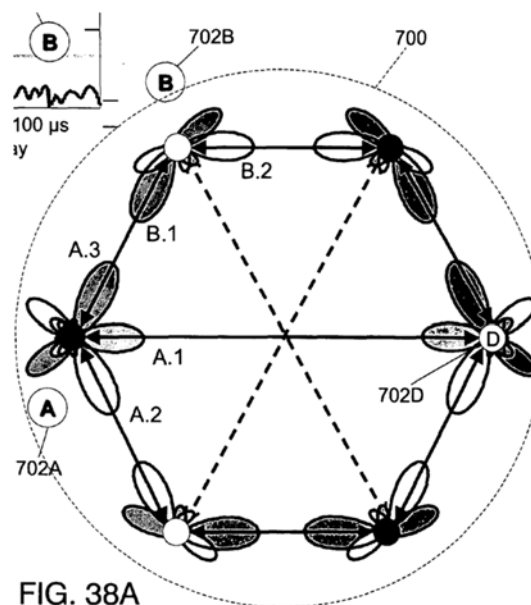
Agee discloses a “transceiver” two ways. EX-1003, ¶¶383-398. First, Agee’s “MIMO transceiver” includes each functional block in Fig. 24 that “illustrates one embodiment of the MIMO transceiver....” EX-1004, 36:6-8.

Agee's "MIMO transceiver contains and uses simultaneously a multiple of single RF feeds...." EX-1004, 59:23-27 (describing Fig. 25). Second, Agee teaches:

[E]ach node preferentially has an antennae array; multiple, multitone, transceivers (one per antenna); ... [that] transmits and receives signal energy during alternating time slots

EX-1004, 45:5-21.

Fig. 38A shows beamformed signals being transmitted / received among nodes (BS). *See also* Figs. 13A/B, 15-20 (showing transmission among BS).



EX-1004, Fig. 38A. EX-1003, ¶¶384-392.

Figure 25 shows the Butler matrix beamformer (380) along with the antennas and transmit/receive circuitry.

element performs the functions in elements 1.3 to 1.7 *infra* of receiving signals, calculating weights and using the weights for a transmission.

Agee BS uses a “processor” for these functions. As detailed below, elements 1.3 to 1.7 are (in part) performed by Agee’s “Multilink weight adaptation algorithm.”⁸

Agee teaches that the incoming, and outgoing, transmissions are processed by algorithms running on a “processor” that also generally controls the BS operations and the signal processing algorithms (including the Multilink Weight Adaptation Algorithm, the “Multilink diversity combining” and “Multilink diversity distributing” algorithms).

Agee describes a processor: (1) receiving a “pilot signal;” (2) using the Multilink weight adaptation algorithm to calculate weights; and (3) using those weights in the “Multilink diversity combining” algorithm to receive data:

When a communication is transmitted, it will be received; and the MIMO reception is, like the transmission, adaptive. See FIG. 30, detailing the logical processing involved. Received data passes through

⁸ Also referenced as the “Multilink RX weight adaptation algorithm,” the “Multilink Receive weight adaption algorithm” or the “Multilink Adaptation Algorithm.”

both a Multilink weight adaptation algorithm and (to which that part is combined) a Multilink diversity combining of the Reception weights.

.... **The functional and firmware processing (fixed logic hardware, limited purpose firmware, or combined software, processors and circuitry).**

EX-1004, 58:43-61. Agee continues forward to describe (at a high-level) the “Multilink weight adaptation algorithm” (detailed in element 1.6).

The **received symbol $[x](i,1)$** , comprising a matrix combination of L Link and M multitone elements, is first modified by the pilot tone generator that sends the recipient node, network, and group modifications for an element-wise reverse multiplication, to strip off that component of the signal and identify if the received symbol is from any originating source trying to send to this particular recipient. If the recipient pilot signal matches, then the signal passed on to a circuit that separates the pilot signal elements from the data signal elements. The pilot signal elements are passed through a link detection circuit that preferentially uses a FFT-LS algorithm to produce link quality statistics for that particular received transmission, identifies the **weighting elements that were contained in the pilot signal** and passes those over to the multilink combination circuit

EX-1004, 58:60-59:15. Thus, this paragraph links a processor to the algorithms that receive data, calculate weights and use those weights as claimed in the ‘235 patent. EX-1003, ¶¶401-412.

Furthermore, Agee describes its processing performed by a “DSP” (“digital signal processor” or “digital signal processing”) which discloses the claimed processor at each node. EX-1003, ¶¶413-414. EX-1004, 35:1-5 (“nodes with multiple antennae, multitone transceivers with DSP capability); 45:53-54; 48:19-45; 19:66-20:15; claim 40 at 87:38-40, 86:58, 86:33-34, 86:19-20. The DSP receives and processes the Butler matrix outputs from the antennas. EX-1004, 45:55-46:6; 48:4-12.

Agee’s claims reflect this the algorithms performed by a DSP at each node. *E.g.*, EX-1004, claim 40 at 87:38-40, 86:58, 86:33-34, 86:19-20. See also EX-1004, claim 180, 106:29-110:34. Agee’s other claims recite elements such as the “diversity capability means” (associated with a “processor” as noted above) and “dynamically adapting the diversity capability means.” *E.g.*, EX-1004, claims 1-7, 12, 20-21, 25-32.

Moreover, Agee’s “algorithms” are implemented in “software.” EX-1004, 44:64-66; 29:14-15; 33:33-35; 40:52-54; 74:11-17; 4:63-64. At a minimum, it would have been obvious to a POSITA to implement the recited functions (including the Multilink Weight Adaptation Algorithm, the “Multilink diversity

combining” and “Multilink diversity distributing” algorithms) in a “processor” or software running on a processor because it is merely an obvious design choice to implement those algorithms in either special-purpose hardware or in a “processor” executing software. EX-1003, ¶¶415-416.

A POSITA would have recognized that processor implementations provided benefits. It is quicker and easier to adjust the algorithm if implemented in software operating on a processor. The algorithm and system can be more adaptable to new technology such as new coding techniques or standards. EX-1003, ¶¶417-422. “Processors” are available off-the-shelf and would not require as lengthy of a implementation time as special-purpose hardware would require.

[1.3] receive a first signal transmission from a remote station via the first antenna element and a second signal transmission from the remote station via the second antenna element simultaneously;

Agee discloses the element.⁹ EX-1003, ¶¶423-514.

⁹ Claim 1 recites a “processor,” not necessarily the antennas, performs a “receive... simultaneously” act. The adverb “simultaneously” modifies the verb “receive” done by the processor. Claim 8 does not expressly recite that the signals be “receiv[ed]” by the antennas simultaneously. Regardless, Agee shows that the signals are received simultaneously both by multiple antenna elements and by other components (including the processor) used in processing the signals.

Claim 1 recites a “first signal transmission” and “a second signal transmission.” However, the claim does not recite that the two “signal transmissions” must be “different.” In contrast, Claim 1 recites “first” and “second” “signal information,” but also expressly recites “the second signal information is different than the first signal information.” EX-1001, 32:49-50.

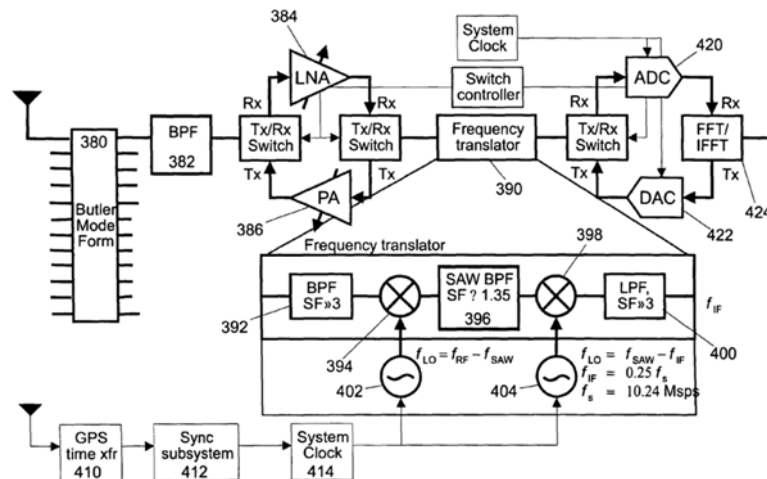
Thus, the words “first” and “second” as used in the claim to modify the signal transmission does not require the transmission to necessarily be two different transmissions. Otherwise, the claim element that “the second signal information is different from the first signal information” is rendered superfluous – which would be an erroneous approach to claim scope. Regardless, the prior art (Agee and Butler) teach this element.

Agee discloses this element in at least three ways that can be considered alone or in combination: (1) using the same Butler matrix operation relied upon by PO during prosecution and in IPR; (2) Agee’s numerous other statements teaching this element, and (3) Agee’s use of OFDM which transmits (and receives) multiple different OFDM tones simultaneously.

(a) Agee’s Butler Matrix Teaches Simultaneously Receiving Signal Transmissions In The Same Way As PO Argued That The ‘235 Patent And Priority Document Teach It.

PO repeatedly asserted that using a Butler matrix satisfies this “simultaneously” claim element. Section V.F, *supra*. Agee discloses this same

arrangement of a Butler matrix with multiple antenna elements with “receivers in simultaneous reception” of multiple signals that have arrived on each antenna.



Agee explains Figure 25 as:

EX-1004, 45:55-61.

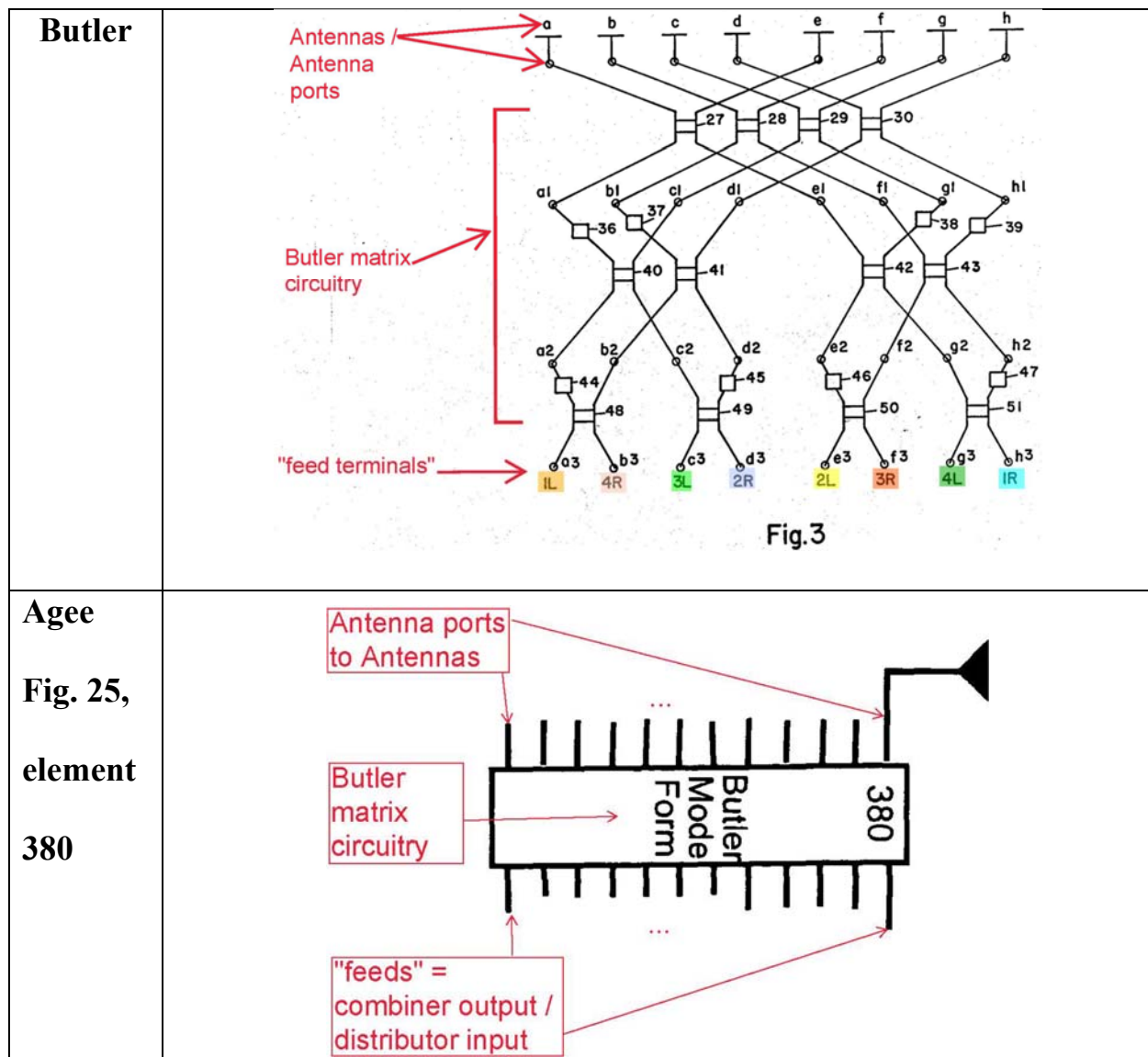
The Butler Mode Forming circuitry also provides the spatial signal separation adaptation, preferentially with a FFT-LS algorithm that integrates the link separation operation with the pilot/data sorting, link

detection, multilink combination, and equalizer weight calculation operations. This Butler Mode Forming approach means that the transmission forming is readily reciprocal with the receiver feeds....

EX-1004, 45:62-46:6. *See also* EX-1004, 86:8-89:60, 106:29-110:33 (claims 40 and 180).

Agee's "spatial signal separation" reflects beamforming. EX-1003, ¶¶435-437, 296-301. EX-1004, 20:25-22:14. For this spatial separation of signals, Agee expressly references the type of processing performed by the Butler matrix which results from "signals that represent the amplitudes and phases of the RF signals received at each antenna element...." EX-1004, 20:21-21:7.

Agee uses "combiner output" to reference the Butler matrix output which consists of "combined" different signals received on multiple antennas and output on the RF feeds. EX-1003, ¶¶439-448. Agee's Butler matrix is arranged like the Butler matrix from the Butler's patent as shown in the following diagrams:



Thus, the different signals from different antennas are output on the Butler matrix outputs that are received to the BS processing circuitry including the Multilink Adaptation Algorithm discussed below.

As noted in Section V.F.1, PO argued successfully to the Examiner that this “receive...” element was disclosed by the single sentence in Littlejoe that stated “C-3: “The signal received by the array elements will be the vector sum of signals

arriving by many paths.¹⁰ This statement is true about **any** antenna and does not say anything about “simultaneously” receiving multiple signal transmissions from the same remote station. The statement applies equally to Agee’s received signals on its array elements for its Butler matrix. EX-1003, ¶451.

If PO argues that this claim element somehow requires “multipath” transmissions, Agee discloses such multipath transmissions. EX-1004, Figs. 11, 12, 4, 28:38-41, 60:13-22, 62:63-64:27. Agee has the same disclosure as Littlejoe because the transmissions would travel to Agee’s antennas along different paths (even originating from the same remote station). As those transmissions were received by each antenna, the signal information (*e.g.*, signal strength and phase) would be different. Agee has the same (or more) disclosure than Littlejoe and/or the ‘235 patent. EX-1003, ¶452.

Thus, Agee discloses this “receive” element.

¹⁰ PO cited also to Littlejoe’s reference to “arrival of signals from the desired and undesired users.” Section V.F.1, *supra*. However, Crilly contained substantively same language. EX-1008, ¶¶0090-0092 (discussing “desired and undesired” signals). Thus, this “desired and undesired” language does not disclose the “simultaneously” aspect because the Examiner repeatedly determined that Crilly did not disclose the “simultaneously” aspect. *See* Section V.F.1.

(b) Agee's Other Teachings Of The Simultaneous Receiving Element.

In addition, Agee's transceiver (and the antennas associated with it) rely upon simultaneous reception of signals from the same remote station. EX-1003, ¶¶454-484. First, given that a Butler matrix is used to simultaneously receive signals on multiple antennas (Section 0, *supra*), Agee expressly notes this simultaneous action:

[Agee's] MIMO transceiver contains and **uses simultaneously a multiple of single RF feeds**. A signal passes between the Butler Mode Forming element and a Band Pass Filter, ...

EX-1004, 59:23-27 (describing Fig. 25 shown below).

Second, Agee uses a "TDD" system in which each node "receives" at very specific times. EX-1004, 30:7-9 ("each node transmits and receives signal energy during alternating time slots (or sequences of time slots in TDD-TDMA systems)"). Fig. 15 shows the reception "time slots 'i'":

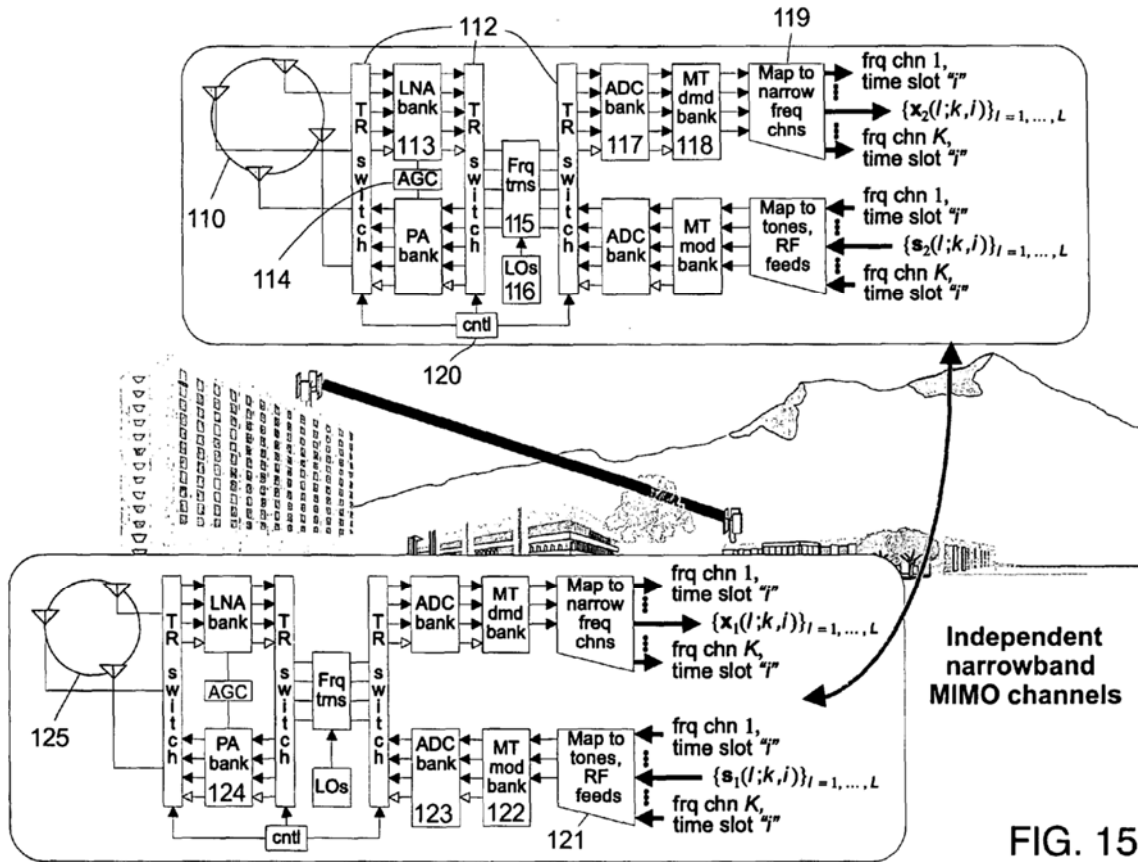


FIG. 15

EX-1004, Fig. 15. An example of the time slots is Fig. 17:

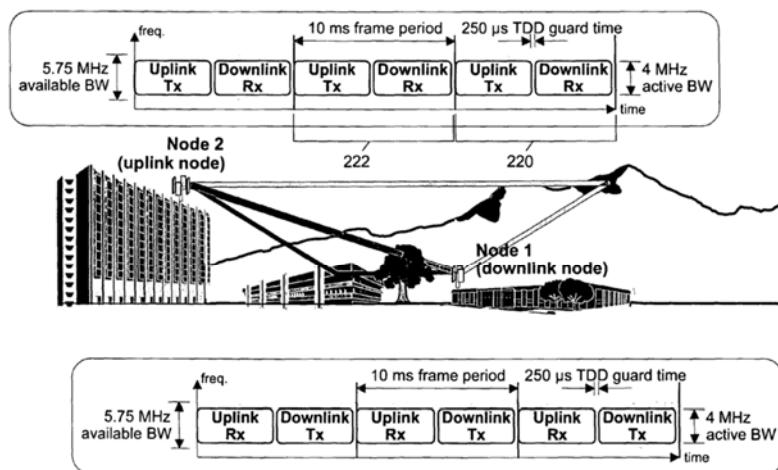


FIG. 17

EX-1004, Fig. 17.

Agee's weights are calculated based upon the different information that is received simultaneously during the receive time slots:

The antennae array ... transmits and receives signal energy during alternating time slots (or sequences of time slots in TDD-TDMA systems). Each transceiver is a vector OFDM transceiver, with digital signal processing elements, that downconverts, A/D converts, and **frequency channelizes data induced on each antenna** (or other diversity channel) during receive time slots, ... and computes combiner and distributer weights that exploit the, narrowband, MIMO channels response on each frequency channel and time slot (FIG. 15).

EX-1004, 45:8-22. Agee thus expressly relies upon the simultaneous reception of signals “on each frequency channel” during the time slots. The antennas necessarily same their received signals at the same time (starting at the time slot beginning) and passing that simultaneously received data to the remaining transceiver portions simultaneously for processing. *See also* EX-1004, 30:7-27, 60:40-45, Figs. 39-41 (all discussing receiving data during the time slot). EX-1003, ¶¶457-469.

Relatedly, Agee relies upon specific timing for the receiver to detect the specific “pilot signals” from each transmitter. EX-1004, 64:44-67:27; Figs. 35-38. The “pilot signals” are received on Agee's Butler matrix antennas (and their radio

OFDM transceivers and the processor) simultaneously as explained in Section V.E.

First, the “pilot signal” is transmitted “at the start of an adaptation frame” which is “tied to the TDD frame.” EX-1004, 64:50-51, 65:58. Thus, the receiver must necessarily simultaneously sample the received signals on all antennas all at the “start of the adaptation frame” (TDD frame) or potentially miss the pilot tones on one or more antennas. EX-1003, ¶¶469-475.

Agee uses “pseudodelays” that are “unique to each transmit node” and include specific time offsets for each different transmitting node. EX-1004, 65:24-46. The “pseudodelays” provide specific timing for the receiver to detect the pilot signals from each transmitting node. EX-1003, ¶¶476-477.

Agee’s BS compares that observed pilot signal to a “known” pilot signal (which reflects the “target pseudodelay”). EX-1004, 66:13-67:4. This matching to the target pilot signal uses the “actual observed timing offset for that [received] link (observed pseudodelay).” EX-1004, 66:14-16.

If the signals are not received and processed simultaneously across all antennas, then the “observed timing offset” could not be used because it would reflect a different “observed timing offset” for different antennas and negatively impact (or defeat) Agee’s ability to detect and use the pilot signals. The timing of the pseudodelays (target and “observed”) is shown in Figs. 38A and B below.

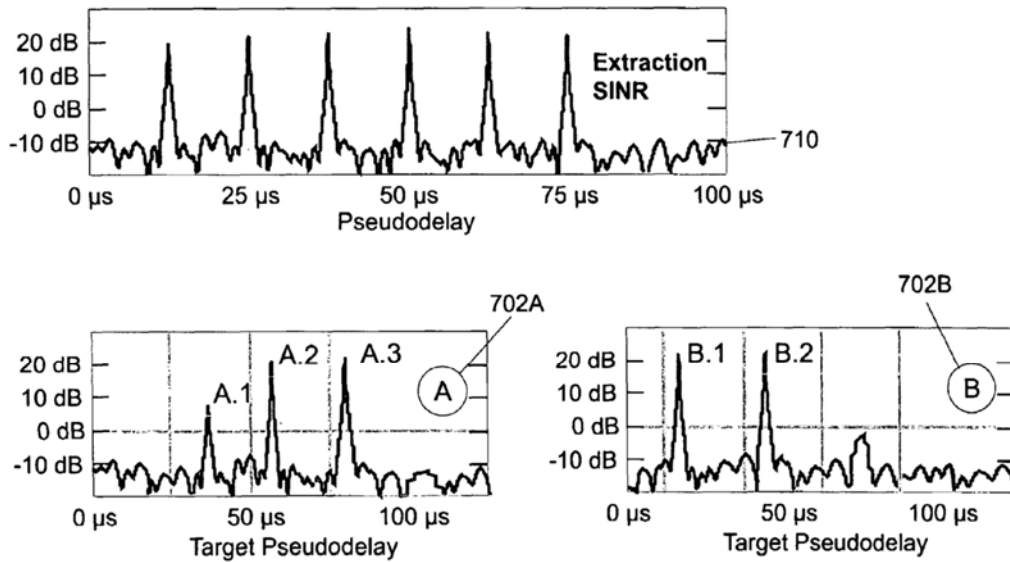


FIG. 38B

EX-1004, Fig 38B. The signals in Fig. 38B and Fig. 38A (lower left) correspond to links A.1, A.2, and A.3 in Fig. 38A:

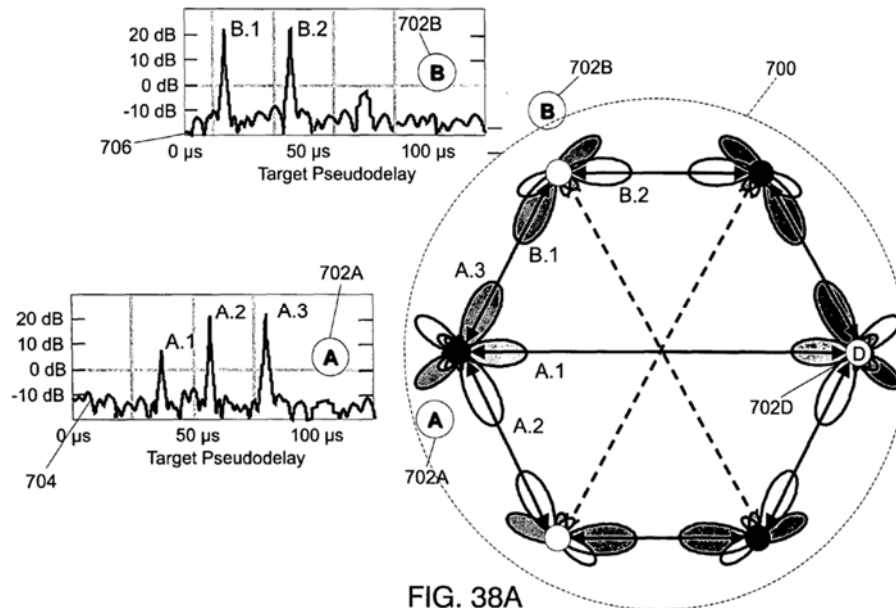


FIG. 38A

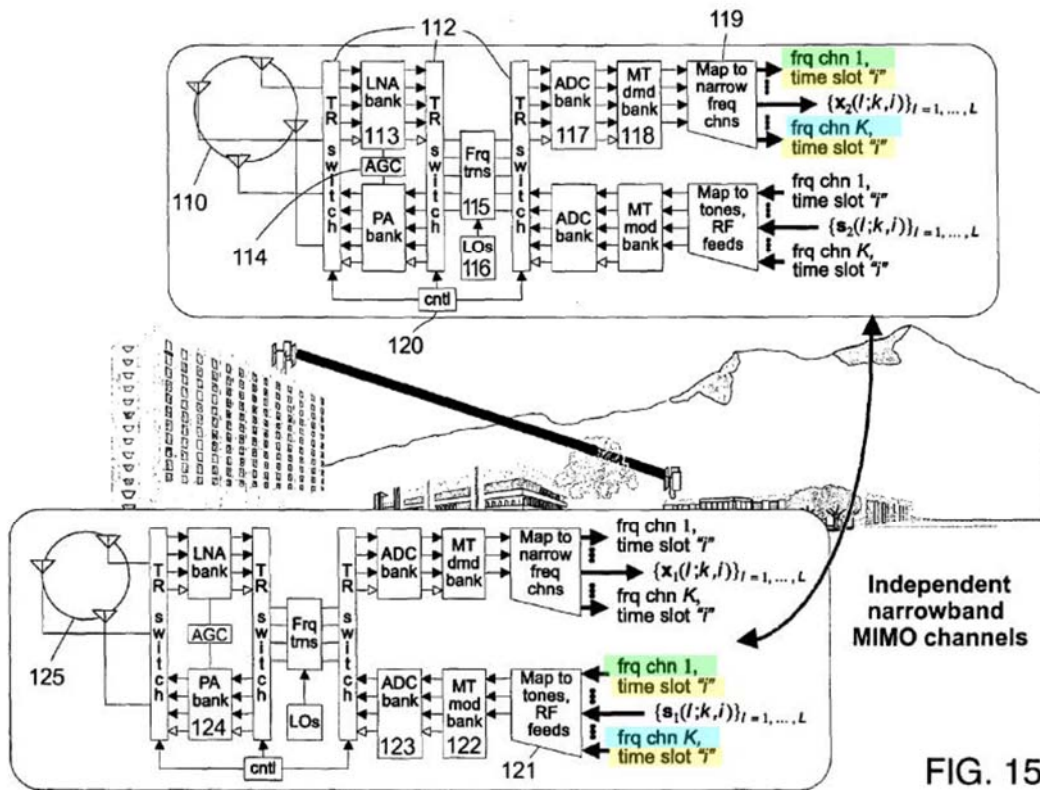
The “observed pseudodelay” timing necessarily has to be based upon using the

antennas to simultaneously received (and pass to the processor) the signals from the known “target” node (performing the transmission). EX-1003, ¶¶478-484.

(c) Agee’s BS Antennas Receive Multiple OFDM Tones Simultaneously

Agee uses OFDM – also referenced as “multitone” or “frequency diversity.” EX-1004, 35:10-26, 45:4-26, 23:62-64, 22:53-56. OFDM uses different frequency “bins” to separately transmit (and receive) OFDM “tones” simultaneously on each antenna. EX-1003, ¶¶485-514. Each OFDM tone is a different claimed “signal transmission” on its own distinct frequency carrying different information and is received on each antenna.

Agee’s “TDD” system uses “time slots.” EX-1004, Fig. 17. Agee’s Fig. 15 shows the different OFDM tones being transmitted (and received):



EX-1004, Fig. 15, 45:10-46:63. In each time slot “i”, there are “1” to “k” different simultaneous transmissions on different frequencies. EX-1004, 45:7-26, 35:10-26, 29:66-30:22. Each frequency carries an OFDM tone. EX-1003, ¶¶493-495.

Agee’s Fig. 22 shows that in each “time slot”, Agee’s system simultaneously uses 13 different frequency “channels” (“Ch 0” to “Ch 12”) – each of which are 320 kHz per channel.

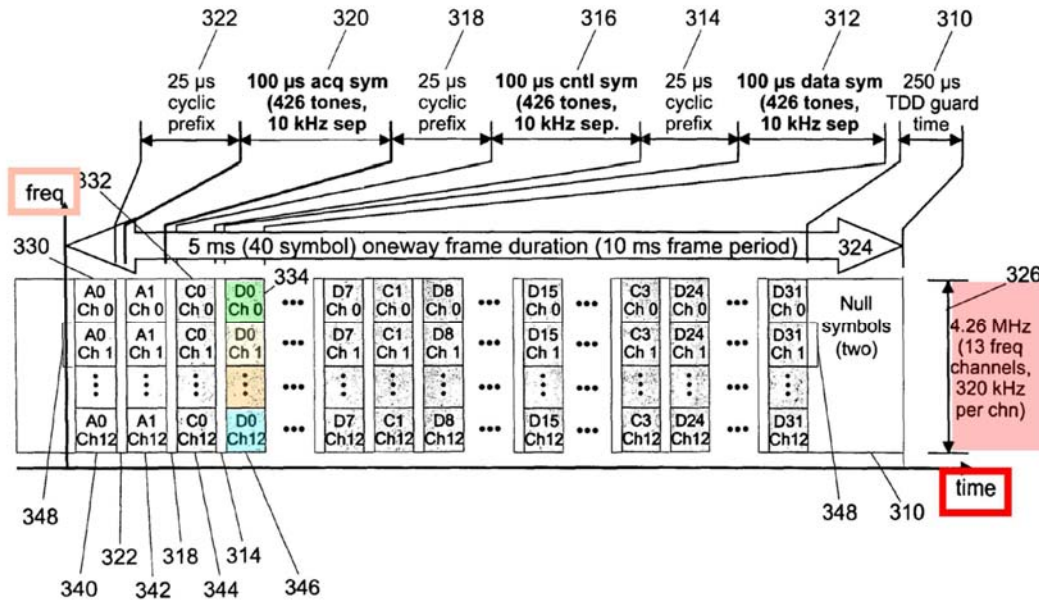


FIG. 22

EX-1004, Fig. 22, 45:29-42, 47:6-42. Fig. 26 shows that each 320 kHz “channel” consists of 32 10 kHz sub-channels that transmit / receive “tones” simultaneously.

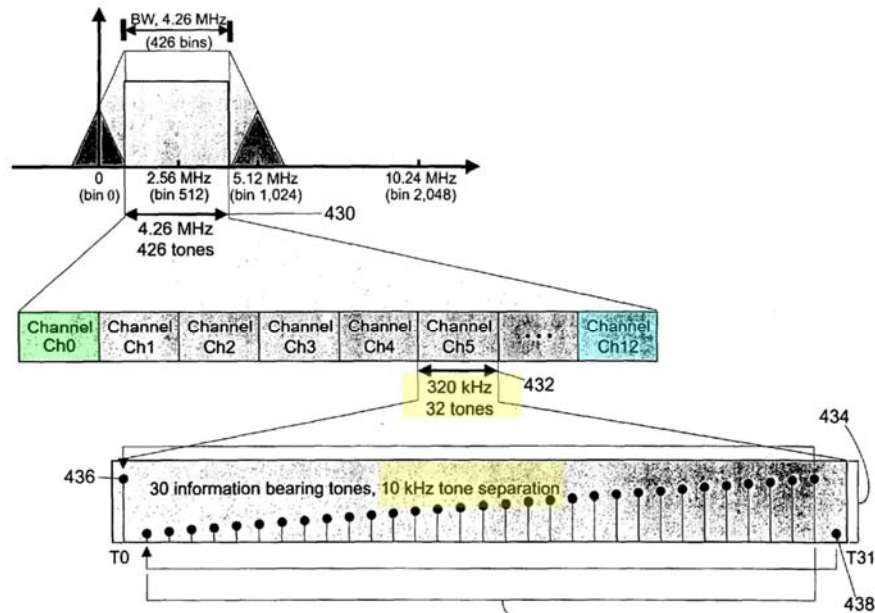


FIG. 26

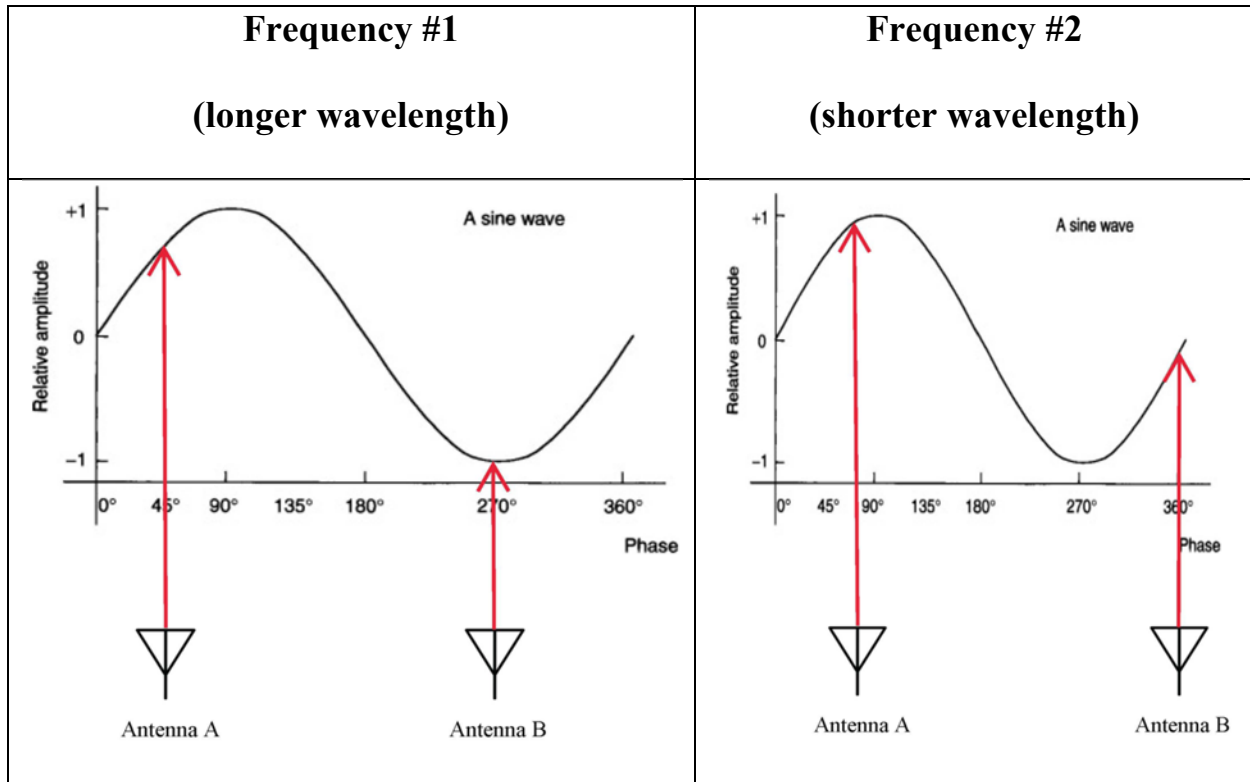
EX-1004, Fig. 26, 47:28-39, claims 40, 180. Each OFDM “information-bearing-tone” transmits information (using its unique 10 kHz frequency). EX-1004, 72:66-

73:24.

Thus, in each time slot, Agee's BS receives simultaneously 32 different OFDM tones transmitted on different frequencies ("frequency bins"). EX-1004, 47:6-39. The 32 OFDM tones transmitted simultaneously in a time slot is an "OFDM symbol." EX-1003, ¶¶496-501.

Agee's Butler matrix processes each of these 32 different OFDM transmissions (tones) separately for each separate antenna. This is conceptually a separate (replicated) Butler matrix for each different tone (frequency). Agee's system includes a separate radio for each antenna that can send / receive all of the different "tones" at the different frequencies. EX-1004, 45:6 (Agee's BS includes "multitone [] transceivers (one per antenna)"). Thus, each antenna can transmit/receive all of the OFDM tones during each time slot (simultaneously). EX-1003, ¶502.

As detailed in section V.E, the Butler matrix measures different signal strengths on different antennas at different phases of a wave. Because different frequencies have different wavelengths, the measurements at each antenna for each tone (frequency bin) will be different. This is depicted below in which frequencies #1 and #2 have different wavelengths resulting in different relative signals strengths on each of Antenna "A" and "B" for the different frequencies.



Agee’s Butler matrix measures (and combines) a different signal strength at each antenna for each of the 32 OFDM tones because they are transmitted using different frequencies. EX-1003, ¶¶503-504.

Agee’s Fig. 30 shows this arrangement. Each input line from the left (coming from the antenna) is for a specific “tone” (from 1 to “M”) tones. “The received symbol $[x](i,1)$, comprising a matrix combination of L Link and **M** multitone elements...” EX-1004, 58-62.

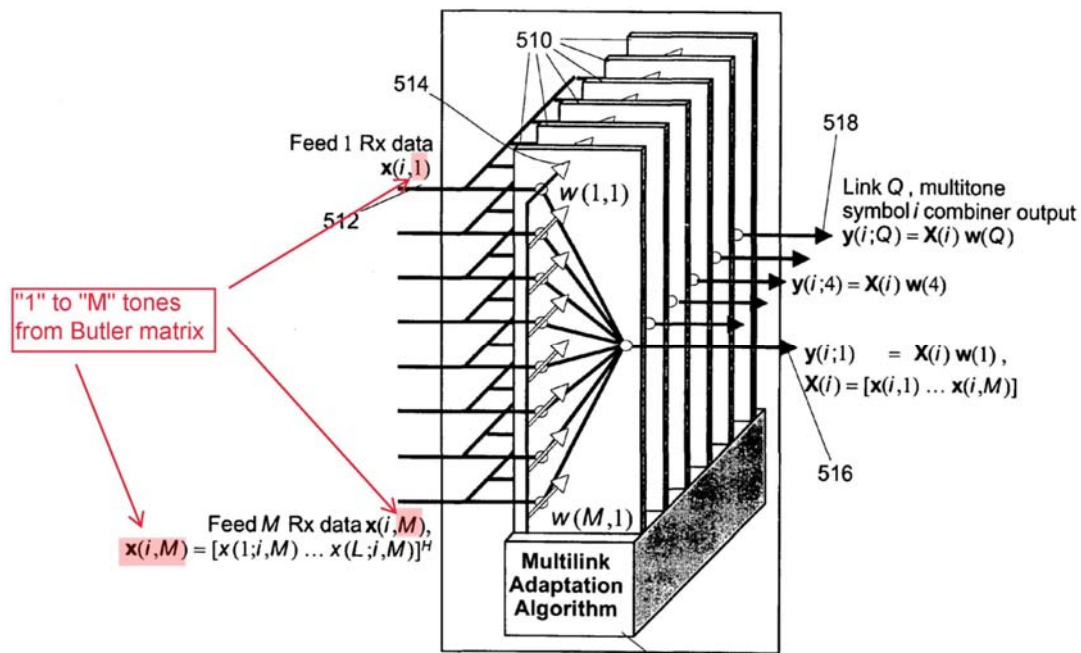
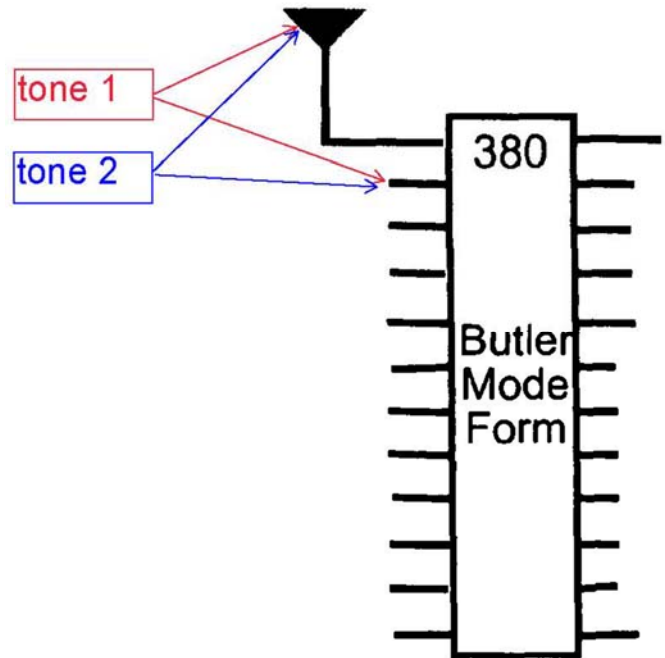


FIG. 30

EX-1004, Fig. 30, 58:43-59:34.

Each OFDM tone (frequency bin) is a different claimed signal transmission. EX-1003, ¶¶505-509. Each OFDM tone is different piece of information being transmitted / received on a different frequency with all tones transmitted / received simultaneously.

Thus, even if the ‘235 claims require “different” signal transmissions, Agee’s use of OFDM tones shows different signal transmissions. For example, Agee uses OFDM **tone 1** is received on antenna #1 and OFDM **tone 2** is received on antenna #2. These are different signal transmissions received simultaneously on different antennas on **different frequencies** conveying **different information** (the different “information-bearing-tone”) from the same remote station. EX-1003, ¶¶510-511.



The fact that each antenna receives all 32 different transmissions (the different tones) does not impact the invalidity analysis. The claims do not exclude each antenna from receiving each transmission. Rather, the claims merely require two antennas receiving two signal transmissions.

Agee calculates weights **for each tone** – thus confirming that the Butler matrix is outputting the (combined) signal strengths for each tone. EX-1004, 64:28-32 (“distribution and combining weights are computed and applied over as broad a range of tones (frequency channels k)”; 65:31-33. EX-1003, ¶512.

Thus, Agee discloses different signal transmissions (the different tones)

received simultaneously on the Butler matrix antenna elements.

Thus, Agee discloses this element in far greater detail than anything that PO can cite in the '235 patent.

[1.4] determine first signal information for the first signal transmission;

[1.5] determine second signal information for the second signal transmission, wherein the second signal information is different than the first signal information;

Agee discloses these elements by using the “signal strength” measured on each antenna. EX-1003, ¶¶515-536.

PO argued that these elements were disclosed by Littlejoe’s statement that “[t]he beamforming application uses the **signal strength information** derived from packet receptions by the ‘searcher’ receivers” using the Butler matrix. EX-1002, 000131, Section V.F.1. Agee does the same “determine” steps when the Multilink Weight Adaptation Algorithm uses the signal strength information derived from the receptions by the antennas and their associated OFDM receivers in the Butler matrix discussed in 1.3 and 1.7. EX-1003, ¶516.

PO argued that Littlejoe disclosed the different “signal information” by measuring different “signal strengths.” Section V.F, *supra*. The '235 specification references “signal information” only one time:

[R]outing and **signal information** which can **include** transmit power level information, transmit data rate information, antenna pointing

direction information, weighting information, constraints information, null/zero location information, peak location information, quality of service (QoS) information, priority information, lifetime information, frequency information, timing information, user and node authentication information

EX-1001, 15:44-56. The “transmit power level” is the “signal strength.”

Agee teaches many forms of the claimed signal information. First, as detailed in Section 0 and element 1.3, Agee’s Butler matrix measures different signal informations (signal strengths) received on each antenna even for the same signal wave due to the phase difference resulting from the antennas’ spatial separation. This corresponds to the “transmit power level information” above – particularly because this is exactly what PO relied upon during prosecution and in prior IPRs for this element. See Section V.F. EX-1003, ¶¶521-526.

Second, as detailed in Section VII.A.3.a(c), Agee’s Butler matrix measures a different signal strength for each of the 32 OFDM tones (channels) on each antenna. As detailed below, these measurements are used to calculate the weights. These represent, for example, the “data induced on each antenna” for each OFDM tone / frequency in a TDD time slot. EX-1004, 45:8-22. EX-1003, ¶¶522-526.

Third, different signals measured on Agee’s antennas provide “antenna pointing direction information,” “null/zero location information,” “peak location

information,” “frequency information,” and “timing information” – which are each forms of “signal information.” EX-1001, 15:44-56.

Agee’s 32 different OFDM tones are all separate transmissions at different frequencies and thus provide “frequency information.” EX-1003, ¶528.

As detailed in Section VII.A.3.a(b), Agee’s measured signals provide the pilot signal’s “observed timing offset” – which is used to provide “timing information” for Agee’s system to properly detect and use the pilot signal to calculate weights to receive (and transmit) data. EX-1003, ¶529.

Agee’s “pseudodelays” are “node authentication information” and thus are “signal informations.” EX-1004, 65:24-66:19. EX-1003, ¶530.

Similarly, as noted above, different antenna informations are used to detect “peaks” in “observed pseudodelays” – which corresponds to “peak location information.” These “peaks” are used to calculate “null/zero location information” (another form of “signal information”) to form beams. EX-1004, 67:3-55. EX-1003, ¶531.

Agee’s different signals on the antennas provide the “observed (possibly time-varying) azimuth and elevation” of a transmitting node. EX-1004, claim 45. The “azimuth” is a “peak location information” and “antenna pointing direction information.” The “link quality statistics” formed from the antenna data is also a form of antenna pointing direction information and QoS information. EX-1004,

59:2-9. EX-1003, ¶532.

In Agee’s Butler matrix, signal informations (signal strengths) from multiple antennas are combined on each Butler combiner output. Thus, each individual Butler combiner output by itself is a determination of a first signal information (from a first antenna’s signal) and second signal information (from a second antenna’s signal) as claimed. EX-1003, ¶533

Relatedly, Agee also teaches the Butler outputs collectively (“combiner output data”) constitute a determination of different signal informations. For example, the first and second signal informations are Butler output #1 and Butler output #2 in Fig. 25, respectively. Each output is a determination of different signal informations resulting from multiple signals on multiple antennas connected to that output. EX-1003, ¶534. Moreover, each is “received” by the processor simultaneously on the Butler outputs.

Thus, Agee discloses this element in the same fashion that PO repeatedly argued that the ‘235 patent and its priority documents disclose the element. At a minimum, Agee renders obvious simultaneous reception through its language, OFDM transmissions, used of TDD and the pseudodelay above.

[1.6] determine a set of weighting values based on the first signal information and the second signal information;

Agee discloses the element. EX-1003, ¶¶537-572.

Agee uses a pilot data signal (the “combiner output data”) that it receives

from the Butler matrix:

[S]ubstantively nulling **combiner weights are formed** using an FFT-based least-squares algorithms that adapt $\{w_1(k,l;n_2,n_1)\}$ and $\{w_2(k,l;n_1,n_2)\}$ to values that minimize the mean-square error (MSE) between the combiner output data and a known segment of transmitted pilot data. Operations used to implement this technique during receive and transmit operations are shown in FIGS. 35 and 36....

EX-1004, 64:43-50. EX-1003, ¶¶538-544. *See also* EX-1004, 36:51-58; cols. 64-68; Figs. 35-37; claim 53. The “w1” and “w2” values are receive weights “used to recover” transmissions. EX-1004, 63:58-67.

Figure 35 shows that if the received data is a “pilot symbol” then block 594 computes “Combiner weights W.”

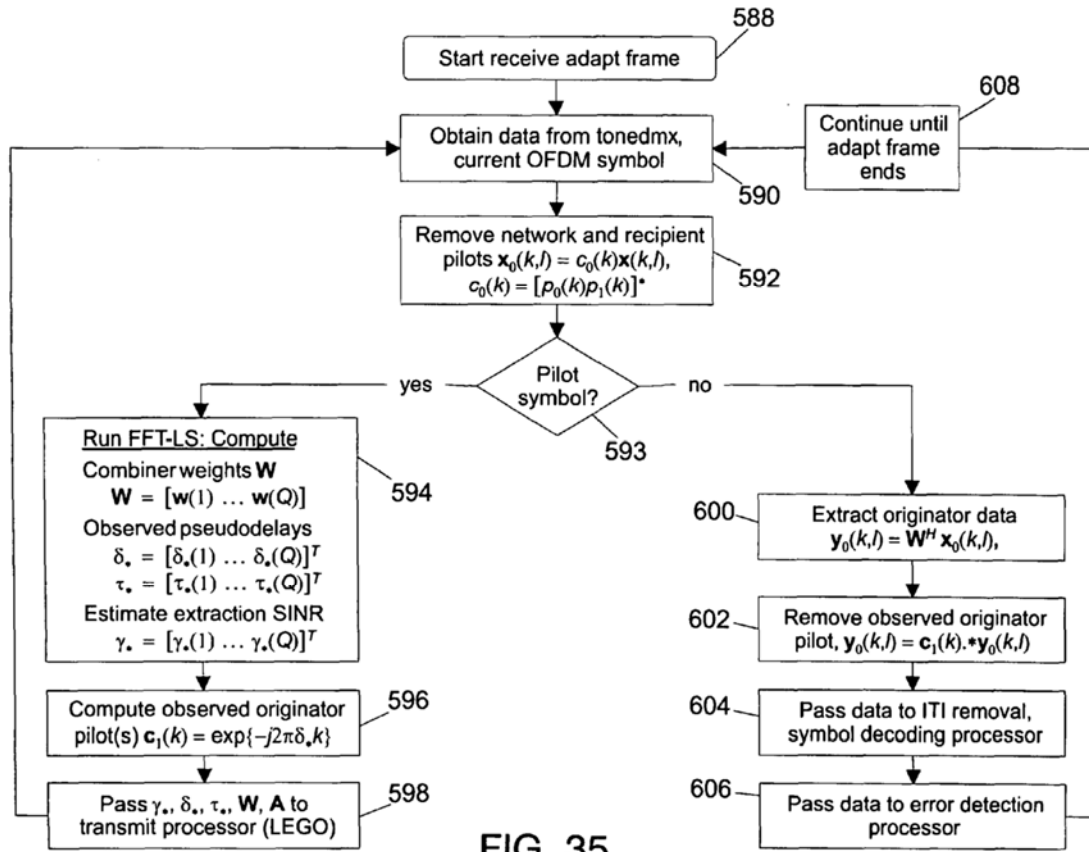


FIG. 35

EX-1004, Fig. 35.

Fig. 37 shows the calculation in box 594 for the “combiner weights W ” using the “FFT-LS” algorithm (using the Butler matrix outputs) processing the pilot signal which is shown as the “ x_0 ” term in Fig. 37.

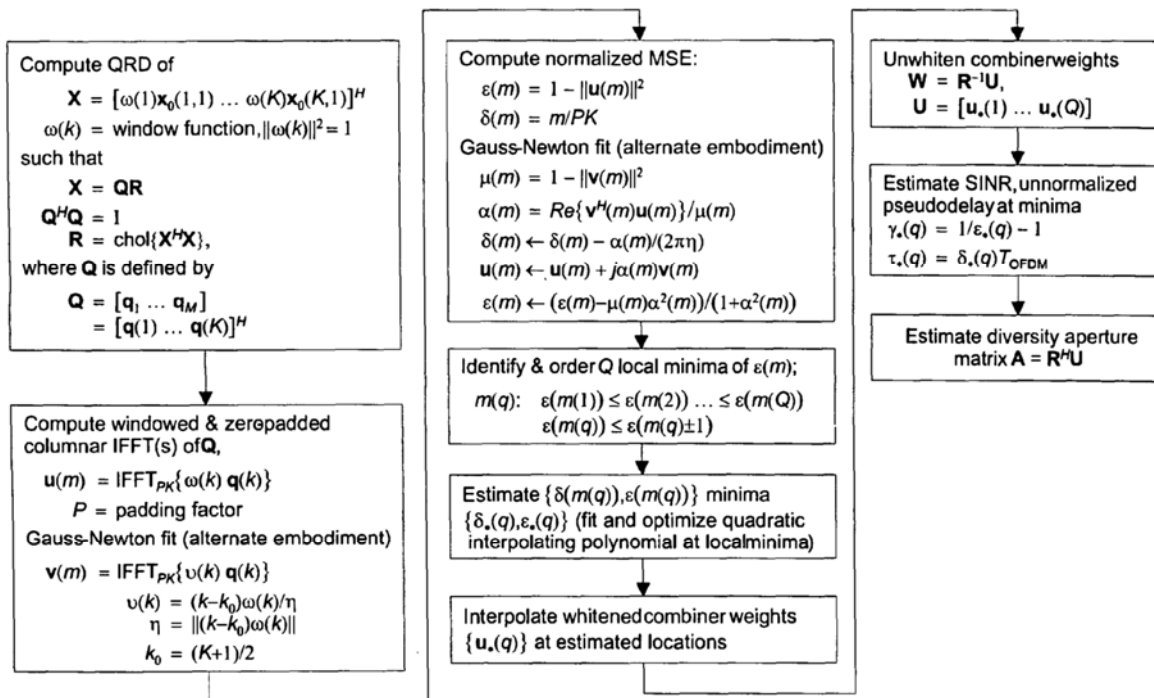


FIG. 37

EX-1004, Fig. 37. See also EX-1004, 66:21-67:27; Fig. 30 (showing “x” data arriving from RF feeds).

“The preferred pilot data is applied to an entire OFDM symbol at the start of an adaptation frame...” EX-1004, 64:50-65:45. Thus, the pilot signal is spread among multiple different transmissions on 32 different frequencies (tones) that are all transmitted / received simultaneously because they are on different frequencies. EX-1003, ¶¶537-553.

Agee teaches that it calculates weights using multiple different OFDM tones for each time slot. “In the preferred embodiment, OFDM modulation formats is used to instantiate the invention, and substantively similar distribution and

combining weights are computed and applied over as broad a range of tones (frequency channels k) and OFDM symbols (time slots l).” EX-1004, 64:27-32. 46:35-54, Abstract (using “pilot tone data” to calculate weights); 58:16-42 (“pilot tone generation”), Fig. 21. As shown above, Fig. 37 uses $x_0(1,1)$ to $x_0(K,1)$ where $1-K$ is the number of OFDM tones. EX-1004, 65:24-46 (“ K is the number of tones used in a single FFT-base LS algorithm” used to calculate “combiner weights.”). EX-1003, ¶¶554-562.

Based on the pilot tones on each antenna, Agee calculates the “combiner weights W ... used in subsequent data recovery operations.” EX-1004, 67:3-28. Figure 35 shows receiving data (including the pilot symbol tones), the weights’ calculation (block 594 corresponding to Fig. 37) and subsequently using the calculated weights to receive data (element 600). Figure 36 shows the same process for transmitting data using the calculated weights (block 630). The “combiner weights W ” are used to form beams and nulls for receiving and transmitting data. EX-1004, 67:43-55 (quoted in 1.7, *infra*). EX-1003, ¶¶563-565.

Agee’s Fig. 30 demonstrates that the “combiner weights W ” are applied to the received RF data to recover the received information using a “Multilink Adaptation Algorithm.” EX-1004, Fig. 30, 36:30-34. The description of Figure 30 teaches (consistent with Figs. 35-37 above) that the received pilot data tones (“ x ”) is received by the FFT-LS algorithm to calculate the weights.

... Received data passes through both a Multilink weight adaptation algorithm and ... a Multilink diversity combining of the Reception weights. ... These sort out the properly weighted tones, ... The received symbol [x](i,1), comprising a matrix combination of L Link and M multitone elements, ... The pilot signal elements are passed through a link detection circuit that preferentially uses a FFT-LS algorithm to ... identif[y] the weighting elements that were contained in the pilot signal

EX-1004, 58:43-59:21.

Agee's Butler matrix output is the input to the algorithms described in Figs. 25, 30. EX-1004, 57:25-43. *See also* EX-1004, Fig. 15, 48:19-46 (describing using Butler element to send / receive signals processed by the various algorithms). EX-1003, ¶¶566-570.

Thus, Agee uses the different signal informations (e.g., signal strengths received on the different antennas in the Butler matrix including for the different OFDM tones) to calculate weights used for receive and transmit beamforming.

[1.7] wherein the set of weighting values is configured to be used by the transceiver to construct one or more beam-formed transmission signals;

As shown in element 1.6, Agee calculates “combiner weights” (“receiver weights”) used to create beams to receive and transmit information. These

“combiner weights” are used as “distribution weights” (“transmit weights”) for transmissions or as the basis for calculating distribution / transmit weights. EX-1003, ¶¶573-590. Agee claims “using at each node the receive combiner weights as transmit distribution weights during subsequent transmission operation.” EX-1004, claim 17; *see also* EX-1004, claims 43, 56. *See also* EX-1004, 32:64-67, 57:30-33, 68:20-31, 60:27-29, 78:66-79:11, 56:41-55, 33:13-19, 72:20-59.

The “combiner weights W” (and the distribution / transmit weights) form beams and nulls for reception and transmission:

The optimized combiner weights are substantively null-steering, in that the **combiner weights** associated with each originating signal will (notionally, in absence of multipath) **form a composite antenna pattern that steers nulls in the direction** of all other time-and-frequency coincident signals (**signals transmitting on the same time slot and frequency channel**) impinging on the array. However, the **weights will also** (notionally, in absence of multipath) **form a beam** in the direction of the originating signal

EX-1004, 67:43-55. This language confirms that weights are calculated using each OFDM tone (“time slot and frequency channel”). EX-1003, ¶¶574-580.

Fig. 38A depicts the beams and nulls:

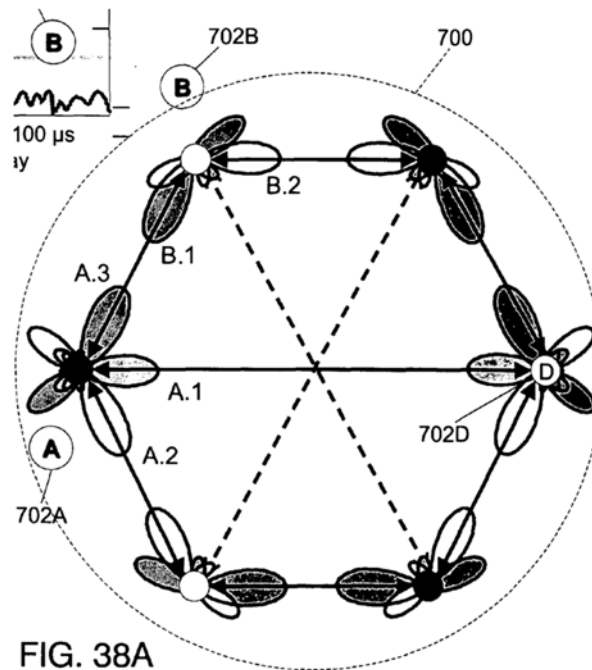


FIG. 38A

EX-1004, Fig. 38A. *See also* EX-1004, 36:59-64.

Agee teaches that the weights are used to form beams. EX-1004, 51:56-52:8, 20:62-21:7. *See also* EX-1004, claims 4, 5, 40, 58, 72-78, 105; 48:18-50; 49:1-2; 50:53-54; 51:36-55; 52:55-58; 78:21-24. EX-1003, ¶¶581-589.

[1.8] cause the transceiver to transmit a third signal to the remote station via the antenna, the third signal comprising content based on the set of weighting values.

Agee discloses the element. EX-1003, ¶¶591-601.

During prosecution, PO argued that this element’s scope included applying the determined weights to the output signal. EX-1002, 000131. In District Court litigation, PO argued that any other construction “excluded the preferred embodiment.”

During patent prosecution, the patentee stated that “transmitting to the

remote station a third signal comprising content based on the set of weighting values” covers the embodiment in Document C describing “compute the complex weights for a second RF beamformer.” Dkt. 42-22, Office Action Response (July 25, 2018).

EX-1016, 000012. According to PO, “The scope of this limitation must include the disclosures that the Patent Owner cited for this limitation during prosecution.”

EX-1016, 000012 (*citing Vitronics*, 90 F.3d at 1583).

Thus, the “content” of the signal is not required to be the weights. Rather, the “content” is “based” on the weights by calculating and applying the weights to the content. EX-1003, ¶¶597-601. Notably, the ‘235 does not include any disclosure of transmitting the weights. EX-1003, ¶598. Thus, this construction is consistent with the specification and Agee therefore discloses this element.

Agee discloses this for the same reason as cited for the ‘235 and Littlejoe. Agee’s weights modify the output data (as shown in elements 1.6-1.7 above) before the data is transmitted (elements 1.4-1.7 above) and therefore meets this element.

b. Claim 2

[2] The receiver as recited in claim 1, wherein the first signal transmission and the second signal transmission comprise electromagnetic signals comprising one or more transmission peaks and one or more transmission nulls.

Agee, alone or in combination with Butler, discloses this limitation for the

Moreover, Agee teaches that each node uses beam-forming on both the transmit and receive paths as detailed above – as shown in Fig. 38A.



In contrast, the ‘235 patent does not describe any “remote station” that simultaneously transmits two “signal transmissions” that comprise peaks and nulls. At most, the ‘235 patent discloses using a Butler matrix to form receive beams

(peaks and nulls) on the “receiving” side. Agee discloses that same Butler matrix to determine the receive beams *and* a Butler matrix on the transmitting node (not disclosed in the ‘235 patent).

c. **Claim 3**

[3] The receiver as recited in claim 2, wherein the first signal transmission and the second signal transmission are directional transmissions.

As discussed for elements 1.3-1.6 and claim 2, each Agee node forms beams (receive and transmit). These beams carry the first / second signal transmissions and thus are “directional transmissions.” EX-1003, ¶¶612-619. *See also* EX-1001, 5:12-20, 6:61-7:21, 26:45-56.

As noted for claim 2, the ‘235 patent does not disclose a remote station transmitting simultaneously two different signals that are “directional signals.” As with claim 2, the ‘235 discloses (at most) using a Butler matrix to form “receive” beams. Agee has this same content, as well as directional beams on the transmit side, and therefore teaches this element. EX-1003, ¶618.

d. **Claim 4**

[4] The receiver as recited in claim 1, wherein the content comprises data configured to be used by the remote station to modify the placement of one or more transmission peaks and one or more transmission nulls in a subsequent signal transmission.

Agee, alone or in combination with Butler, discloses this limitation. EX-

1003, ¶¶620-624. The “data configured to be used by the remote station...” is the pilot signals that each Agee BS transmits to other BSs.¹¹

As detailed in elements 1.4-1.7, Agee’s (receiving) BS’s use the pilot signals received from other (transmitting) BS’s to calculate receive weights. As detailed in elements 1.7-1.8 and claim 2, those receive weights are used for transmit weights that form beam-formed transmissions that modify the placement of peaks and nulls in subsequent transmissions. EX-1003, ¶¶622-624.

e. **Claim 5**

[5] The receiver as recited in claim 4, wherein the set of weighting values is further based on one or more of: a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data.

Agee, alone or in combination with Butler, discloses this limitation for the reasons for limitations 1.3 – 1.6. As noted therein, Agee discloses at least the transmit power level (in the same way as the ‘235 patent using the Butler matrix), the antenna direction (reflecting the receive beams’ direction), and timing data (in the ability to located the “observed timing offset” for the pseudodelay to detect the specific node from which data is being received, and quality of service data (the “link quality statistics”). EX-1003, ¶¶625.

¹¹ The ‘235 patent does not disclose that the content of any communication is the weights themselves.

f. **Claim 8**

[8] 8. A method in a wireless communications system, the method comprising.

See claim 1.

[8.1] receiving a first signal transmission from a remote station via a first antenna element of an antenna and a second signal transmission from the remote station via a second antenna element of the antenna simultaneously, wherein the first signal transmission and the second signal transmission comprise electromagnetic signals comprising one or more transmission peaks and one or more transmission nulls;

See limitations 1.3 – 1.7.

[8.2] determining first signal information for the first signal transmission;

[8.3] determining second signal information for the second signal transmission, wherein the second signal information is different than the first signal information;

See limitations 1.4 – 1.5.

[8.4] determining a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used by the remote station to construct one or more beam-formed transmission signals; and;

Agee, alone or in combination with Butler discloses this element. As discussed in elements 1.6 – 1.7, Agee determines a set of weighting values based on the first and second signal informations. EX-1003, ¶¶537-590.

Regarding the clause “configured to be used by the remote station,” Agee discloses this term for the reasons that the Applicant cited to the Examiner and that

the PO cited to the District Court.

During prosecution, the applicant stated the calculation of beam-forming weights met this element:

- determining a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used by the remote station to construct one or more beam-formed transmission signals
 - C-4: “The beamforming algorithm computes the beamforming weights for a particular client (identified by its wireless MAC address) and stores it in a table which is made available to the application running the modified (polling) MAC protocol on ‘card 13’”.

EX-1002, 000131.

Before the District Court, PO successfully argued that this element merely required the preparation of weights.

[C]laim 8 does not require the successful combination with the remote station, much less that the remote station actually use the weighting values... a POSITA understands that this only requires that the device that is performing the method of claim 8 *prepare* or *arrange* the set of weighting values ...

EX-1015, 000028. According to PO this limitation merely “requires that the set of weighting values be determined for *that* remote station based on *that* station’s received signals.” EX-1015, 000028-000029. PO further argued:

[C]laim 8 ... only requires that weighting values be prepared or

arranged for use by another station, regardless of whether that station will succeed in using them.

Moreover, *preparing* a set of weighting values for use by another station is performed entirely within “access station 102” without any combination with a remote station. For example, “access station 102” prepares the set of weighting values for use by a remote access station (e.g., “nodes within the wireless routing network”) by computing the weighting values that are associated with received signals from that remote access station.

EX-1016, 000013-000014. Notably, the ‘235 patent does not include any embodiment in which the weights are transmitted between nodes. Thus, any construction that requires such transmission would be unsupported by the specification.

The District Court adopted PO’s construction. EX-1017. During IPR2022-00367, PO cited the District Court’s construction that were based on PO’s arguments above. EX-1012, 000012.

Agee discloses this element for the same reasons cited in prosecution (and to the District Court). Agee meets this element “by computing the weighting values that are associated with received signals from that remote access station” – exactly as PO argued to the District Court that this element was met. EX-1003, ¶¶630-

641.

At a minimum, because Agee operates in exactly the same way that PO argued meets the claims, Agee renders this element obvious.

Moreover, Agee teaches that, because of reciprocity, the transmit weights used by Agee's BS would be the same as the receive weights used by the remote station (*e.g.*, another Agee BS as shown in Fig. 38A). 32:44-33:38, 62:56-64:27; Figs. 13A, 13B. Each of Agee's BS's employ the weight calculation. EX-1004, 72:20-28. Moreover, in Agee, each side of the transmission (transmitting and receiving) seeks to place the same "nulls" and "peaks" (form the same beams). EX-1004, Fig. 38A, 76:46-51, 32:17-27, 67:42-55. Such reciprocity either discloses this element or, at a minimum, renders this element obvious. EX-1003, ¶¶642-643.

[8.5] transmitting to the remote station a third signal comprising content based on the set of weighting values.

See limitations 1.8.

g. Claim 9

[9] The method as recited in claim 8, further comprising: transmitting the third signal to the remote station via the antenna.

Agee, alone or in combination with Butler discloses this claim for the reason discussed for limitations 1.8. EX-1003, ¶¶645-647. Agee transmits data transmissions using the same antennas and through the same Butler matrix as used

for receiving as discussed in limitations 1.3-1.7.

h. Claim 10

See claim 3.

i. Claim 11

See claim 5.

j. Claim 12

See claim 4.

k. Claim 15

[15] 15. An apparatus for use in a wireless communications system, the apparatus comprising: an antenna

See claim 1.

[15.1] a transceiver operatively coupled to the antenna;

See limitation 1.1.

[15.2] a processor operatively coupled to the transceiver, the processor configured to:

See limitation 1.2.

[15.3] receive a first signal transmission from a remote station via the antenna;

[15.4] the first signal transmission comprising first signal information, wherein the first signal information comprises one or more of: a transmit power level, a data transmit rate, an antenna direction, quality of service data, or timing data;

[15.5] receive a second signal transmission from the remote station via the antenna, the second signal transmission comprising second signal

information;

See limitations 1.3 - 1.6, 5. Elements 1.4 – 1.5 and claim 5 detail that the “first signal information comprises” multiple different recited options.

[15.6] determine a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used by the transceiver to construct one or more beam-formed transmission signals;

Limitation 1.6 above explains how the signal informations are used to determine the weighting values. Limitation 1.7 explains how the weighting values are used to construct beam-formed transmission signals for both receiving and transmitting data.

[15.7] cause the transceiver to generate a third signal comprising content based on the set of weighting values.

See limitation 1.8.

l. Claim 16

[16] The apparatus as recited in claim 15, wherein the first signal transmission and the second signal transmission comprise electromagnetic signals comprising one or more transmission peaks and one or more transmission nulls.

See claim 2.

m. Claim 17

[17] The apparatus as recited in claim 16, wherein the processor is configured to receive a fourth signal transmission from an interferer source, the fourth signal transmission being undesired, and the processor is configured to store identifying information concerning the undesired interferer source and the remote station.

Agee, alone or in combination with Butler, discloses this limitation. EX-1003, ¶¶658- 667. In Agee, each “node” has “links” to multiple other nodes. EX-1004, 38:13-25. For example, in Fig. 38, node 702A has “links” to three other nodes as highlighted below.

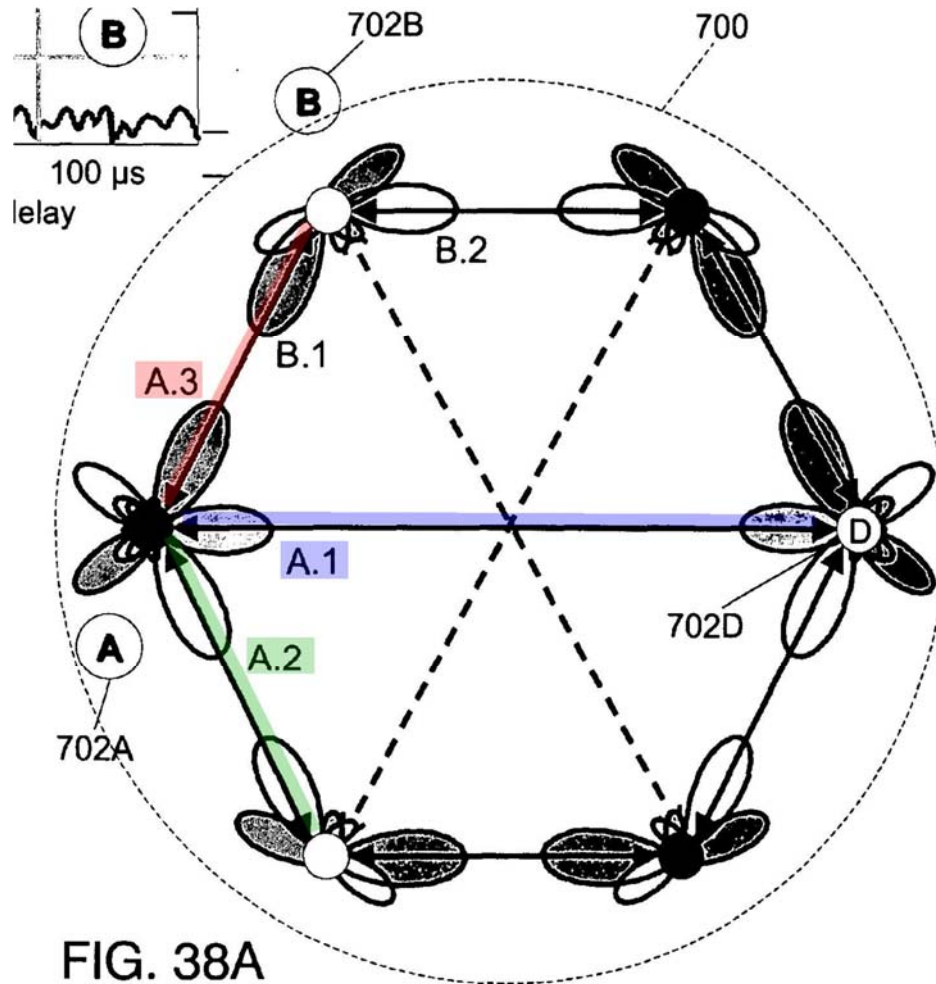


FIG. 38A

EX-1004, Fig. 38A. *See also* EX-1004, Figs. 13, 16, 18-19, 39-40.

Agee stores “identifying information” about each network node including, for example, the “known” pilot data for each node as well as the “pseudodelay” discussed in element 1.4-1.6 above. EX-1004, 64:43-67:28, 58:16-67 (including

for nodes that require “intervening” channels and are not directly connected), claim 53. Agee describing using “pseudodelays” that “can be unique to each transmit node” and include specific time offsets for each of the different nodes. EX-1004, 65:24-46; 58:29-42, 66:21-67:15 (“target pseudodelay”). Storing additional “identifying information” for each node would be, at most, an obvious modification to Agee. EX-1003, ¶¶659-663.

When Agee calculates the “weights” for a particular link, the transmissions from the other nodes are considered as interference – thus making those other nodes an interfering source. So, for example, when detecting link A.1 above and calculating the weights specific to A.1 (for node D), the transmissions on links A.2 and A.3 constitute interference to the weight calculation for A.1.

For that reason, the calculation of weights (for each node / link) results in “nulls” being directed toward those other interfering sources (the other nodes with links). EX-1004, 51:57-67 (“...The reciprocity equation insures that the optimal transmit weights puts substantive nulls in the direction of these same co-channel interferers.”); 67:42-55 (“combiner weights are substantively null-steering...”); 69:10-22; claims 40, 98, 110; EX-1004, 32:17-27; 46:43-45; 21:12-15, 4:2-5, 19:63-67; 76:47-51. The analogous calculation occurs when calculating weights for link A.3 (A.1 and A.2 are interference) and A.2 (A.1 and A.3 are interference).

Thus, when Agee’s BS calculates weights for link A.1, the BS “store[s]

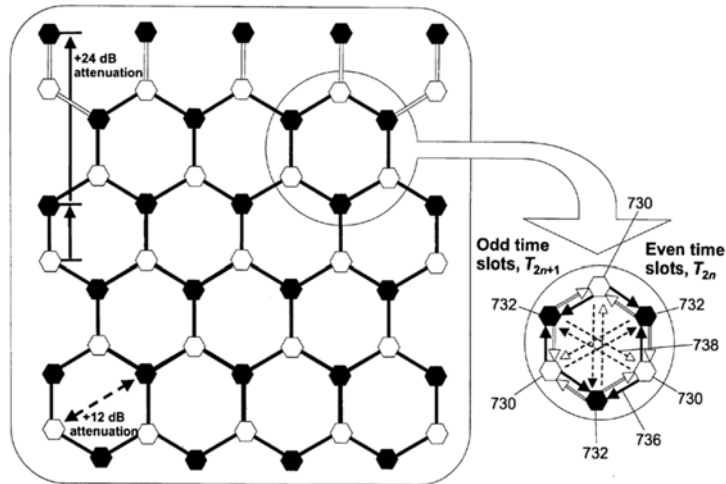
identifying information concerning the undesired interferer source (each other node in Fig. 38A) and the remote station (node “D”). EX-1003, ¶¶664-667.

n. **Claim 18**

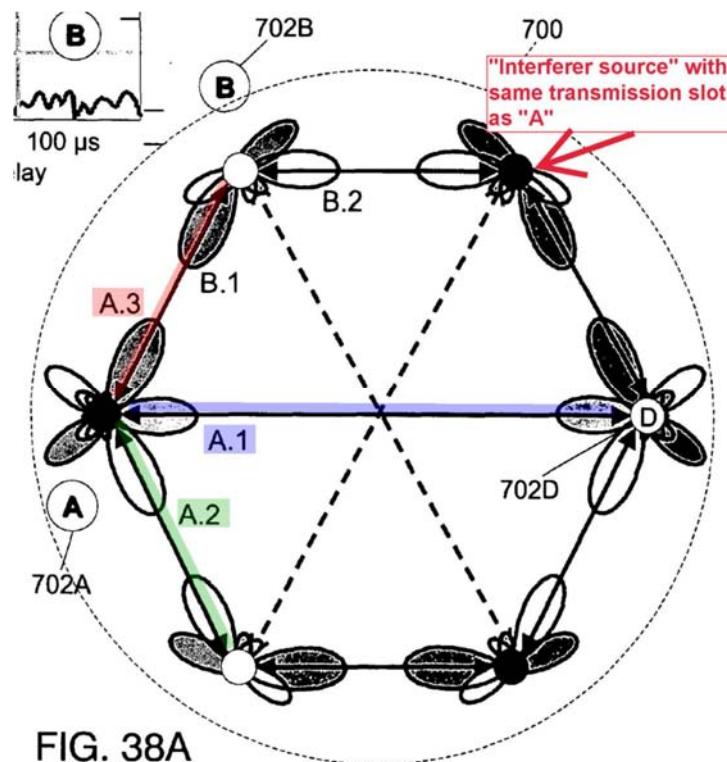
[18] The apparatus as recited in claim 17, wherein the processor is configured to identify a further interferer signal transmission from the interferer source, and to identify a further desired signal transmission from the remote station, wherein the processor is further configured to prevent the transceiver from transmitting a fifth signal transmission via the antenna during reception of the further desired signal transmission but to allow the transceiver to transmit a sixth signal transmission via the antenna during reception of the further interferer signal transmission.

Agee, alone or in combination with Butler, discloses this limitation.¹² EX-1003, ¶¶668-675. Agee discloses this the TDD system in which different nodes transmit and receive in alternating time slots. Fig. 40 shows different time slot allocations for BS’s.

¹² As noted for claim 1, the “desired signals” include each OFDM tone transmitted on its own frequency.



EX-1004, Fig. 40. This hexagonal arrangement of BS's is shown in Fig. 38A:



EX-1004, Fig. 38A. Thus, Agee's BS is configured to "prevent the transceiver from transmitting ... during reception of the further desired signal" because the BS will not transmit during its "receive" time slots during which it is receiving

information along links A.1, A.2, and A.3 (the various “desired” signals).

Because BS “A” has the same “transmit” slot as the BS to which no link is shown (the “interferer sources” above), the transceiver is allowed to transmit a sixth signal transmission via the antenna during reception of the further interferer signal transmission. EX-1003, ¶¶670-675.

o. Claim 19

[19] The apparatus as recited in claim 15, wherein the set of weighting values are applied to the third signal, and wherein the transceiver is configured to receive a fourth signal transmitted from the remote station, and the processor is configured to apply the set of weighting values to the fourth signal.

Agee, alone or in combination with Butler, discloses this limitation for the reasons discussed for limitation 1.3 – 1.7. EX-1003, ¶¶676-677. As noted above, the weights that are calculated in Agee are used for receiving and for transmitting.

For example, that “combining weights” are used by Agee’s BS to process the pilot signal and then any subsequent data transmissions from a particular remote station until another pilot symbol is received (which results in the weights being updated / adapted). EX-1004, Fig. 24, 48:19-46, 57:25-43, 58:43-59:22, 67:3-27, Figs. 35-37, claim 40.

VIII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION

A. The Board Should Not Deny Institution Under 35 U.S.C. § 325(d)

Petitioners have not previously challenged by IPR the ‘235 Patent.

Likewise, neither the Examiner nor the Board considered any prior art herein.

Moreover, Agee discloses the exact element that provided patentability during prosecution.

B. The Board Should Not Deny Institution Under 35 U.S.C. § 314(a)

Related to the Director’s June 2022 interim guidance regarding application of the *Fintiv* factors,¹³ (1) the Petition is particularly strong in the underlying merits, and (2) Petitioners will not pursue in the Related Litigation any ground raised in this IPR. Thus, under the Interim Guidance, the Board should not exercise its discretion to deny institution under 35 U.S.C. § 314(a).

The decision in *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (Dec. 1, 2020) instructs that a holistic view of the remaining *Fintiv* factors also weighs in favor of institution.

Factor 1 is neutral because no request for stay has been filed.

¹³ Interim Procedure For Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director’s Memorandum (June 21, 2022).

Under factor 2, the earliest scheduled trial date is March 3, 2025. A Final Written Decision is expected in the present matter in September of 2025.

Considering the inherent uncertainties of litigation scheduling, this factor is neutral. Because much can change in four months, the current trial date does not support denial. *Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).

Factor 3 heavily favors institution. The *Markman* hearing is scheduled for September 11, 2024 which is near the projected institution date. Fact discovery closes on October 4, 2024, and expert discovery closes on November 18, 2024. Thus, the Related Litigation is in its early stages, and the investment in it has been minimal. The district court will not invest significant resources or issue substantive orders related to the challenged patent prior to an institution decision. Moreover, Petitioners diligently prepared this Petition and filed well in advance of the statutory deadline, which weighs further against denying institution.

Under factor 4, there will not be complete overlap in the issues raised in the IPR and the Related Litigation and this favors institution. PO asserted 88 claims from five patents in the Related Litigation – an amount that far exceeds the number of claims that the district court will allow to be presented at trial. See

<https://txed.uscourts.gov/?q=model-order-focusing-patent-claims-and-prior-art->

[reduce-costs](#). (Model Order limiting patentees to a “Final Election of Asserted Claims, which shall identify no more than five asserted claims per patent from among the ten previously identified claims and no more than a total of 16 claims”). Given that the patentee will likely be limited to only five claims from the ’235 Patent, it is highly unlikely the district court will be addressing the validity of all 15 Challenged Claims. Furthermore, Petitioners stipulate that they will not pursue invalidity against the Challenged Claims in the district court using the specific combination of prior art references set forth in the grounds herein for establishing obviousness. *Sand Revolution II LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 11-12 (PTAB June 16, 2020) (holding a similar stipulation weighs against discretionary denial).

Under factor 5, Petitioners are Intervenor / Defendants in the Related Litigation. This factor is neutral as it is “far from an unusual circumstance that a petitioner in inter partes review and a defendant in a parallel district court proceeding are the same.” *Sand*, No. IPR2019-01393, Paper 24, at 12-13.

Under factor 6, other circumstances weigh in favor of institution. Here, the Petition’s merits are particularly strong. For example, Agee is directed at the same problem and proposes the same solution as the ’235 Patent, and discloses identical architecture and the identical concepts disclosed in the ’235 Patent, demonstrating that the Petition is particularly strong in the underlying merits. Moreover, as

detailed above, except for the claim portions disclosed by Agee's Butler matrix, the Examiner determined all claim elements to be in the prior art.

When viewed holistically, the Petition's timing is reasonable, there has been limited investment in the Related Litigation, and there is minimal overlap between the present IPR and the Related Litigation. Coupling these *Fintiv* considerations with the compelling evidence of unpatentability presented herein, the efficiency and integrity of the IPR process is best served by instituting review.

IX. MANDATORY NOTICES UNDER 37 C.F.R. §42.8

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest in this Petition is Ericsson Inc., and corporate parent Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation. No other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

To avoid additional issues associated with real parties in interest, Petitioners likewise identify T-Mobile USA, Inc., AT&T Services Inc., AT&T Mobility LLC, AT&T Corporation, and Cellco Partnership d/b/a Verizon Wireless because Petitioners' products provided to these entities have been accused of infringement in the Related Matters identified below.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

1. Judicial Matters

As of the filing date of this Petition and to the best knowledge of Petitioners,

the ‘235 Patent is (or was) involved in the following litigations:

- *XR Communications LLC v. Verizon Communications, Inc. et al.*,
U.S.D.C. EDTX Case No. 2:23-cv-00203-JRG-RSP;
- *XR Communications LLC v. T-Mobile USA, Inc.*, U.S.D.C. EDTX
Case No. 2:23-cv-00204-JRG-RSP;
- *XR Communications LLC v. AT&T SERVICES INC.; AT&T
MOBILITY LLC; AND AT&T CORP.*, U.S.D.C. EDTX Case No.
2:23-cv-00202-JRG-RSP.

These are referenced collectively herein as the “Related Litigation(s).” In addition, to the best knowledge of Petitioners, the ‘235 Patent is (or was) involved in the additional litigations:

- *XR Communications, LLC v. Apple Inc.*, 6:21-cv-00620, W.D. Tex.;
- *XR Communications, LLC v. HP Inc.*, 6:21-cv-00694, W.D. Tex.;
- *XR Communications LLC v. Microsoft*, 6-21-cv-00695, W.D. Tex.;
- *XR Communications LLC v. Amazon*, 6-21-cv-00619, W.D. Tex.;
- *XR Communications LLC v. Asustek*, 6-21-cv-00622, W.D. Tex.;
- *XR Communications LLC v. Google*, 6-21-cv-00625, W.D. Tex.;
- *XR Communications LLC v. Samsung*, 6-21-cv-00626 W.D. Tex.

2. Administrative Matters:

As of the filing date of this Petition and to the best knowledge of Petitioners,

the ‘235 Patent was subject to the following administrative matters.

- IPR2022-01398
- IPR2022-01362
- IPR2022-01353
- IPR2022-01155
- IPR2022-00367

3. Related Patents

The ‘235 patent is related to the following U.S. Pat. Nos.: 8,412,106; 9,462,589; 10,009,085; 10,594,376; 11,777,569; 11,750,256.

C. Lead/Back-up Counsel (37 C.F.R. § 42.8(b)(3)):

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D. Notice of Service Information (37 C.F.R. § 42.8(b)(4)):

Please direct all correspondence to lead and back-up counsel at the above addresses. Petitioners consent to electronic service at the email addresses above.

X. CONCLUSION

Petitioners request the Board institute IPR and cancel all Challenged Claims.

Respectfully submitted,

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Dated: March 6, 2024

CERTIFICATION OF SERVICE ON PATENT OWNER

Pursuant to 37 C.F.R. §§ 42.6(e), 42.8(b)(4) and 42.105, the undersigned certifies that on the 6th of March, 2024, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 10,715,235 and all supporting exhibits were served via email and/or electronic download by agreement of Patent Owner, to the correspondence address of record for the '235 Patent:

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24 *et seq.*, the undersigned certifies that this document complies with the type-volume limitations. This document contains 13,774 words as calculated by the “Word Count” feature of Microsoft Word 2010, the word processing program used to create it.

Dated: March 6, 2024

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