

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

QUALCOMM INCORPORATED and
ZyXEL COMMUNICATIONS CORPORATION¹,

Petitioner,

v.

UNM RAINFOREST INNOVATIONS,

Patent Owner.

PTAB Case No. IPR2021-00375

Patent 8,265,096 B2

PATENT OWNER'S MOTION TO AMEND

¹ ZyXEL Communications Corporation was joined as a petitioner in this proceeding based on a petition and motion for joinder filed in IPR2021-00734, which were granted.

UPDATED LIST OF EXHIBITS

Exhibit No.	Descriptions
2001	Declaration of Dr. Branimir Vojcic
2002	'096 Provisional
2003	2018 Economic Impact Report
2004	'096 claim chart
2005	Dell litigation scheduling order
2006	Dell litigation amended scheduling order
2007	Dell litigation notice of withdrawn claims
2008	Asus litigation notice of withdrawn claims
2009	Apple litigation joint motion to dismiss with prejudice
2010	Apple litigation order of dismissal
2011	Asus ROG Phone 3 Home Page
2012	Asus litigation Qualcomm subpoena
2013	Supplemental Declaration of Dr. Branimir Vojcic
2014	12/06/21 excerpts from rough draft depo transcript of Sumit Roy, Ph.D.

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TABLE OF AUTHORITIES

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Statutes

35 U.S.C. § 102 2

35 U.S.C. § 103 1, 2

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37 C.F.R. § 42.121(a)(2)(i) 2

37 C.F.R. § 42.121(a)(3) 2

I. INTRODUCTION

Patent Owner UNM Rainforest Innovations (hereinafter “UNM” or “Patent Owner”) respectfully submits this Motion to Amend (“Motion”) to request amendment of certain claims of U.S. Patent 8,265,096 B2 (EX1001, “’096 Patent”).

Petitioner asserts that claims 1-4 and 6-8 of the ’096 Patent are unpatentable on two grounds based solely on 35 U.S.C. § 103:

Ground 1 – Claims 1-4, 6, and 7 are unpatentable as obvious over *Talukdar* and *Li*.

Ground 2 – Claim 8 is unpatentable as obvious over *Talukdar* and *Nystrom*.

Patent Owner requests amendment of independent claim 1 to provide further limitation and clarification of its claimed invention and reflect the proper scope of this claims considering the specification.

II. MOTION TO AMEND PILOT PROGRAM

Pursuant to 84 FR 9497, Patent Owner requests that this Motion to Amend be subject to the MTA Pilot Program. This IPR was instituted on July 19, 2021, *see* Paper 14, and, therefore, it qualifies for the MTA Pilot Program effective on March 15, 2019. Patent Owner requests preliminary guidance from the Board on this Motion to Amend and reserves the right to file a revised Motion to Amend subject to the Board’s preliminary guidance.

III. A REASONABLE NUMBER OF CLAIMS ARE AMENDED.

Pursuant to 37 C.F.R. § 42.121(a)(3), a motion to amend may propose a reasonable number of substitute claims for each challenged claim. Generally, it is presumed “that only one substitute claim would be needed to replace each challenged claim,” but that challenge may be rebutted by a showing of need. 37 C.F.R. § 42.121(a)(3); *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 4-5 (PTAB Feb. 25, 2019). Petitioner challenges independent claims 1 and 8, and dependent claims 2-4, 6, and 7. Patent Owner now proposes only one substitute claim for challenged independent claim 1. Dependent claims 2-4, 6, and 7 are amended only by virtue of depending from proposed amended independent claim 1.

IV. THE PROPOSED AMENDMENT RESPONDS TO A GROUND OF UNPATENTABILITY INVOLVED IN THIS TRIAL

A motion to amend is proper where the amendment “respond[s] to a ground of unpatentability involved in the trial.” 37 C.F.R. § 42.121(a)(2)(i). Where the proposed amendment is intended to address the grounds for institution, additional modifications may be permissible to address potential § 101 or § 112 issues. *Lectrosonics*, IPR2018-01129, Paper 15, 5-6. The Petition here necessarily alleges that every element of each challenged claim is disclosed by a combination of prior art references under 35 U.S.C. §§ 102 and 103. Based thereon, the Board found in its institution decision that “there is a reasonable likelihood Petitioner would prevail in showing claim 1 is unpatentable under 35 U.S.C. § 103 over *Talukdar* and *Li*.”

(Paper 14 at 44) and “there is a reasonable likelihood Petitioner would prevail in showing claims 2–4, 6, and 7 are unpatentable under 35 U.S.C. § 103 over *Talukdar* and *Li*.” *Id.* Adding the proposed substantive limitation to independent claim 1 is, thus, responsive to these grounds for institution.

V. PROPOSED AMENDED CLAIMS

The proposed amended claims are set forth in **Appendix A** below. Brackets are used to indicate deletions, and underlining is used to indicate additions.

A. The Proposed Amended Claims Do Not Broaden Claim Scope.

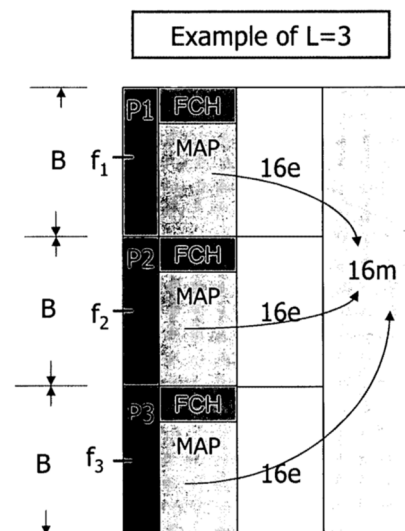
Proposed amended claim 44 is narrower than the original claim 1 and does not broaden claim scope. The additional claim element “wherein the second communication system has pilot symbols that are denser than those in the first communication system” further narrows the claim by requiring that the “second communication system” has pilot symbols that are denser than those in the first communication system. Therefore, new proposed amended claim 44 is narrower than original claim 1.

B. The Proposed Amended Claims Do Not Introduce New Matter And Are Supported By The Original Specification.

As explained below, support for Patent Owner’s proposed amendments is found in at least the following disclosures: EX1010 at 6-7, ¶ 0028; 9-10, ¶ 0035; 10-11, ¶ 0037.

The additional claim element “wherein the second communication system has pilot symbols that are denser than those in the first communication system” finds support in the written description of the ’096 Patent at 5:17-18 (“denser pilot symbols may achieve better channel estimation accuracy”); 5:35-36 (“the placements of the pilot symbols may be denser”); 7:23-24; 7:61-8:6; *see also* EX1010 at 6-7, ¶ 0028; 9-10, ¶ 0035; 10-11, ¶ 0037. Indeed, the claim element is present in original claim 8: “wherein the second communication system has pilot symbols that are denser than those in the first communication system.” ’096 Patent at 9:18-20.

The additional claim element also finds support in provisional application No. 60/929,798, filed on Jul. 12, 2007. Specifically, the provisional application discloses a second section in a second format compatible with 802.16m, which follows the first section compatible with 802.16e in one transmission scheme.



EX2002 ('096 Provisional) at 3.

❖ Structure A

- An OFDMA system with multiple zones

EX2002 ('096 Provisional) at 8. The proper construction of “pilot symbols that are denser than” as “more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system.” EX1011 (Claim Construction Order in *UNM Rainforest Innovations v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex). Petitioners have accepted this construction. *See* Paper 1 at 23. As explained by Dr. Vojcic, the provisional application, thus, discloses this new claim limitation by pointing to increased density (in the temporal dimension) as a natural result of reduced symbol period:

The provisional discloses that the second format compatible with 802.16m is designed to support higher mobility, *i.e.*, speed at which the mobile unit is moving, and uses symbols that are shorter (*i.e.* the bandwidth is larger) than the symbols in 802.16e.

- ❖ New standard 802.16m is being developed for next generation wireless communication
 - Enhanced spectrum efficiency
 - Higher speed

EX2002 ('096 Provisional) at 2. Both, “spectrum efficiency” and “higher speed” are advantages of the second communication system. The former implies higher data speed, which clarifies the meaning of “higher speed” as referring to a higher velocity mobile unit.

Frequency planning

- Occupy the same band class as 802.16e
- A 802.16m channel uses multiple (L) contiguous 802.16e channels
- L BS's share the same 802.16m zone with L*B bandwidth (802.16e BW with B)

EX2002 ('096 Provisional) at 3.

A POSITA would have known at the time of the provisional application that by use of the following formulas a “shorter symbol period” can be shown for the second system.

N = number of subcarriers

K = number of samples in the cyclic prefix

$$T_s = \frac{N + K}{3B}$$

$$T_{sL} = \frac{N_L + K_L}{B}$$

Where T_s is the symbol period of the second system and T_{sL} is the symbol period of the legacy system.

EX2001 at ¶ 52. “Further, the goal of achieving ‘higher speed’ in conjunction with the proposed dual-system frame structure would suggest modifying density of pilots in one of the systems as a solution to the problem caused by increased Doppler shifting due to high speed.” *Id.*

The Board considered the above in its Institution Decision (Paper 14), and questioned the written description support for “wherein each symbol in the second communication system has a shorter symbol period than that in the first communications system,” recited in challenged claim 1, and “wherein the second

communication system has pilot symbols that are denser than those in the first communications system,” recited in challenged claim 8.” Paper 14 at 26. Specifically, the Board found that “Patent Owner and its declarant Dr. Vojcic do not provide underlying facts to support the contention that a person of ordinary skill in the art ‘would have known at the time of the provisional application that by use of the following formulas a ‘shorter symbol period’ can be shown for the second system.”” More specifically, Patent Owner does not provide the factual basis for the formulas:

$$T_s = \frac{N + K}{3B} \text{ and } T_{sL} = \frac{N_L + K_L}{B}$$

Id. Further, the Board further found that “Patent Owner also does not explain whether there is an assumption that N and NL and K and KL are the same for the second system and the legacy system.” *Id.* To address these questions, Patent Owner hereby supplements the record.

Specifically, Dr. Vojcic provides the following background supporting that “a POSITA as of July 2007 would have known that $TSYM = TGI + TDFT = N/F_s + K/F_s$, where TDFT is the IDFT/DFT period, TGI is the length of the cyclic prefix (also called guard interval), N is the number of carriers.” EX2013 at ¶ 19. Indeed, OFDM, the origin of this formula, dates back to the 1970s. *Id.* at ¶ 20. Even as early as 1971, a seminal paper disclosed sufficient information to inform a POSITA that

“the symbol period is the product of the sampling period Δt , and the number of samples N , $\text{TDFT} = N \Delta t$.” *Id.* at ¶ 22. The complex underlying mathematical proof is shown as well:

$$y(t) = 2 \sum_{n=0}^{N-1} (a_n \cos 2\pi f_n t + b_n \sin 2\pi f_n t),$$

$$0 \leq t \leq N \Delta t.$$

Id. at ¶ 21. This is further confirmed by another seminal paper in 1985, which “shows that “the signaling interval”, in other words the symbol period, is $\text{TDFT} = N \Delta t$.” *Id.* at 23. The cited paper “also establishes the now well-known result that $\Delta t = 1/F_s$.” *Id.* at ¶ 24. Further, “the 1985 paper also shows a modulo extension (which present-day systems refer to as a cyclic prefix or guard interval). At the bottom of Fig. 8 of *Cimini*, the length of a block is “now $N+1$ long”. In the *Cimini* system, 1 is the length of the guard interval, which in our notation is K .” *Id.* at 25. “Consequently, a block is now $N+K$ long. Including this extension, the length of a block is $\text{TSYM} = \text{TGI} + \text{TDFT}$.”

Dr. Vojcic further provides an example to illustrate the application of the well-known formula in the modern WiFi standard:

28. Another prior art system is the 1999 standard IEEE 802.11a.

Table 79—Timing-related parameters

Parameter	Value
N_{SD} : Number of data subcarriers	48
N_{SP} : Number of pilot subcarriers	4
N_{ST} : Number of subcarriers, total	52 ($N_{SD} + N_{SP}$)
Δ_F : Subcarrier frequency spacing	0.3125 MHz ($=20 \text{ MHz}/64$)
T_{FFT} : IFFT/FFT period	3.2 μs ($1/\Delta_F$)
$T_{PREAMBLE}$: PLCP preamble duration	16 μs ($T_{SHORT} + T_{LONG}$)
T_{SIGNAL} : Duration of the SIGNAL BPSK-OFDM symbol	4.0 μs ($T_{GI} + T_{FFT}$)
T_{GI} : GI duration	0.8 μs ($T_{FFT}/4$)
T_{GI2} : Training symbol GI duration	1.6 μs ($T_{FFT}/2$)
T_{SYM} : Symbol interval	4 μs ($T_{GI} + T_{FFT}$)
T_{SHORT} : Short training sequence duration	8 μs ($10 \times T_{FFT}/4$)
T_{LONG} : Long training sequence duration	8 μs ($T_{GI2} + 2 \times T_{FFT}$)

See IEEE 802.11a at p. 9.

29. IEEE 802.11 specifies that the number of carriers N is 64, N=64. These carriers are shown in the figure below, labeled from 0 to 63.

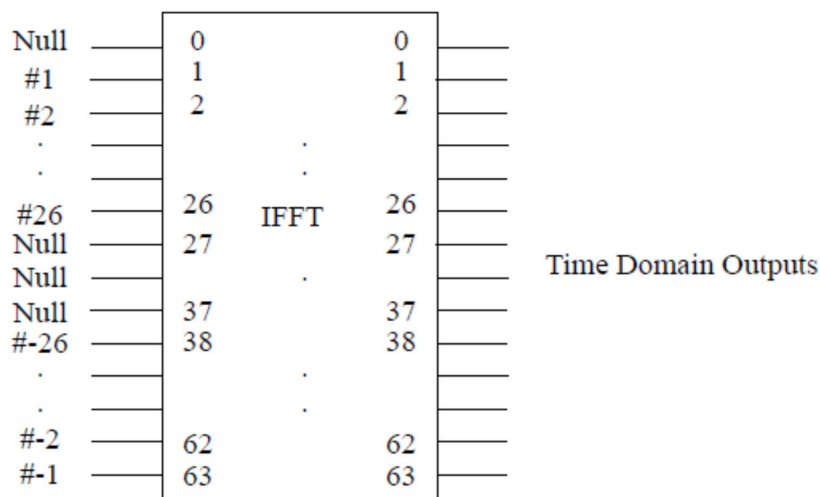


Figure 109—Inputs and outputs of IDFT

See IEEE 802.11a-1999 at page 12.

30. A POSITA in 1999 would have known the 1971 and 1985 papers and would have been able to understand Table 79 of the standard, shown above. According to Table 79 the IFFT/FFT period is $3.2 \mu\text{s}$. Therefore $\text{TDFT} = 3.2 \mu\text{s} = 64 \Delta t = 64 / F_s$.
31. The conclusions are that $\Delta t = 50 \text{ ns}$ and $F_s = 1 / \Delta t = 20 \text{ MHz}$.
32. According to Table 79 above, the guard interval is $\text{TDFT} / 4$. Therefore, the guard interval in samples is $K = 64 / 4 = 16$ samples. The duration of the guard interval is 800 ns .
33. A POSITA would have been able to calculate the symbol interval as $\text{TSYM} = \text{TGI} + \text{TDFT} = 4 \mu\text{s}$. Table 79 itself contains an entry for the symbol period as $4 \mu\text{s}$.

Id. at ¶¶ 28-33. Based on these disclosures and examples, “a POSITA as of at least 1999 would have been able to calculate the symbol period of an OFDM system as $\text{TSYM} = \text{TGI} + \text{TDFT} = N / F_s + K / F_s = (N + K) / F_s$.” *Id.* at 32.

Dr. Vojcic further provides a logical explanation based on the fact that “a POSITA would understand that OFDM systems are sensitive to frequency errors and Doppler shifts and that Inter-carrier interference in OFDM increased with Doppler shift. Thus, in a system with higher mobility inter-carrier spacing should be increased, or equivalently, OFDM symbol duration should be decreased.” *Id.* at ¶ 35.

36. Specifically, as shown in Figure 5 (shown below) in Ex. 4 (Armstrong, Grant, and Povey, *Polynomial Cancellation Coding Of OFDM To Reduce Inter-carrier Interference Due To Doppler Spread*), signal to inter-carrier interference (ICI) ratio rapidly decreases, adversely impacting the performance) as the Doppler shift increases due to higher mobility. T is equal to $1/\text{carrier separation}$, *i.e.*, $1/F_s$, thus, as the Doppler shift f_d increases, the normalized Doppler shift $f_d T$, for a fixed T , increases and, thus,

signal to ICI ratio decrease. Thus, to mitigate adverse Doppler effects at higher mobility, symbol duration T must be decreased which also results in a larger subcarrier frequency spacing F_s , *i.e.*, decrease $f_d T$, making the system more tolerant to Doppler. In some very high-speed scenarios, it might also be needed to implement very complex ICI cancelation schemes in addition, as in Ex. 4.

Id. at ¶ 36. It is for this reason that “a POSITA would understand that the symbol duration in a high mobility 802.1m system needs to be shorter than in the legacy system 802.1e, *e.g.*, L times, or, equivalently, the inter-carrier spacing needs to be larger L times.” *Id.* at ¶ 36. This is directly responsive to the Board’s question of “whether there is an assumption that N and N_L and K and K_L are the same for the second system and the legacy system” and directly relates to slide 3/9 of the provisional application of the ’326 Patent (EX2002 at 3) “where it is stated that subcarriers bandwidth (*i.e.*, spacing) in a legacy system 16.e is B , while in 16.m system it is $B \cdot L$, *i.e.*, L times larger.” *Id.* at ¶ 37. Dr. Vojcic further explains that

Therefore, a POSITA would understand that the number of subcarriers N , and therefore the number of samples in the cyclic prefix, K , in both systems are the same in the provisional disclosure, taking into account the arrangement in the example $L=3$ in the provisional application at 3/9. Thus, it also follows that $T_s = (N+K)/3B$ is 3 times shorter than $T_{sL} = (N_L+K_L)/B$. However, this example in the provisional should not be read as limiting, as a POSITA would understand that there are other possible arrangements such that T_s is shorter than T_{sL} while the number of subcarriers is not necessarily the same. *Id.* at ¶¶ 36, 37.

Id. at ¶ 37 (emphasis added).

Finally, Petitioner’s expert admitted that a shorter symbol period inherently implies that there are more pilot signal symbols per unit of time:

Q. Would a shorter symbol period also imply that you will get more pilot signal symbols per unit of time?

A. So depending on how you -- there's a nuance how you framed that question, yes, because if we mean by density, you know, the number of pilot symbols we are unit time -- so let's say I have two designs in which I have a symbol duration T and then I have a symbol duration T by two, if I keep the same number of pilots in the T symbol duration compared to the T by 2 I would get more pilots per unit time but per symbol duration the number of pilots are the same, so.

Q. A POSITA would have understood that at the time of Li?

A. The POSITA would have understood that, yes.

EX2012 (Roy depo of Dec. 6, 2021– rough transcript) at 71:22-72:20. Dr. Roy thereby explicitly confirms that the disclosure of the '326 provisional application implicitly shows denser pilot symbols (based on the construction of “pilot symbols that are denser than” as “more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system.”)

Therefore, new proposed amended claim 44 does not introduce new subject matter and claims priority to Jul. 12, 2007, the filing date of the provisional patent application No. 60/929,798.

C. The Proposed Amended Claims Are Patentable.

“A patent owner does not bear the burden of persuasion to demonstrate the patentability of substitute claims presented in a motion to amend.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 4 (PTAB Feb. 25, 2019). Rather, “the burden of persuasion ordinarily will lie with the petitioner to show that any

proposed substitute claims are unpatentable by a preponderance of the evidence.”
Id.

The additional claim element “wherein the second communication system has pilot symbols that are denser than those in the first communication system” is not taught by *Talukdar*, *Li*, or *Nystrom*. Petitioners have not met their burden to show that the proposed substitute claims are unpatentable by a preponderance of the evidence.

VI. CONCLUSION

For the reasons set forth herein, Patent Owner asserts that the proposed amended claims meet all statutory requirements and respectfully requests that the Board allow proposed amended claim 44 and dependent amended claims 45-47, 49, and 50.

Dated: December 7, 2021

Respectfully submitted,

/s/ Jay P. Kesan

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e)(4) and 42.25(b), the undersigned certifies that on December 7, 2021, a complete copy of Patent Owner's Motion to Amend was filed electronically through the Patent Trial and Appeal Board's PTABE2E System and provided, via electronic service, to the Petitioner by serving the correspondence address of record.

Dated: December 7, 2021

/s/ Jay P. Kesan
Jay P. Kesan

APPENDIX A

Patent Owner's proposed amended claims are set forth below. Use of brackets indicates deleted text (if any) and underlining indicates inserted text. For ease of reference, the below table indicates the correspondence between original and amended claims:

Original Claim	Amended Claim
1	44 (Amended)
2	45
3	46
4	47
6	49
7	50

The indicated independent claim 44 is amended. Dependent claims 45-47, 49 and 50 are amended only by virtue of being dependent from an amended independent claim. The remaining original claims are not amended.

A. AMENDED CLAIM 44 REPLACING ORIGINAL CLAIM 1

Proposed Amended Claim 44 (replacing claim 1). A method of constructing a frame structure for data transmission, the method comprising:

generating a first section comprising data configured in a first format compatible with a first communication system using symbols;

generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols, wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and wherein:

the second format is compatible with the second communication

system configured to support higher mobility than the first communication system,

wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system; and

wherein the second communication system has pilot symbols that are denser than those in the first communication system;

generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section; and

combining the first section, the second section and the at least one non-data section to form the frame structure.

B. AMENDED CLAIMS 2-4, 6 AND 7

Amended Claim 45 / Original Claim 2. The method of claim [1]44, wherein the non-data section comprises mapping information for at least one of the first section and the second section.

Amended Claim 46 / Original Claim 3. The method of claim [1]44, wherein the non-data section comprises at least one of a preamble, a frame control header 60 (FCH), a burst, and a map of at least one of the first section and the second section.

Amended Claim 47 / Original Claim 4. The method of claim [3]46, wherein the second section follows the first section in at least one of time sequence and frequency spectrum.

Amended Claim 49 / Original Claim 6. The method of claim [1]44, wherein each of the first section and the second section carries at least one of uplink and downlink data.

Amended Claim 50 / Original Claim 7. The method of claim [1]44, wherein the second section carries mapping information for data in the second section.