UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

In re Patent Of:	Collision Communications, Inc.
U.S. Patent No.:	9,814,071
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Title:	MEDIA ACCESS CONTROL PROTOCOL FOR MULTIUSER DETECTION ENABLED AD-HOC WIRELESS COMMUNICATIONS

IPR2022-01233

PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 9,814,071 UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104

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PETITIONER'S EXHIBIT LIST

Ex.1001	U.S. Patent No. 9,814,071 to Niedzwiecki *et al.* ("the '071 Patent")
Ex.1002	Prosecution File History of the '071 Patent
Ex.1003	Declaration of Sumit Roy
Ex.1004	CV of Sumit Roy
Ex.1005	U.S. Patent No. 5,867,478 to Baum *et al.* ("Baum")
Ex.1006	U.S. Patent No. 7,486,735 to Dubuc *et al.* ("Dubuc")
Ex.1007	U.S. Patent Pub. No. 2007/0149128 to Das *et al.*
Ex.1008	*Modern Dictionary of Electronics, Seventh Edition*, Butterworth-Heinemann (1999) (selected pages)
Ex.1009	U.S. Patent Pub. No. 2002/0181509 to Mody *et al.*
Ex.1010	U.S. Patent Pub. 2008/0032630 to Kim et al. ("Kim")
Ex.1011	U.S. Patent Pub. No. 2004/0114618 to Tong et al. ("Tong")
Ex.1012	U.S. Patent No. 7,778,337 to W. Tong and P. Zhu et al. ("Zhu")
Ex.1013	B. Sklar, *Digital Communications: Fundamentals and Applications*, Prentice Hall, Inc. (1988) (selected pages)
Ex.1014	R. van Nee *et al.*, *OFDM Wireless Multimedia Communications*, Artech House (2000) (selected pages)
Ex.1015	Reserved
Ex.1016	U.S. Patent No. 7,042,858 to Ma *et al.*
Ex.1017	Docket Control Order, *Collision Communications, Inc. v. Telefonaktiebolaget LM Ericsson et al.*, 2-21-cv-00327 (E.D.Tex.), December 3, 2021
Ex.1018	Complaint, *Collision Communications, Inc. v. Telefonaktiebolaget LM Ericsson et al.*, 2-21-cv-00327 (E.D.Tex.), August, 27, 2021

Ex.1019	U.S. District Court, Eastern District of Texas, Calendar Events Set for 1/1/2023-1/4/2023, Judge Rodney Gilstrap (as of July 20, 2022)
Ex.1020	U.S. Patent Pub. No. 2004/0066866 to W. Tong and M. Jia *et al.* ("Jia")
Ex.1021	U.S. District Courts – Case Statistics, obtained at https://www.uscourts.gov/statistics-reports/analysis-reports/federal-court-management-statistics, per Director Vidal, Memorandum, "Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation" at n.4, dated June 21, 2022

Note that, for non-patent documents, the following analysis will cite to the original page numbers of the exhibits themselves if such exists, and the labeled page numbers otherwise. Also, the following analysis may bold and underline quotations and add color and/or annotations to the figures from these exhibits for the sake of emphasis, unless otherwise indicated. All claim language appears in italics.

I. INTRODUCTION

U.S. Patent No. 9,814,071 ("the '071 Patent") relates to a communication system having a "shared communication channel" for data communication and unshared "parameter channels." Ex.1001, 4:37-51. "Parameter-estimating signals" are received over "unshared parameter channels," and data is "simultaneously received" from different "transmitting nodes" over the shared channel. *Id.* Signal parameters are affected by the wireless environment, such as "relative distances between nodes, as well as by the presence of any intervening buildings or other structures…" *Id.*, 3:31-36.

The technology of the '071 Patent "distinguishes … overlapping digital signals [in the shared channels] by capitalizing on differences in certain signal parameters [identified based on transmissions in the unshared parameter channels]." *Id.*, 3:26-29. Figure 3 illustrates communication resources (frequency spectrum in this example) that are for shared data transmission among multiple transmitters and resources that are for unshared transmission of parameter-estimating signals.

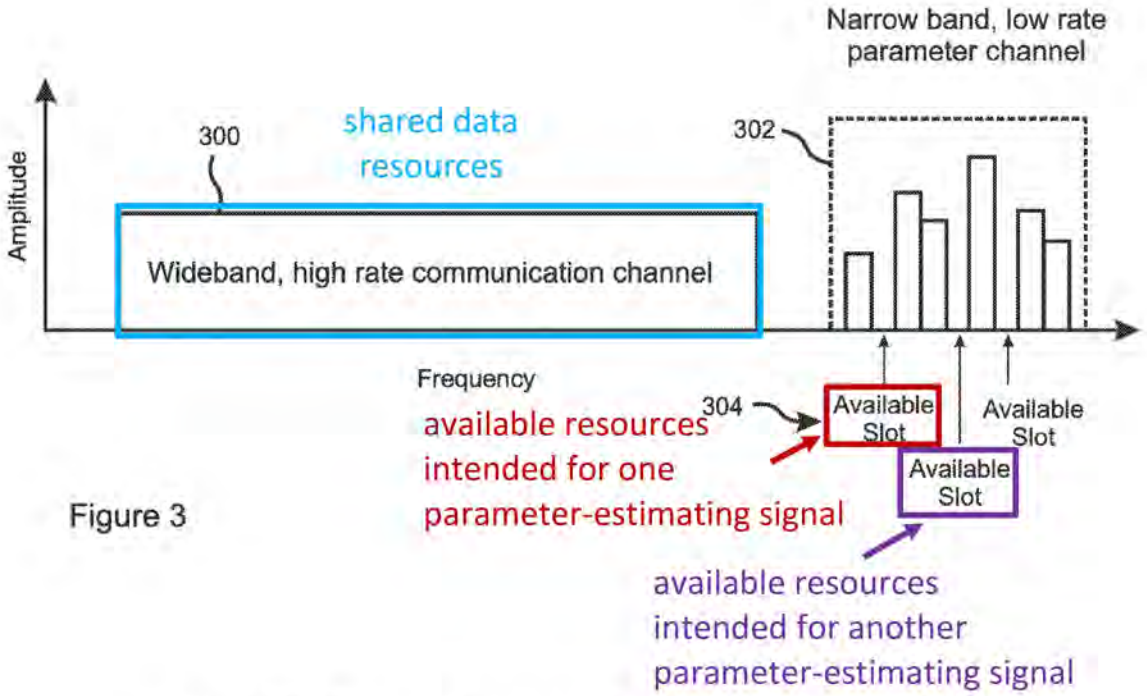
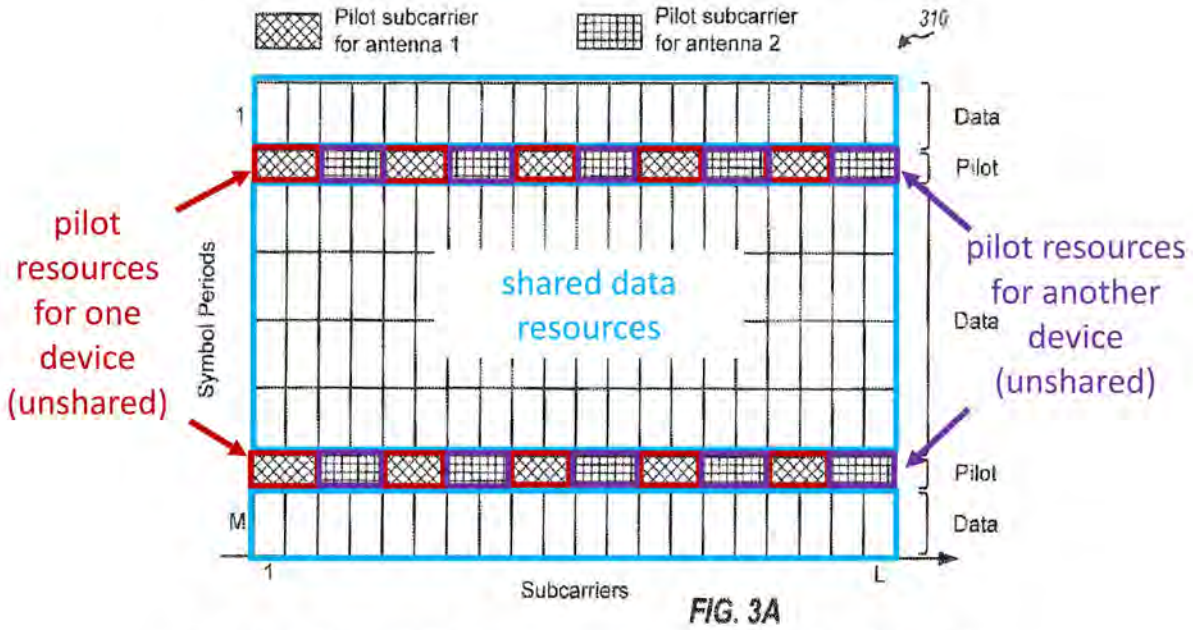


Figure 3

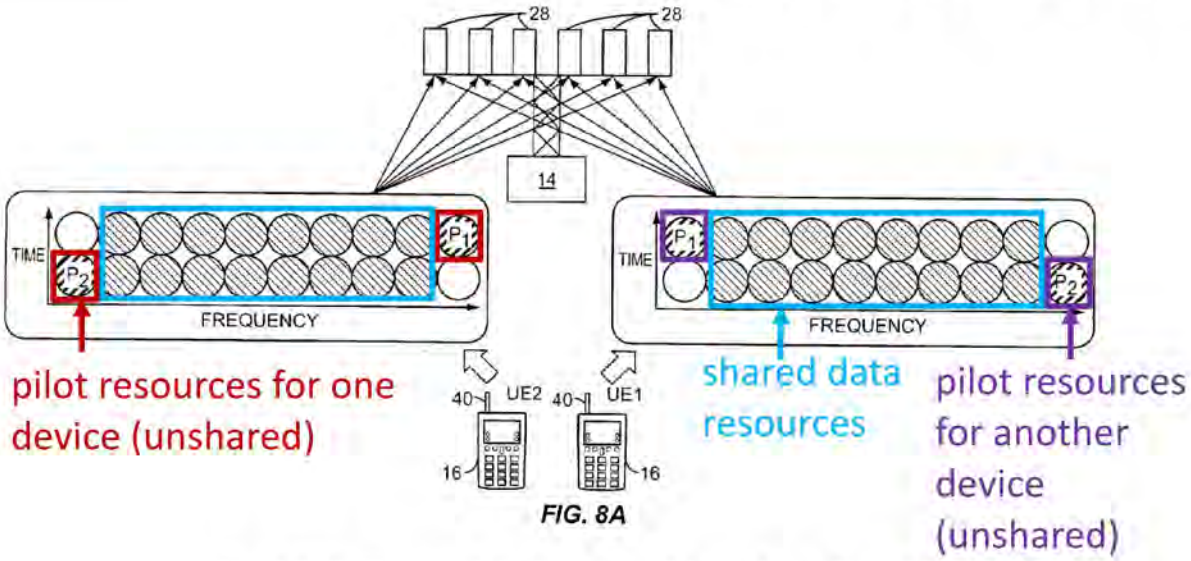
Ex.1001, Figure 3 (annotated in color); Ex.1003, ¶33

In the context of orthogonal frequency division multiplexing (OFDM) systems, multiple references describe the same techniques as the '071 Patent as shown herein. OFDM is a flexible technique that allows both time and frequency communication resources to be partitioned into channels for different transmissions. In both Kim (Ex.1010) and Tong (Ex.1011), as examples, certain user-specific, or unshared, time and frequency resources are designated for parameter-estimating signals known as pilots, and certain resources are designated as being shared among users for simultaneous data transmission. Pilots received on unshared, user-specific channels are used for estimating channel parameters, while data symbols simultaneously received on shared data channels from multiple

transmitters are jointly decoded using these channel parameter estimates derived from pilots. Both Tong and Kim illustrate these unshared resources for transmitting pilots and shared resources for transmitting data, as shown below in two-dimensional grids of time and frequency (referred to subcarriers in OFDM).



Ex.1010, Figure 3A (annotated in color); Ex.1003, ¶56



Ex.1011, Figure 8A (annotated in color); Ex.1003, ¶131

As another example, Baum (Ex.1005) presents the use of shared data channels and unshared resources for synchronization in an OFDM system. While applying similar teachings as Kim and Tong, Baum discloses alternative or additional system features, which relate to certain claims either not addressed in other grounds (claims 8 and 9) or addressed in only one other ground (claims 4 and 10).

Accordingly, Ericsson Inc. and Nokia of America Corporation (collectively, "Petitioner") ask that the Board review the accompanying prior art and analysis and institute a trial for *inter partes* review of claims 1-10, 13, 14, 16, and 21 of the '071 Patent.

II. THE '071 PATENT AND PROSECUTION HISTORY

A. The '071 Patent

The '071 Patent relates to the use of "technology so as to allow a plurality of nodes to transmit simultaneously over a shared communication channel." Ex.1001, 3:18-21. This "technology distinguishes, or 'demodulates,' overlapping digital signals by capitalizing on differences in certain signal parameters." *Id.*, 3:26-29.

The '071 Patent also discloses the use of "an unshared, dedicated, low-collision or collision-free parameter channel, such as may be created using frequency division multiple access (FDMA) or time division multiple access (TDMA) technology," for parameter estimation. *Id.*, 3:45-49. In Figure 3, for example, FDMA is used to divide the frequency spectrum into "a main communication channel 300 and a plurality of parameter channels 302." Ex.1001, 8:27-30.

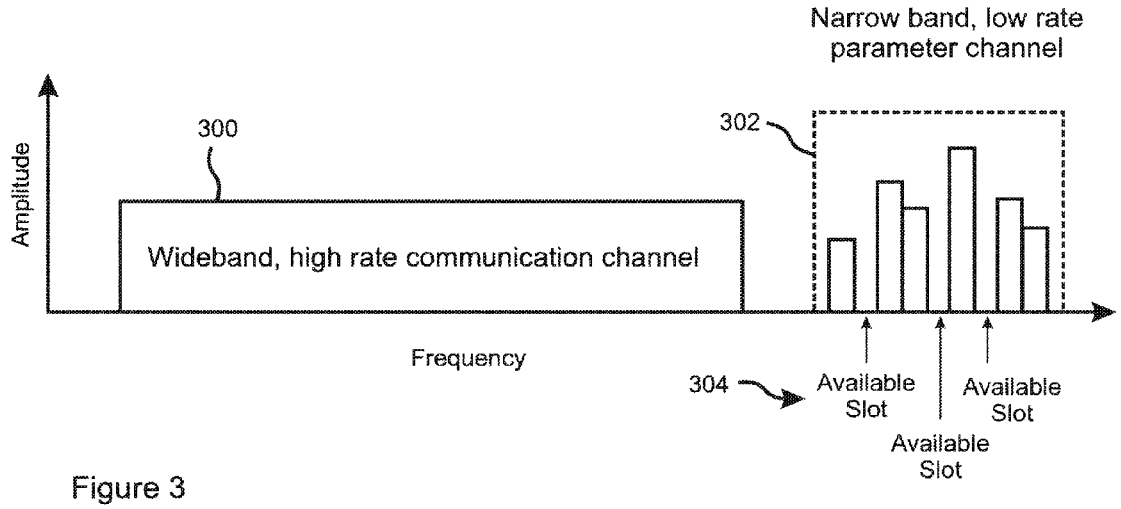


Figure 3

Ex.1001, Figure 3

Representative claim 1 reflects some of these concepts, such as "*a shared communication channel*," "*a plurality of parameter channels*" that are "*unshared*," and "*distinguishing the information simultaneously received*" on the "*shared communication channel*." Ex.1003, ¶¶32-34.

B. Prosecution History

In the first office action, many of the claims were rejected as anticipated. Ex.1002, 215-227. The Applicant responded with only arguments and no claim amendments, focusing on the "unshared" aspect of "unshared parameter channels." *Id.*, 243-253. The examiner maintained the rejections in the next office action. *Id.*, 259-277. The Applicant responded by filing an appeal brief, *id.*, 294-312, and thereafter the PTAB reversed the examiner and the claims were allowed, *id.*, 343-348; Ex.1003, ¶¶36-38.

None of the prior art used herein was considered during prosecution.

III. GROUNDS FOR STANDING

Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the '071 Patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified herein.

IV. LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the art may be reflected by the prior art of record. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). However, to the extent a definition is needed, a person of ordinary skill in the art ("POSITA") at the time of the earliest claimed priority date of September 26, 2008 is someone who had an undergraduate degree in electrical engineering, computer engineering, computer science, or a related field, and two to three years of experience in the design, research, development, operations, and/or testing of radio communications networks, or equivalent combination of education and experience. Someone with more technical education, but less experience could have also met this standard, and vice versa. Petitioner's technical expert, Sumit Roy, whose declaration this Petition cites, was at least a POSITA. Ex.1003, ¶¶18-21.

V. CLAIM CONSTRUCTION

During IPR, claims are construed according to the standard as set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*). *See* 83 Fed. Reg. 51341 (Oct. 11, 2018). For the purposes of this proceeding, no claim term requires express construction. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999). Accordingly, this Petition analyzes the claims consistent with the ordinary and customary meaning as would be understood by a POSITA in light of the specification. *Phillips*, 415 F.3d at 1314-17; Ex.1003, ¶39.

VI. REQUESTED RELIEF

Petitioner asks that the Board review the accompanying prior art and analysis, institute a trial for *inter partes* review of claims 1-10, 13, 14, 16, and 21 and cancel those claims as unpatentable.

VII. IDENTIFICATION OF CHALLENGE

A. Challenged Claims and Statutory Grounds

This Petition challenges claims 1-10, 13, 14, 16, and 21 on the following grounds.

Grounds	Claim(s)	Prior Art Combination Applied Under 35 U.S.C. § 103
1A	1-3, 5-7, 13, 14, 16, 21	Kim (Ex.1010)
2A	1-5, 10, 16, 21	Tong (Ex.1011) combined with Jia (Ex.1020)
2B	6, 7	Tong combined with Jia and Zhu (Ex.1012)
2C	13, 14	Tong combined with Jia, Zhu, and Dubuc (Ex.1006)
3A	1, 4, 8-10	Baum (Ex.1005)

B. Status as Prior Art

All prior art pre-dates the earliest claimed priority date of the '071 Patent of September 26, 2008. Baum issued in 1999, and Tong and Jia published in 2004, making each of those references prior art under 35 U.S.C. § 102(b) (pre-AIA). Dubuc was filed on February 26, 2004, and Zhu was filed on September 29, 2006, making each of those references prior art under 35 U.S.C. § 102(e) (pre-AIA). Kim

published on February 7, 2008, making it prior art under 35 U.S.C. § 102(a) (pre-AIA).

VIII. IDENTIFICATION OF HOW THE CLAIMS ARE UNPATENTABLE

A. Ground 1A: Claims 1-3, 5-7, 13, 14, 16, and 21 are unpatentable as obvious over Kim.

1. Summary of Kim

Kim describes a wireless communication system having base stations, also known as Node Bs, and mobile stations, each also known as user equipment (UE). Ex.1010, [0022]-[0023], Figure 1. Kim explains that its techniques may be used for systems that use "orthogonal frequency division multiplexing (OFDM)," which "partition the system bandwidth into multiple (K) orthogonal subcarriers ... Each subcarrier may be modulated with data." *Id.*, [0024]-[0025], [0031]; Ex.1003, ¶50.

Kim also describes the use of multiple input multiple output (MIMO) communication, in which transmissions are sent from "multiple [] transmit antennas to multiple [] receive antennas at a Node B." Ex.1010, [0006]. Kim describes two types of MIMO – single-user MIMO (SU-MIMO) and, most relevant herein, multi-user MIMO (MU-MIMO), illustrated in Figure 1 below. *Id.*, [0035]. In MU-MIMO, multiple UEs transmit data simultaneously using the same data subcarriers(s). *Id.*, [0036]; Ex.1003, ¶51.

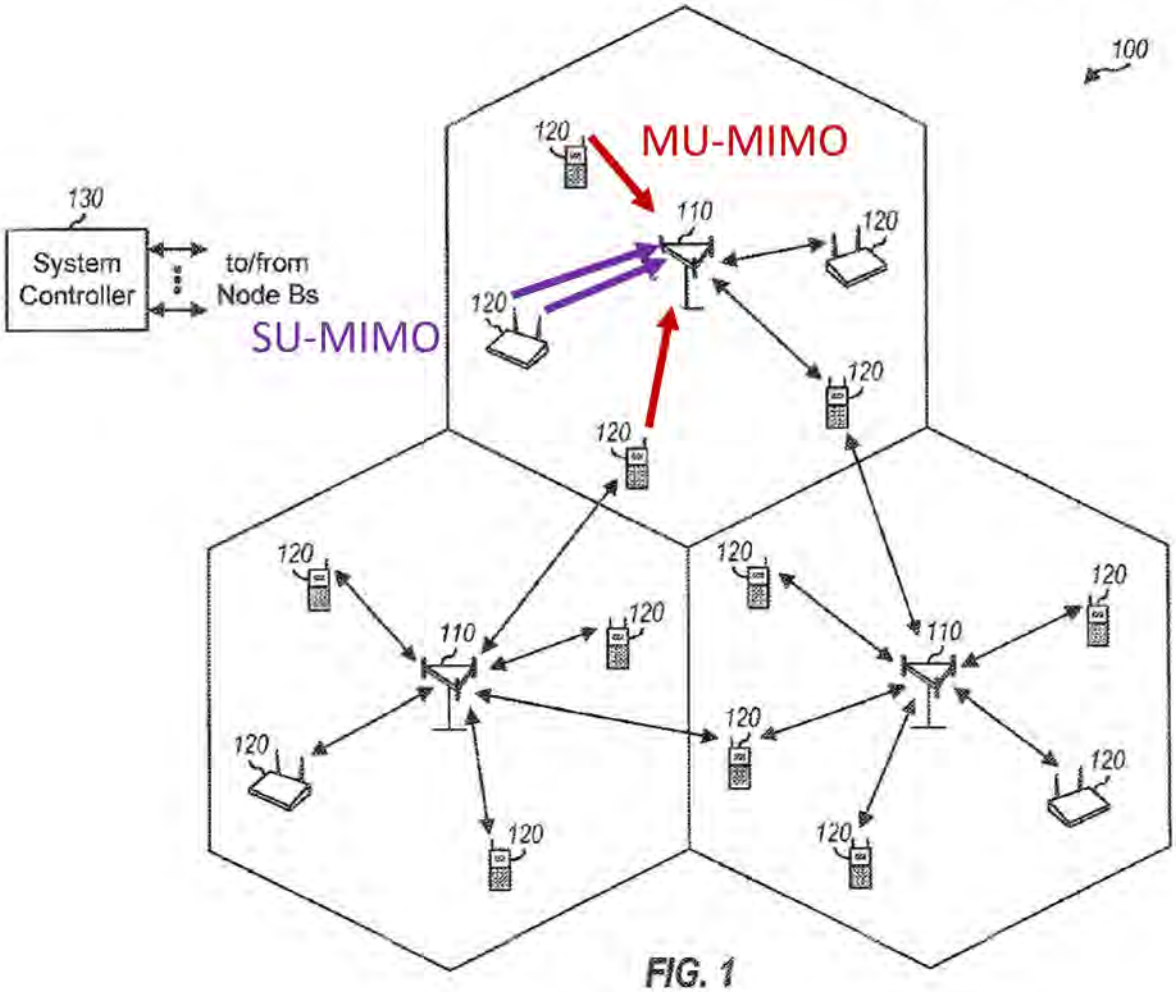


FIG. 1

Ex.1010, Figure 1[1]; Ex.1003, Ex.1003, ¶52

Kim describes the transmission of data symbols and pilot symbols, with certain subcarriers designated as subcarriers for carrying data symbols, or "data subcarriers," and certain subcarriers designated for carrying pilot symbols, or "pilot subcarriers." Ex.1010, [0031], [0074]; Ex.1003, ¶53.

[1] All color is added to figures herein, unless otherwise specified.

Pilot symbols are received and used for estimating the channel between a transmitter antenna and a receiver antenna. Ex.1010, [0074]-[0075] ("A receive (RX) spatial processor 1060 may estimate the channel responses for different UEs based on received pilot symbols."). The pilot symbols are known beforehand at a receiver, so the receiver can determine the effect of the radio channel on the pilot symbols, thereby estimating the channel. Ex.1003, ¶54.

Figure 3A shows a design of a data and pilot structure that may be used for OFDM, and "[i]n this design, a time frequency block covers a set of L subcarriers in a slot of M symbol periods." Ex.1010, [0031]. Further, "FIG. 3A shows an example assignment of data and pilot subcarriers in one time frequency block to two UEs for MU-MIMO," where each UE has a transmit antenna. Ex.1010, [0037]; Ex.1003, ¶¶55-56.

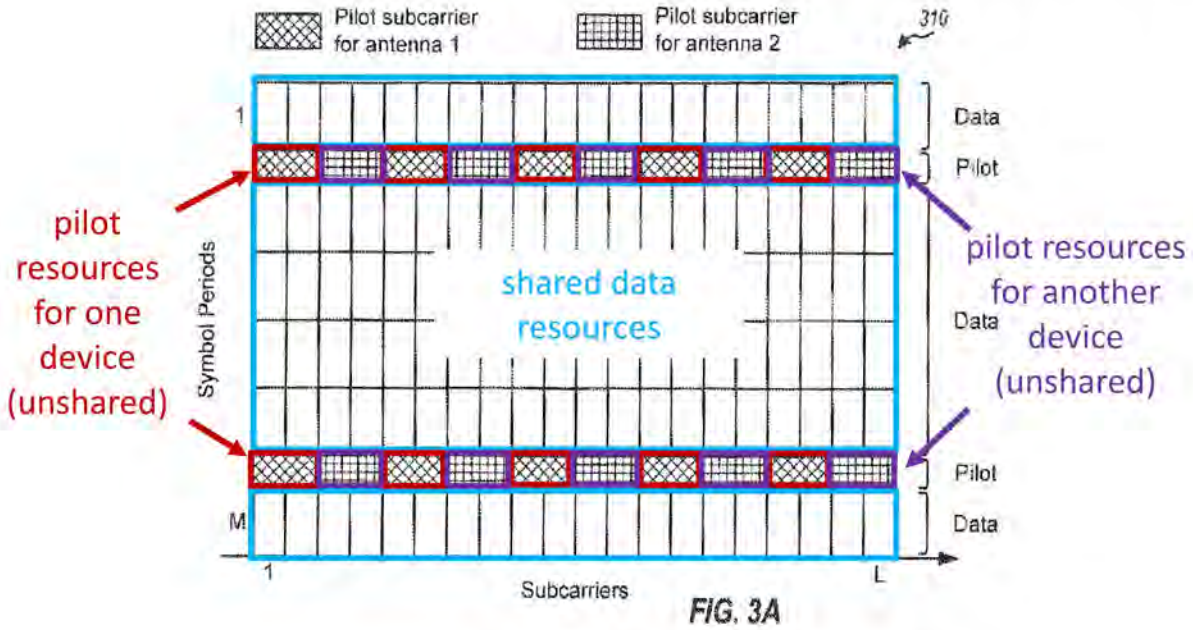


FIG. 3A

Ex.1010, Figure 3A; Ex.1003, ¶56

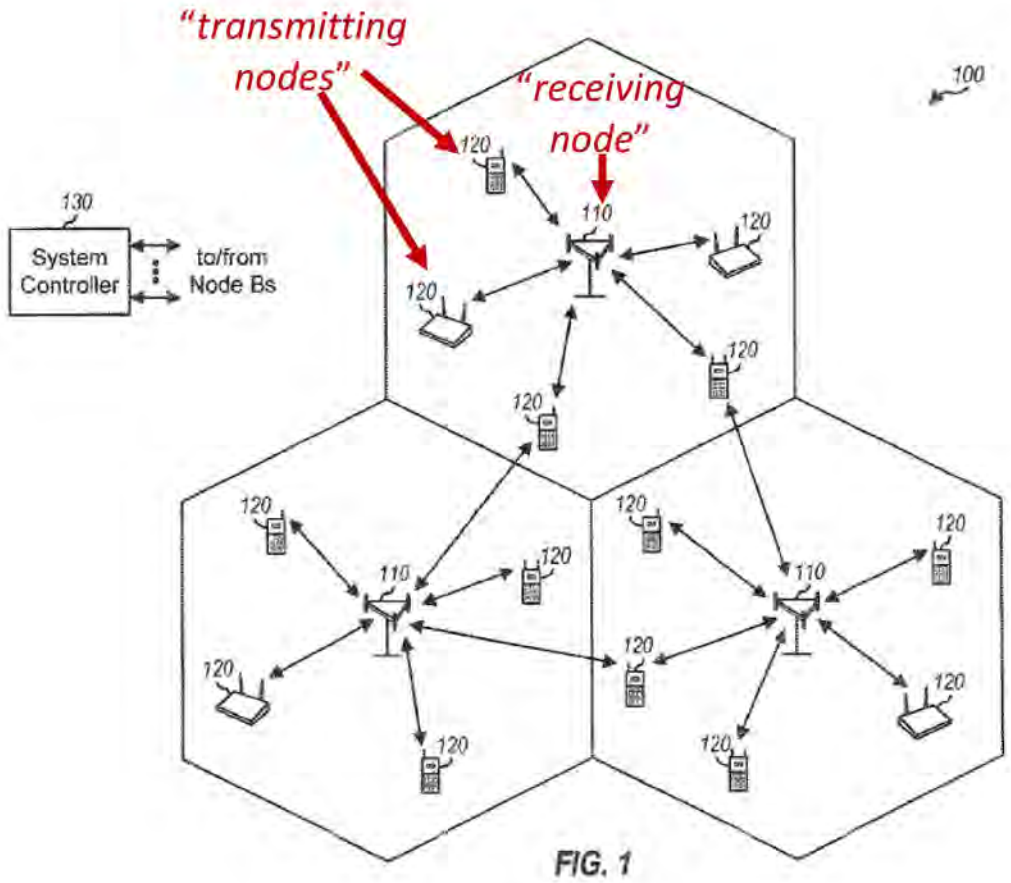
The channel estimates derived from pilot symbols in a base station are used in the detection of data symbols. For example, referring to Figure 12, Kim explains that "[c]hannel estimator 1212 may derive channel gain estimates ... based on the received pilot symbols ... detector 1220 may perform detection on the received data symbols with the channel gain estimates and provides data symbol estimates." Ex.1010, [0080]; Ex.1003, ¶57.

2. **Claim 1**

[1.0] ***A method for enabling a receiving node to distinguish information simultaneously received from a plurality of transmitting nodes on a shared communication channel of a wireless digital network, the method comprising:***

Kim's Figure 1 illustrates an exemplary "wireless communication system 100 with multiple Node Bs 110 and multiple UEs 120." Ex.1010, [0022]. A "Node

B," or base station, is an example "*receiving node*," the UEs, or mobile stations, are examples of "*a plurality of transmitting nodes*," and the network of base stations and mobile stations is an example "*wireless digital network*." Ex.1003, ¶59.



Ex.1010, Figure 1; Ex.1003, ¶59

Kim discloses data transmission from multiple UEs using the same time and frequency resources, thereby disclosing or rendering obvious the use of a "*shared communication channel*." For example, Kim explains that a base station "may support ... multi-user MIMO (MU-MIMO)," which "refers to MIMO transmission

from multiple UEs on the same time frequency block." Ex.1010, [0035], [0036] ("Multiple UEs may also send multiple data symbols on the same data subcarrier via different transmit antennas at these UEs."). "For MU-MIMO, different UEs may share the same data subcarriers ... (e.g., as shown in FIG. 3A)." *Id.*, [0038]; Ex.1003, ¶¶60-62.

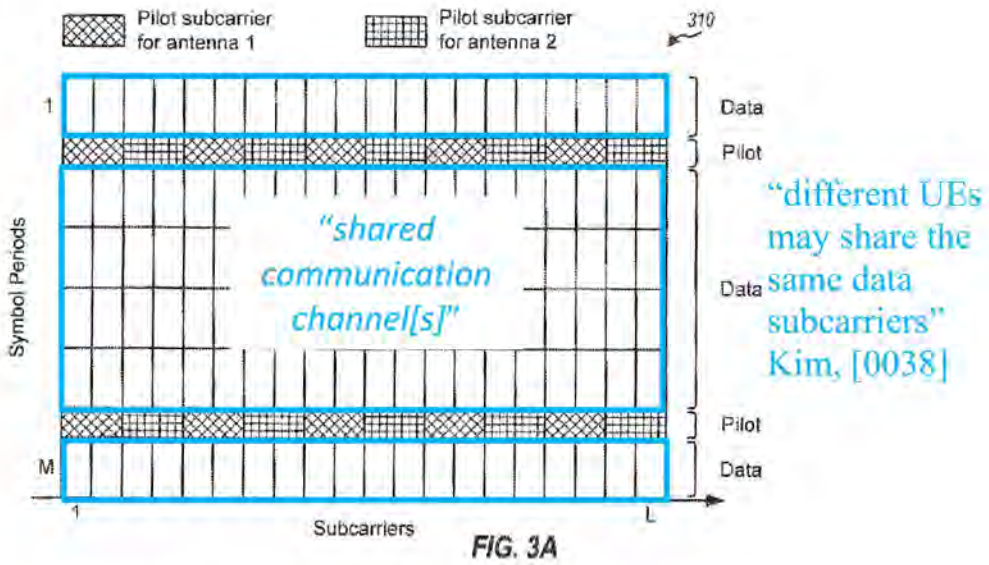


FIG. 3A

Ex.1010, Figure 3A; Ex.1003, ¶62

As discussed in more detail in the analysis of [1.1]-[1.4], Kim describes the use of pilot symbols at a base station to provide channel estimates and the use of those channel estimates to demodulate symbols transmitted from different UEs ("*a plurality of transmitting nodes*") using the same time frequency block ("*shared communication channel[s]*"), Ex.1010, [0075], [0080], thereby disclosing or rendering obvious claim element [1.0]. Ex.1003, ¶¶58-65.

[1.1] ***providing a plurality of parameter channels on the network in addition to the shared communication channel***

Kim describes the sharing of data subcarriers among UEs for data transmission ("*shared communication channel*") and the assignment of different pilot subcarriers to different UEs ("*plurality of parameter channels*") for pilot transmission. As shown in Figure 3A,

> **two UEs may share the L data subcarriers in each long symbol period** [*shared communication channel[s]*]. **Each UE may be assigned half of the pilot subcarriers in each short symbol period** [*plurality of parameter channels*].

Ex.1010, [0037]. Kim further explains that "[f]or MU-MIMO, **different UEs** may share the same data subcarriers but **may be assigned different pilot subcarriers** (e.g., as shown in FIG. 3A)." *Id.*, [0038]. The different pilot subcarriers assigned to different UEs in a time frequency block represent different "*channels*." Ex.1003, ¶67. The pilot symbols in the pilot subcarriers assigned to a UE are used to derive a channel estimate for the radio channel between a transmitting UE and the corresponding base station. Ex.1010, [0038]. Figure 3A is reproduced below, as understood by a POSITA. Thus, the different pilot subcarriers assigned to different UEs in a time frequency block, used to carry pilot symbols for estimating channels for different UEs, represent different "*parameter channels*," distinct from the "*shared communication channel*," thereby disclosing or rendering obvious claim element [1.1]. Ex.1003, ¶¶66-69.

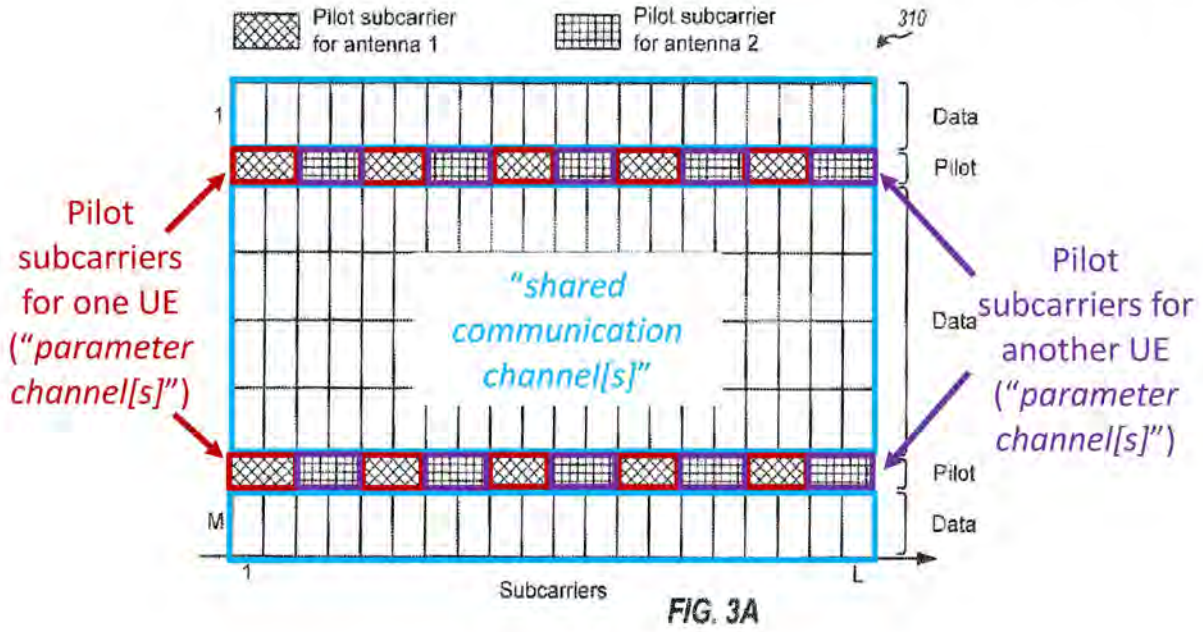


FIG. 3A

Ex.1010, Figure 3A; Ex.1003, ¶68

[1.2] ***requiring each transmitting node to transmit a parameter-estimating signal on an unshared said parameter channel***

Kim discloses that different UEs ("*each transmitting node*") are "assigned" different (non-overlapping, or "*unshared*") pilot subcarriers. Ex.1010, [0037] ("Each UE may be assigned half of the pilot subcarriers in each short symbol period."); Figure 3A. Pilot symbols are transmitted on the pilot subcarriers for estimating channel responses or "channel gains." Ex.1010, [0069], [0075], [0080]. Kim's teachings regarding assigning different UEs disjoint sets of pilot subcarriers for transmission of pilot symbols ("*a parameter-estimating signal*"), used for channel estimation, discloses or renders obvious claim element [1.2]. Ex.1003, ¶¶70-71.

[1.3] ***detecting the parameter-estimating signals on the unshared parameter channels and estimating therefrom at least one unique signal parameter for each of the transmitting nodes***

Kim discloses receiving pilot symbols ("*detecting the parameter-estimating signals*") over unshared pilot subcarriers ("*unshared parameter channels*") from different UEs ("*transmitting nodes*") and estimating channel gains/channel responses for each UE ("*estimating therefrom at least one unique signal parameter for each of the transmitting nodes*"). Ex.1010, [0075] ("Each demodulator 1054 may also perform demodulation (e.g., for SC-FDM, OFDM, etc.) on the samples to obtain received symbols. A receive (RX) spatial processor 1060 may estimate the channel responses for different UEs based on received pilot symbols."); [0080] ("Channel estimator 1212 may derive channel gain estimates for the pilot subcarriers based on the received pilot symbols."). Because the radio propagation conditions (radio channel) are different between each transmit antenna-receive antenna pair, each channel gain estimate is "*unique*." Ex.1003, ¶74. Thus, Kim discloses or renders obvious claim element [1.3]. Ex.1003, ¶¶72-75.

[1.4] ***detecting and distinguishing the information simultaneously received from each of the transmitting nodes according to their respective said unique estimated signal parameters***

Kim explains that the pilot symbols, transmitted on non-overlapping pilot subcarriers from each UE, are used to derive channel gain estimates that are used for MIMO detection (e.g., MU-MIMO) of data symbols, and the data symbols

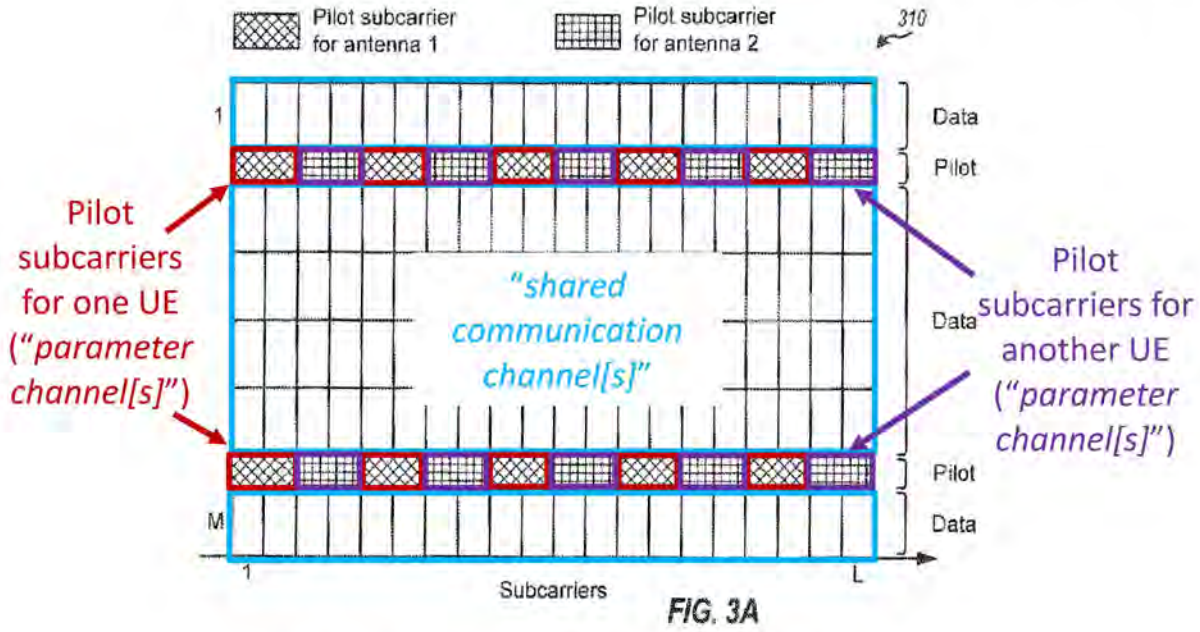
from the UEs are transmitted simultaneously in a shared channel, as explained previously. For example, referring to Figure 12, Kim explains that "**[c]hannel estimator 1212 may derive channel gain estimates for the pilot subcarriers based on the received pilot symbols,**" which **"may be as shown in FIG. 3A,"** and a MIMO detector **"may perform detection on the received data symbols with the channel gain estimates and provides data symbol estimates**." Ex.1010, [0080]. Example MIMO detectors are "minimum mean square error (MMSE)" and "zero-forcing" detectors, *id.*, which were well-known MIMO receivers for demodulating data simultaneously communicated among multiple antennas using channel estimates. Ex.1003, ¶77 (citing Jia).

Thus, Kim discloses detecting the received data symbols for MIMO (e.g., transmitted from multiple UEs over a shared channel for MU-MIMO) and providing data symbol estimates using the channel gain estimates ("*respective said unique estimated signal parameters*"). Similarly, Kim also discloses that the "channel gain estimate[s] may be … used for coherent demodulation of the data subcarriers," *i.e.*, distinguishing the simultaneously received information. Ex.1010, [0049], [0069], [0081]. Therefore, Kim discloses or renders obvious [1.4]. Ex.1003, ¶¶76-78.

3. Claim 2

The method of claim 1* [2.1] *wherein said providing a plurality of parameter channels comprises using channel-spreading technology

Kim discloses the assignment of pilot subcarriers (using frequency division multiple access/FDMA) within time slots (using time division multiple access/TDMA) to UEs. For example, "FIG. 3A shows a design of a data and pilot structure 310" in which "a time frequency block covers a set of L subcarriers in a slot of M symbol periods." Ex.1010, [0031]. The assignment of different time-frequency resources to different UEs for use as pilot subcarriers discloses or renders obvious claim element [2.1]. Moreover, Kim's assignment of pilot symbols to time-frequency blocks is a combination of TDMA and FDMA, examples of "*channel-spreading technology*." Ex.1003, ¶81.



Ex.1010, Figure 3A; Ex.1003, ¶82

The '071 Patent confirms that the use of different time slots (TDMA) or different frequencies (FDMA) for "*parameter channels*" are examples of "*channel-spreading technology*." Ex.1001, 4:52-56, claim 3; Ex.1003, ¶83.

4. **Claim 3**

The method of claim 2* [3.1] *wherein said channel spreading technology comprises at least one of FDMA, TDMA, CDMA, and SDMA

Per the analysis of [2.1], Kim describes the use of TDMA and FDMA, which discloses or renders obvious [3.1]. Ex.1003, ¶86.

5. **Claim 5**

The method of claim 1* [5.1] *wherein the parameter-estimating signal is a parameter-estimating symbol pattern

Kim discloses that its pilot symbols ("*parameter-estimating signal[s]*") are "known a priori by both the UEs and Node B," thereby rendering obvious claim element [5.1]. Ex.1010, [0074] ("[A] pilot symbol is a symbol for pilot... Pilot is data that is known a priori by both the UEs and Node B."). Ex.1003, ¶88. Moreover, in the same way that "FIGS. 5A to 5C show three example ... pilot patterns," Kim, [0048], Figure 3A illustrates a pilot pattern, which is an example "*parameter-estimating symbol pattern*." Ex.1003, ¶¶88-89.

6. **Claim 6**

The method of claim 1* [6.1] *wherein the at least one unique signal parameter comprises signal amplitude

As discussed previously, Kim discloses that its channel estimator "derive[s] channel gain estimates for the pilot subcarriers based on the received pilot symbols." Ex.1010, [0080]. It would have been obvious or understood by a POSITA that a channel gain includes a "*signal amplitude*," thereby rendering obvious [6.1].

A symbol was known to be represented by a "complex value." Ex.1010, [0074]. Data and pilot symbols may be symbols from "a modulation scheme such as ... QAM." *Id.* And QAM symbols were known as representing binary

information using amplitude and phase of the complex value. Ex.1003, ¶¶40-42, 93.

Similarly, the channel gains in Kim are repeatedly referred to as a "complex channel gains." Ex.1010, Abstract, [0010], [0052]. These complex values have an associated amplitude and phase. Ex.1003, ¶43-44, 94. Furthermore, Kim uses "coherent demodulation" of data symbols. Ex.1010, [0049], [0069]. Coherent demodulation or detection is a term of art in which the amplitude and phase of the received signal is estimated and used for detection. Ex.1003, ¶94-95 (discussing Exs.1012 and 1014).

Thus, Kim (in view of the background of a POSITA) renders obvious [6.1]. Ex.1003, ¶¶91-96.

7. Claim 7

The method of claim 1* [7.1] *wherein the at least one unique signal parameter includes a signal phase

As explained in the analysis of claim element [6.1], Kim discloses estimation of "complex channel gains" in an OFDM system and the use of those gains in its coherent detection/demodulation. It would have been obvious to a POSITA, based on basic knowledge of OFDM and multi-carrier systems, as confirmed by basic textbooks and other references, that estimation of a complex channel gain for Kim's coherent detection includes estimation of a channel phase

value, thereby rendering obvious [7.1]. Ex.1003, ¶¶98-102 (discussing Exs. 1012 and 1014).

8. Claim 13

The method of claim 1,* [13.1] *wherein the parameter channels are randomly shifted over time between a plurality of wireless frequencies.

Kim discloses the transmission of a request for uplink resources on a request channel (REQCH). Ex.1010, [0040]. Figure 5C illustrates the transmission of a request on a REQCH "from multiple antennas simultaneously." *Id.*, [0047]. The pattern of pilot and data subcarriers "is based on ... FIG. 3B." *Id.* However, the pattern of subcarriers is not limited to Figure 3B, as "[t]he REQCH may also be transmitted in other manners, based on other data and pilot patterns." *Id.*, [0048]. Thus, it would have been obvious to a POSITA that the pattern of subcarriers may also be based on Figure 3A. Ex.1003, ¶104. Furthermore, although Figure 5C illustrates transmission from a UE with multiple antennas, it would have been obvious that data, such as requests, may be simultaneously transmitted from different UEs, each with a single antenna in a MU-MIMO configuration, as discussed previously. *Id.* Figure 5C is modified to use the pilots of Figure 3A below.

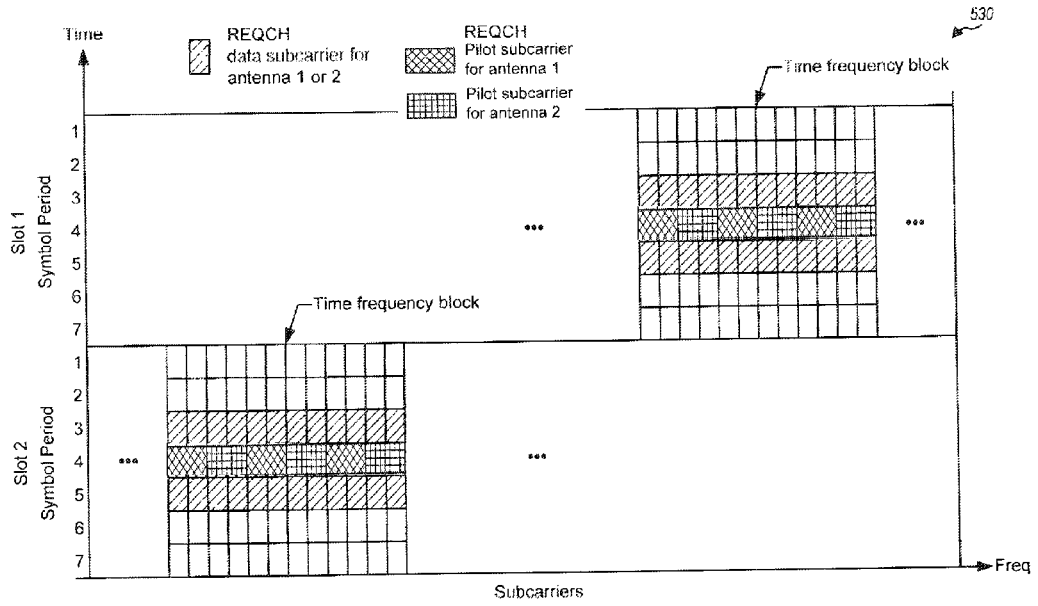


FIG. 5C

Ex.1010, Figure 5C (modified using pilot pattern of Figure 3A); Ex.1003, ¶105

As illustrated in modified Figure 5C above, it would have been obvious for the pilot subcarriers (and associated data subcarriers, which would be shared by multiple UEs in a MU-MIMO scenario, such as illustrated in Figure 3A) to hop to different frequencies over time. And the subcarriers could "hop across frequency in any manner." Ex.1010, [0047]; Ex.1003, ¶105.

Kim's teachings regarding hopping among different frequencies, as understood and applied in context of the MU-MIMO transmissions illustrated in Figure 3A, renders obvious that "*the parameter channels are [] shifted over time between a plurality of wireless frequencies*." Since the transmissions may "hop across frequency in any manner," according to Kim, it would have been obvious that the hopping is performed to appear random. For example, pseudo-random

frequency hopping, which is "*random*" in the sense of the claim, was well-known in the art and also provided the benefit of effective distribution of transmissions across the available frequency band. Ex.1003, ¶¶106-107 (discussing Exs.1006 and 1008). Thus, Kim (in view of the background of a POSITA) renders obvious [13.1]. *Id.*, ¶¶104-108.

9. Claim 14

The method of claim 13* [14.1] *wherein the parameter channels are shifted according to a random hopping pattern

Kim renders obvious claim element [14.1] for the same reasons as presented in the analysis of [13.1]. Kim renders obvious mobile stations transmitting pilot symbols using frequency hopping, with a well-known example, according to the background of a POSITA, being a pseudo-random hopping pattern (e.g., per Dubuc), thereby rendering obvious [14.1]. Ex.1003, ¶110.

10. Claim 16

The method of claim 1* [16.1] *wherein the parameter channels are low in communication rate compared to the shared communication channel

As explained in [1.1] and [2.1], Figure 3A illustrates "*parameter channels*" and at least one "*shared communication channel*" as follows:

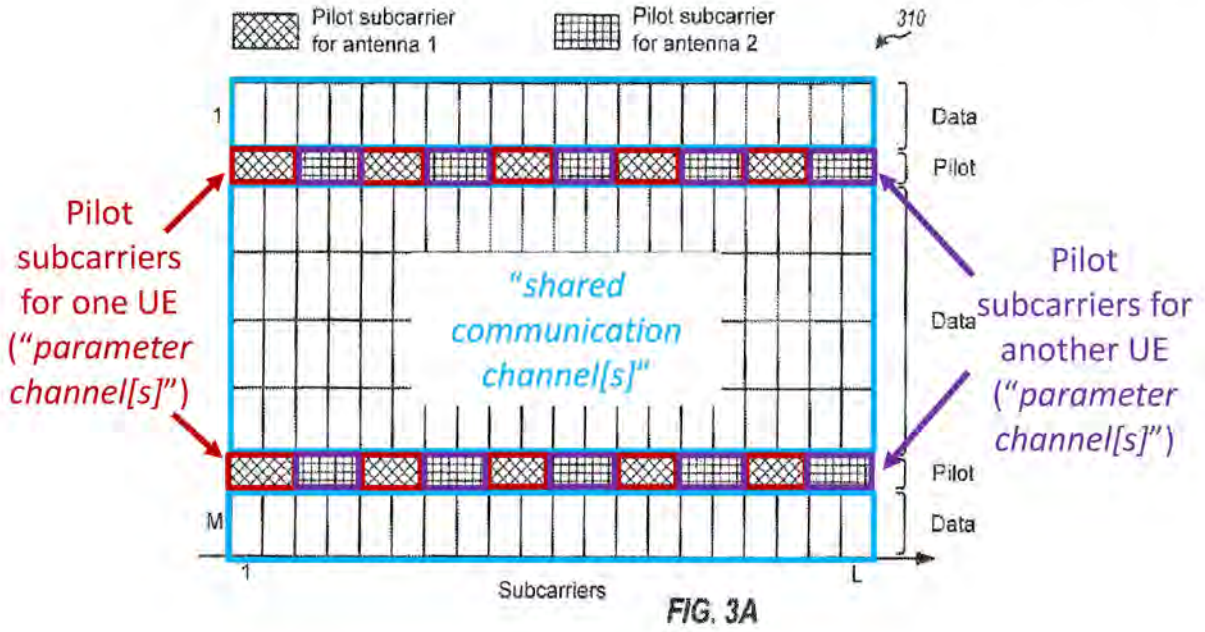


FIG. 3A

Ex.1010, Figure 3A; Ex.1003, ¶112

In Figure 3A, the symbol periods carrying pilots are half the duration and with half the number of subcarriers as the symbol periods carrying data. Ex.1010, [0031]. Accounting for the symbol period, the communication rate of a "*parameter channel*" is at most one half of the "*shared channel*" for a given UE, thereby rendering obvious [16.1]. And since a "*shared channel*" is shared by two UEs, the cumulative communication rate in the "*shared channel*" is double that of one UE. Ex.1003, ¶113.

Furthermore, given the general teachings of Kim with respect to the symbol durations and the number of UEs that may share a time frequency block, Ex.1010, [0031], [0038], it would have been obvious that other scenarios result in even

greater disparities in communication rate, further rendering obvious [16.1]. Ex.1003, ¶114.

11. Claim 21

[21.0] ***A method for enabling a receiving node to distinguish information concurrently received from a plurality of transmitting nodes on a shared communication channel of a wireless digital network, the method comprising***

Claim element [21.0] is substantially the same as claim element [1.0]. Thus, Kim renders obvious [21.0] for the same reasons as [1.0]. Ex.1003, ¶115.

[21.1] ***receiving a plurality of parameter-estimating signals each on an unshared parameter channel from a corresponding transmitting node***

[21.2] ***estimating at least one unique signal parameter for each of the received plurality of parameter-estimating signals***

Claim elements [21.1] and [21.2] have significant overlap with claim elements [1.1]-[1.3], so claim elements [1.1]-[1.3] are referenced below. Ex.1003, ¶116.

As explained in the analysis of claim element [1.1], each of the different sets of pilot subcarriers assigned to different UEs is an example of a "*parameter channel*." As explained in the analysis of claim element [1.2], the pilot subcarriers assigned to different UEs are also "*unshared*."

As explained in the analysis of claim element [1.3], using known pilot symbols from different UEs, transmitted over unshared time-frequency resources, ("*unshared parameter channels*") to estimate complex channel gains ("*at least one unique signal parameter*"), renders obvious estimating "*at least one unique signal*

parameter for each of the transmitting nodes," as claimed.

For at least these reasons, Kim discloses or renders obvious claim elements [21.1] and [21.2]. Ex.1003, ¶¶117-119.

[21.3] ***distinguishing information concurrently received from the transmitting nodes according to their corresponding estimated unique signal parameter.***

Claim element [21.3] is broader than claim element [1.4]. Thus, Kim renders obvious claim element [21.3] for at least the same reasons as presented in the analysis of [1.4]. Ex.1003, ¶¶120-121.

B. Ground 2A: Claims 1-5, 10, 16, and 21 are unpatentable as obvious over Tong combined with Jia.

1. Summary of Tong

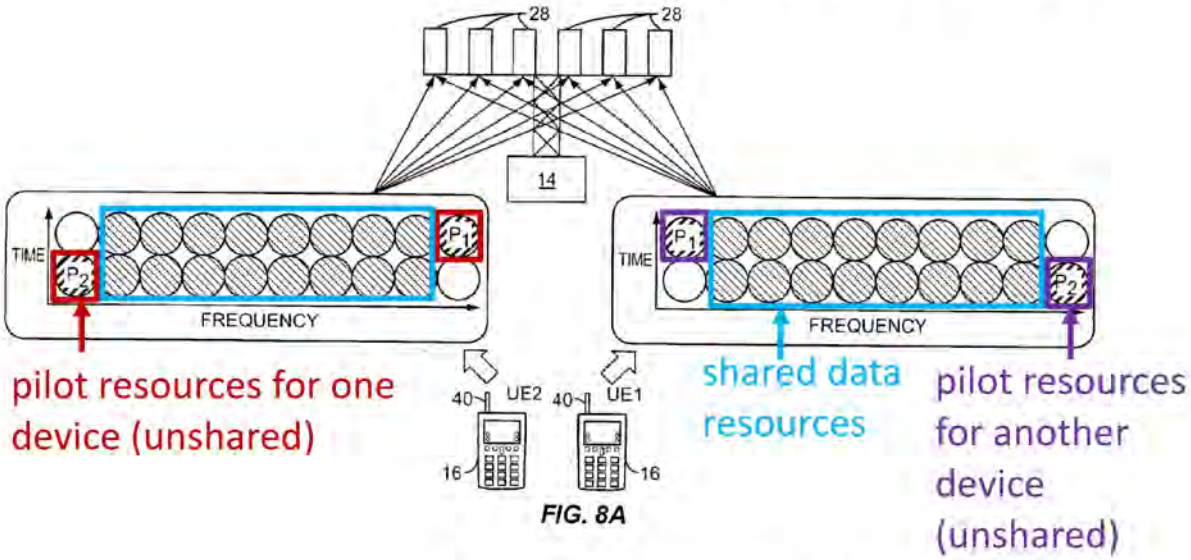
Tong describes an OFDM wireless communication system having base stations and mobile terminals, Ex.1011, [0023], [0030], Figure 1. Tong describes the creation of a "virtual MIMO" system

> by assigning mobile terminals to a group and assigning certain shared resources and user-specific resources to those mobile terminals in the group. In a synchronized fashion, the mobile terminals will provide uplink transmission in concert, as if they were a single entity having multiple transmission paths and antennas. Preferably, the shared resources bear on how the data is transmitted, and the user-specific resources relate to pilot signals.

Ex.1011, [0004].

Tong describes the assigning of "shared resources" to "cooperating mobile terminals" for the transmission of data. Ex.1011, [0043]. Tong also describes the assignment of "user-specific resources" to the mobile terminals in an OFDM system for the transmission of pilot signals. Ex.1011, [0044]. In other words, multiple mobile terminals cooperate and operate in a synchronized fashion to transmit data at the same time on "shared resources" and pilot signals on "user-specific resources." Ex.1003, ¶¶126-128.

Figures 8A (reproduced below), 9A, and 10A illustrate cooperative uplink transmissions from multiple UEs in which the UEs transmit data symbols on the same subcarriers and pilot symbols (P_1, P_2) on user-specific subcarriers, unique to a UE. Ex.1011, [0032], [0046]; Ex.1003, ¶129. The pilot information provided by UE1 and UE2 "do not interfere with one another" as shown, whereas the data symbols share the same subcarriers. Ex.1011, [0046]. Tong illustrates unshared resources for transmitting pilots and shared resources for transmitting data, as shown below in a two-dimensional grid of time and frequency. Ex.1003, ¶¶130-131.



Ex.1011, Figure 8A; Ex.1003, ¶131

The pilot information is used for channel estimation so that the data transmitted simultaneously on the same subcarriers from two different UEs can be detected by the base station. Ex.1011, [0046]; Ex.1003, ¶131.

2. **Summary of Jia and Reasons to Combine with Tong**

Jia is explicitly incorporated by reference into Tong. Ex.1011, [0041]. Jia is discussed in combination with Tong only with respect to claim element [1.4] because Tong alone is relied upon for all other claim elements in this ground. As shown in the analysis of claim element [1.4], not only does Tong alone render obvious claim element [1.4], but Tong combined with Jia also renders obvious claim element [1.4]. Thus, Jia is presented in the analysis of claim element [1.4], along with reasons to combine Tong and Jia. Ex.1003, ¶133.

3. Claim 1

[1.0] ***A method for enabling a receiving node to distinguish information simultaneously received from a plurality of transmitting nodes on a shared communication channel of a wireless digital network, the method comprising:***

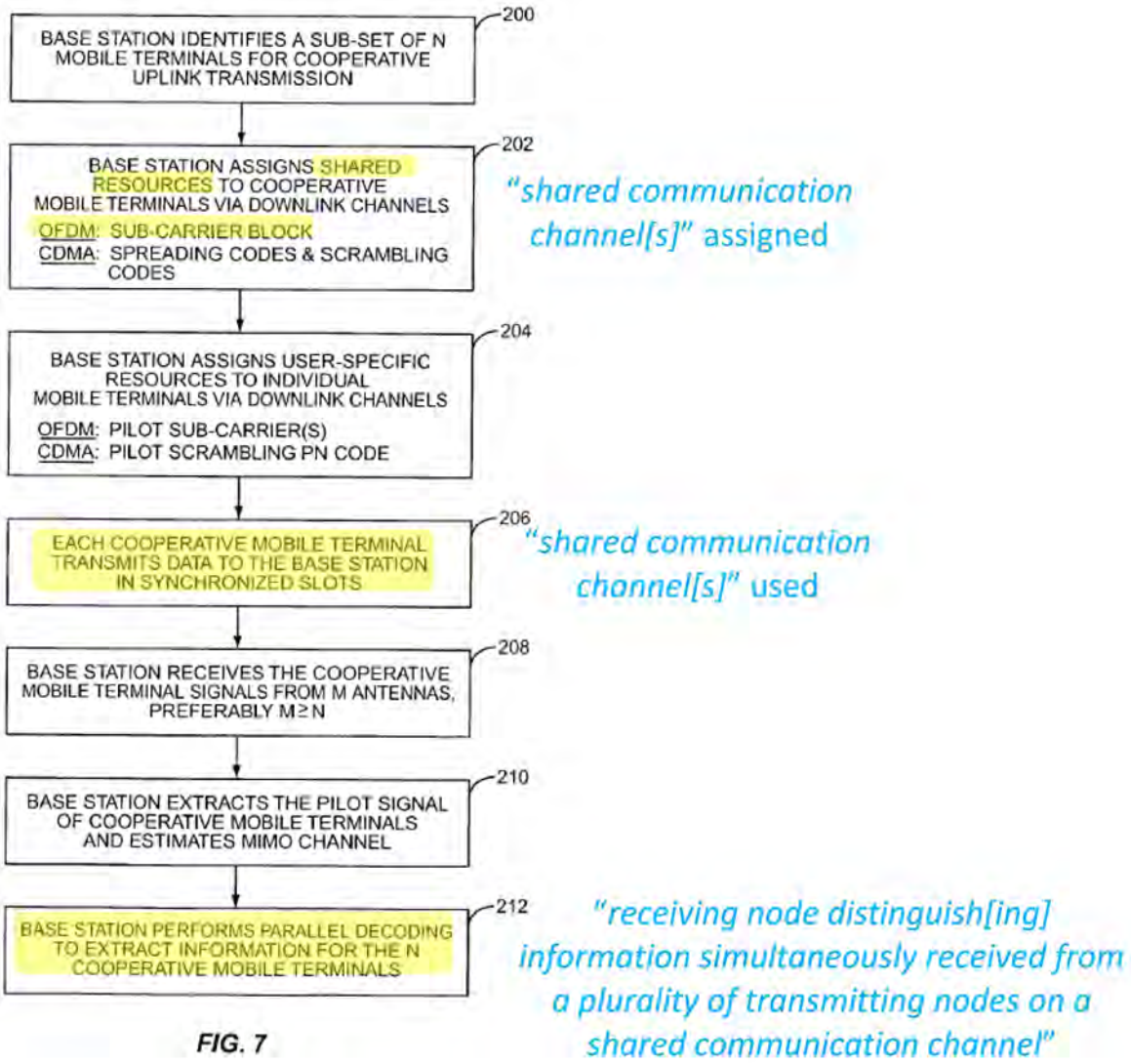
Tong describes the use of "shared resources" ("*shared communication channel*") among mobile terminals ("*plurality of transmitting nodes*") for the simultaneous transmission of data to a base station ("*receiving node*") in a wireless network. For example, Tong explains that mobile terminals act "[i]n a synchronized fashion ... [to] provide uplink transmission in concert" using "shared resources" such that transmissions are simultaneously received at a base station. Ex.1011, Abstract; Ex.1003, ¶¶135-136.

Referring to Figure 7, Tong describes a method for enabling a base station to distinguish information simultaneously received from a plurality of mobile terminals over a "common sub-carrier block" in OFDM ("*shared communication channel*").

> [T]he base station 14 will **assign shared resources to each of the cooperating mobile terminals 16** via downlink channels (block 202). For an OFDM embodiment, **the shared resources will include a common sub-carrier block**. … **Each of the cooperating mobile terminals 16 will transmit information using the common sub-carrier block at the same time**.
>
> …

Finally, the base station 14 will decode the received signals to extract the data or information transmitted by each of the cooperating mobile terminals 16 (block 212).

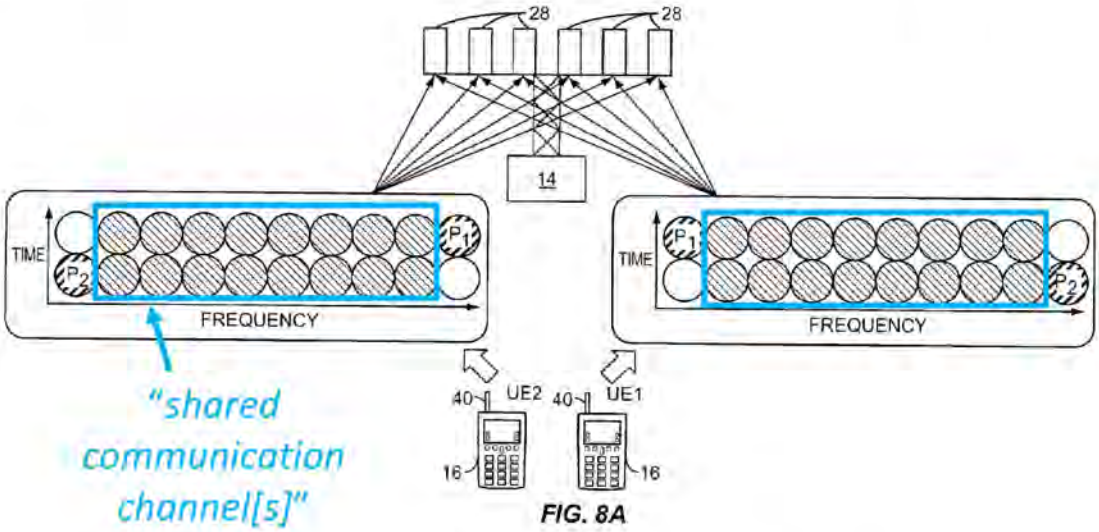
Ex.1011, [0043]-[0045]. Figure 7 is annotated and highlighted and presented below. Ex.1003, ¶137.



Ex.1011, Figure 7; Ex.1003, ¶137

Figure 8A (reproduced below), 9A, and 10A illustrate example assignments

of data subcarriers and transmission of data symbols in an OFDM system.

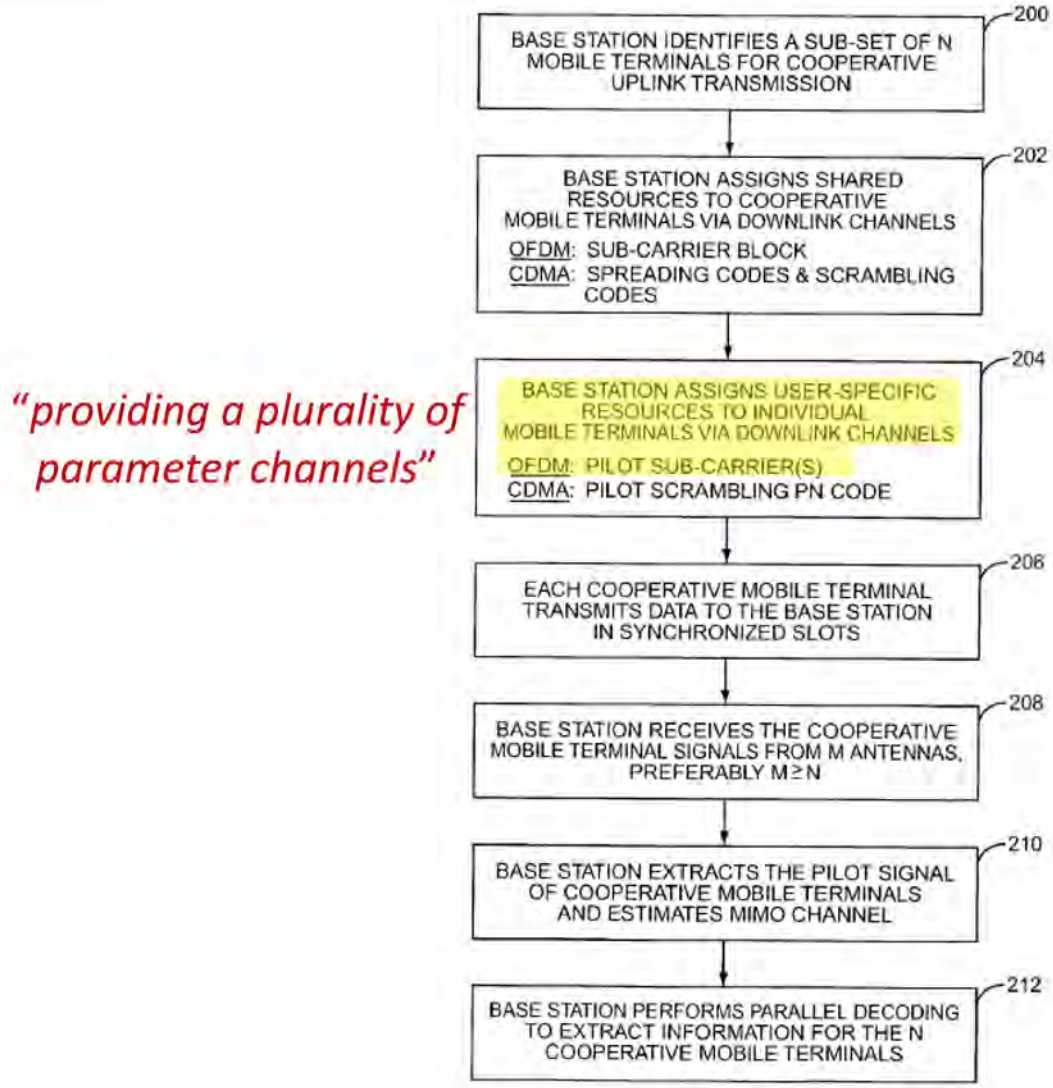


Ex.1011, Figure 8A; Ex.1003, ¶138

Thus, Tong discloses or renders obvious [1.0]. Ex.1003, ¶¶134-139.

[1.1] ***providing a plurality of parameter channels on the network in addition to the shared communication channel***

Tong describes the use of "user-specific resources" for the transmission of "pilot" signals. Ex.1011, Abstract. In an example OFDM system, the "user-specific resources are the pilot sub-carriers." *Id.*, [0044]. The user-specific pilot subcarriers are used to transmit pilot signals to "estimate the channel conditions for the MIMO channel," *Id.*, [0045], thereby disclosing or rendering obvious "*a plurality of parameter channels*." Ex.1003, ¶141.



"providing a plurality of parameter channels"

FIG. 7

Ex.1011, Figure 7; Ex.1003, ¶141

In addition to the "*shared communication channel*," Figures 8A, 9A, and 10A of Tong illustrate user-specific pilot subcarriers as example "*parameter channels.*" Ex.1003, ¶141.

Thus, Tong discloses or renders obvious [1.1].

[1.2] ***requiring each transmitting node to transmit a parameter-estimating signal on an unshared said parameter channel***

After the "user-specific resources," such as pilot subcarriers, are assigned to mobile terminals:

> each mobile terminal 16 in the cooperating group will transmit data to the base station 14 in synchronized time slots using the shared resources and user-specific pilots (block 206). The base station 14 will receive the transmitted signals from the mobile terminals 16 at each of its M antennas 40 (block 208) and extract the pilot signals for each of the mobile terminals 16 to ... estimate the channel conditions for the MIMO channel (block 210).

Ex.1011, [0045]. Thus, pilot signals are used to "estimate the channel conditions," thereby disclosing or rendering obvious "*a parameter-estimating signal*," which is transmitted over "user-specific" pilot subcarriers ("*unshared said parameter channel*"). Ex.1003, ¶143.

Figures 8A, 9A, and 10A illustrate example transmission of pilot symbols on user-specific pilot subcarriers. The pilot symbols transmitted by mobile terminals "do not interfere" with one another, Ex.1011, [0046], further reflecting the unshared nature of pilot subcarriers. A "virtual MIMO" channel is created with two transmit antennas (from two UEs) and six receive antennas 28 at base station 14. For example, pilot symbol P_1 is transmitted from UE1 using one subcarrier in a time interval and from UE2 using a different subcarrier in the same time interval as shown, such that each pilot subcarrier is unshared by the UEs. Ex.1003, ¶144.

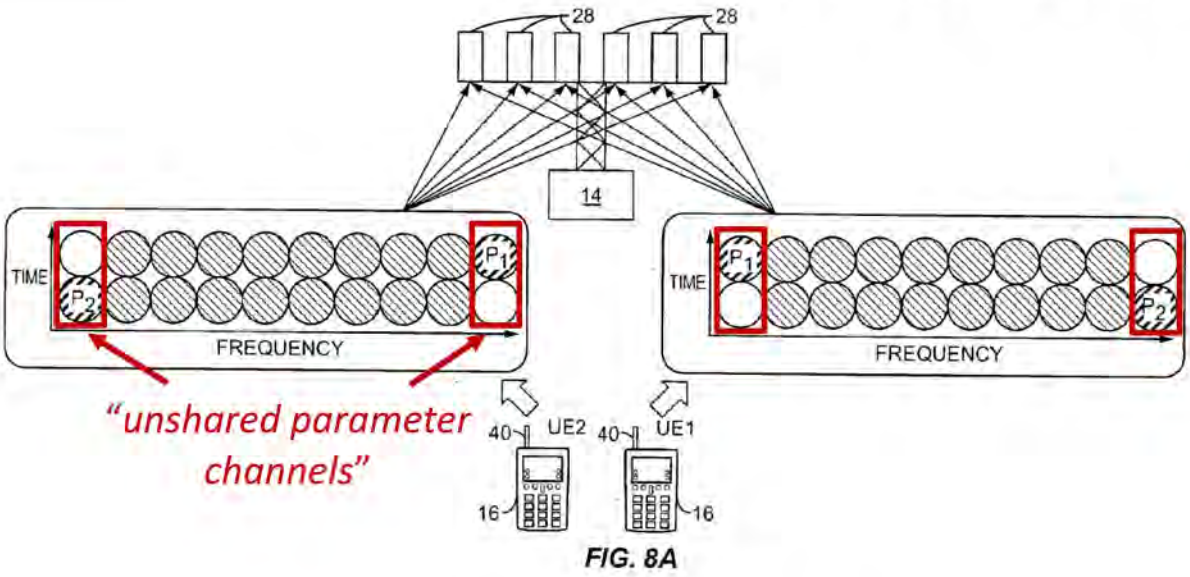


FIG. 8A

Ex.1011, Figure 8A; Ex.1003, ¶144

Figure 8A is further annotated to highlight the different time and frequency resources (channels) assigned to different UEs for pilot signals.

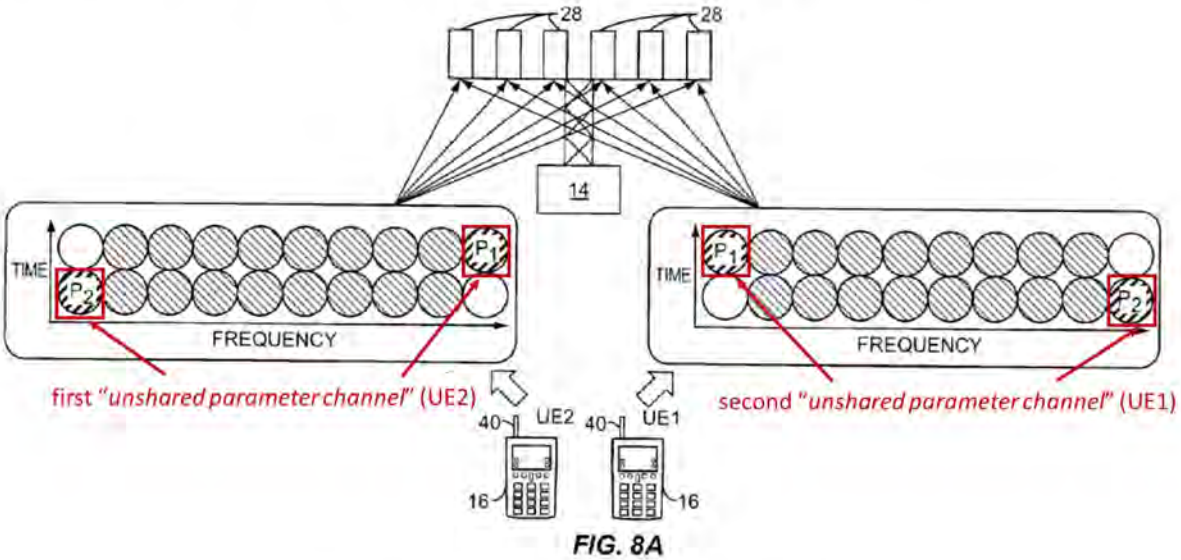


FIG. 8A

Ex.1011, Figure 8A; Ex.1003, ¶145

Thus, Tong discloses or renders obvious claim element [1.2]. Ex.1003,

¶¶142-145.

[1.3] ***detecting the parameter-estimating signals on the unshared parameter channels and estimating therefrom at least one unique signal parameter for each of the transmitting nodes***

As explained previously (e.g., with reference to Figures 8A, 9A, and 10A), Tong discloses a base station extracting pilot signals transmitted from each mobile terminal over user-specific pilot subcarriers, such that the pilot signals do not interfere with each other ("*detecting the parameter-estimating signals on the unshared parameter channels*").

The pilot signals are used for estimating channels associated with each mobile terminal – for example, "the base station 14 will receive the transmitted signals from the mobile terminals 16 at each of its M antennas 40 (block 208) and extract the pilot signals for each of the mobile terminals 16 to ... estimate the channel conditions for the MIMO channel (block 210)." Ex.1011, [0045] (referencing Figure 7); [0046]. The "MIMO channel" refers to the channels that exist between each mobile terminal's antenna and each receiver antenna at a base station. For example, Figure 8A illustrates a "MIMO channel" as having six paths from each UE antenna to six corresponding base station antennas 28, yielding six channel coefficients per OFDM subcarrier. Ex.1003, ¶148.

The effects of the radio channel on transmitted signals were known to be represented by complex numbers, and these are the numbers (each an example

"*unique signal parameter*") that are estimated when Tong references estimating the channel conditions. Ex.1003, ¶¶148, 150-151. Because the radio propagation conditions (radio channel) are different between each transmit antenna-receive antenna pair, each channel estimate is "*unique*." *Id.*, ¶148. Using pilot signals to form a channel estimate for channels from each mobile terminal to a base station is an example of "*estimating therefrom at least one unique signal parameter for each of the transmitting nodes*." Ex.1003, ¶148.

Thus, Tong's disclosure of a base station receiving pilot signals transmitted from each mobile terminal over user-specific pilot subcarriers, such that the pilot signals do not interfere with each other, and using the pilot signals to form a channel estimate for channels from each mobile terminal to a base station discloses or renders obvious [1.3]. Ex.1003, ¶¶146-151.

[1.4] ***detecting and distinguishing the information simultaneously received from each of the transmitting nodes according to their respective said unique estimated signal parameters.***

Tong alone renders obvious claim element [1.4].

In Tong, the channel estimates derived from pilot symbols are used to detect and distinguish information received simultaneously over shared resources from multiple mobile terminals, thereby rendering obvious [1.4]. For example, with respect to base station 14 in Figure 5 (reproduced below), Tong explains that **"[t]he channel estimates provide sufficient channel response information to**

allow the diversity decoder 88 to decode the symbols according to the transmission and/or encoding used by the mobile terminal 16." Ex.1011, [0037]. The description above is presented for an embodiment of communication with a mobile terminal 16 with multiple antennas, but the description was understood to apply to a "virtual MIMO environment" involving simultaneous transmissions from multiple mobile terminals that have only a single antenna. Ex.1011, [0042]; Ex.1003, ¶153. Transmissions to Tong's base station 14 may be made using the OFDM subcarrier allocation of Figures 8A, 9A, or 10A as examples. Ex.1003, ¶154.

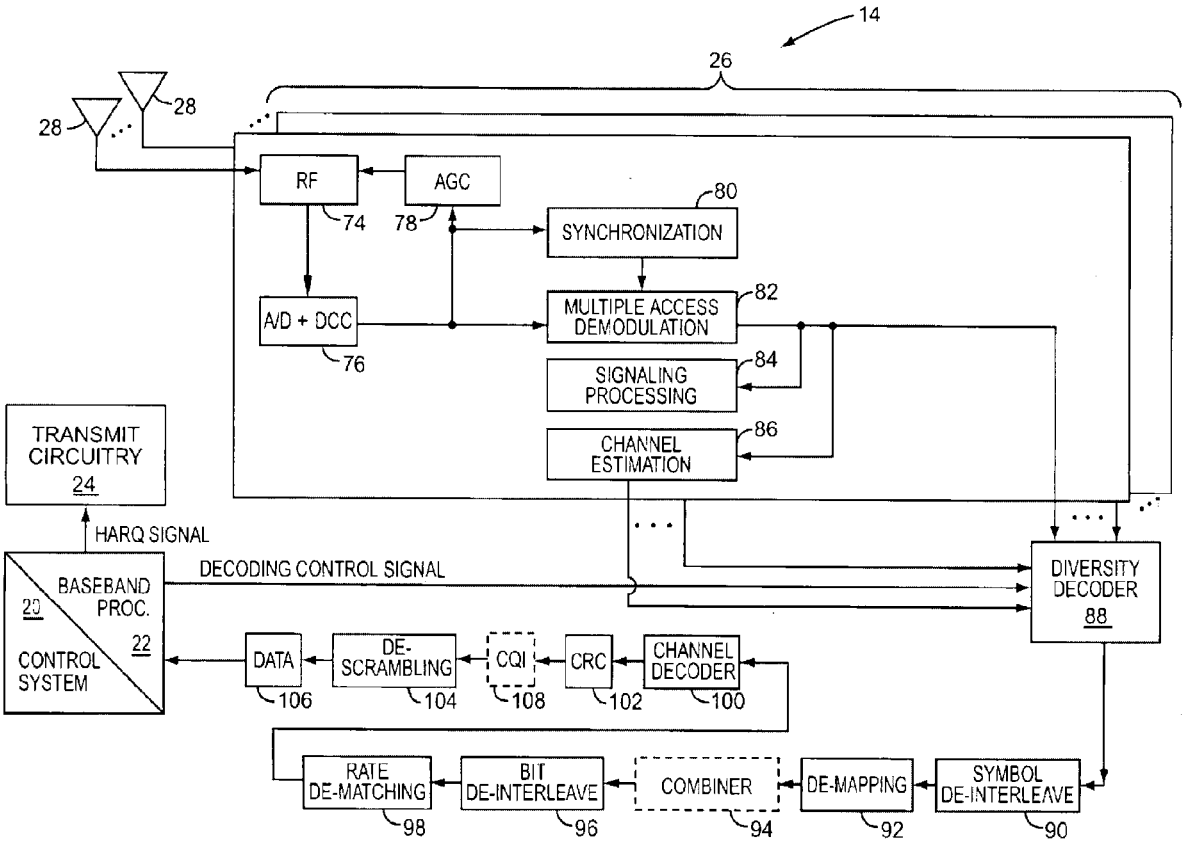


FIG. 5

Ex.1011, Figure 5

In describing Figure 7 (reproduced below), Tong explains that the channel estimates are used by the base station 14 (e.g., diversity decoder 88) to detect and distinguish information received simultaneously over shared resources from multiple mobile terminals 16 according to their corresponding channel estimates, Ex.1011, [0045], thereby rendering obvious [1.4]. Ex.1003, ¶154.

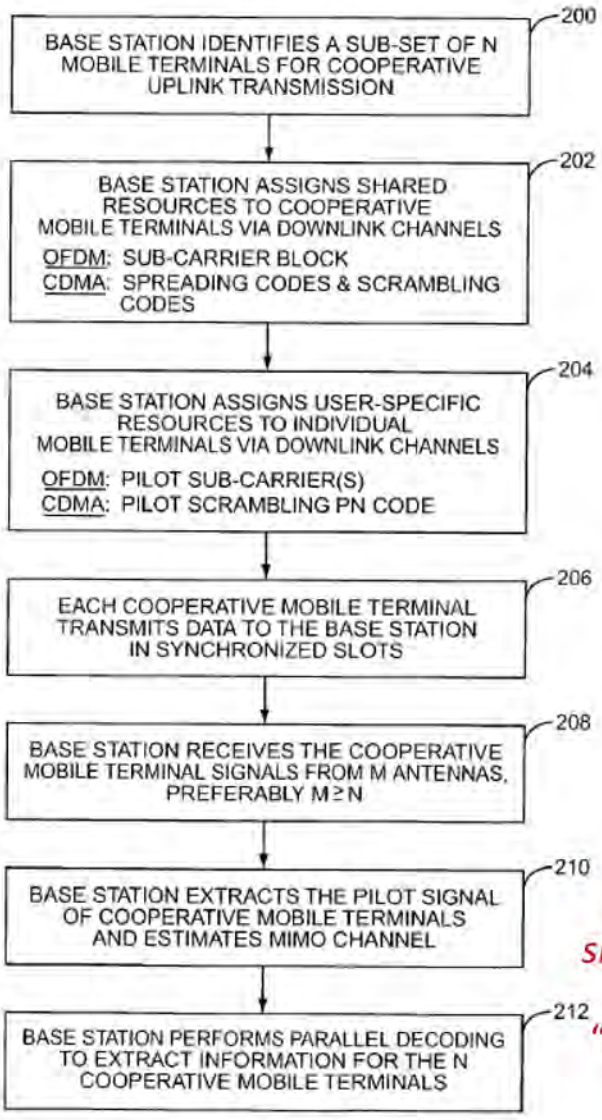


FIG. 7

Ex.1011, Figure 7; Ex.1003, ¶154

Tong combined with Jia also renders obvious [1.4].

Tong describes the use of a "BLAST [Bell Laboratories Layered Space Time] or parallel like transmission technique," Ex.1011, [0040], "wherein each antenna 40 transmits different data," Ex.1011, [0041]. The technique of each

antenna (in this case from each UE) transmitting different data is presented in Figures 8A, 9A, and 10A of Tong, for example, in which at least two different UEs transmit different data at the same time and frequency. Tong incorporates by reference Ser. No. 10/263,268 (published as Jia) for "[f]urther information regarding ... BLAST techniques." Ex.1011, [0041]. Thus, Tong provides explicit motivation for a POSITA seeking more information about "BLAST techniques," or parallel transmission of data from different antennas, to consult Jia (a reference that shares many of the same inventors as Tong). Ex.1003, ¶155. Additionally, as a threshold matter for combining with Tong, Jia is analogous art to the '071 Patent, as Jia is directed to the field of wireless communication networks. *See*, *e.g.*, Ex.1001, 1:22-24; Ex.1020, [0001], Figure 1.

Jia refers to various exemplary techniques for decoding of parallel data transmission from different antennas, such as maximum likelihood decoding (MLD), zero-forcing (ZF), or minimum mean square error (MMSE). Ex.1020, [0006] [0017]. The received signal y can be represented as

$$y=H_{N\times M}x+n. \qquad \text{Equation 4,}$$

where H represents a matrix of complex channel values to be estimated between M transmit antennas and N receive antennas, x is a vector of transmitted symbols, and n is noise. Ex.1020, [0007]-[0010]; Ex.1003, ¶156.

Jia also provides further detail regarding how MIMO channel estimates were understood as being used in a zero-forcing receiver, Ex.1020, [0007] [0013], consistent with the higher-level discussion of a receiver in Tong. The transmitted symbols are estimated as $\hat{x}$ based on the received signal y and channel estimate matrix H as follows:

$$\hat{x} = (H'H)^{-1}H'y, \qquad \text{Equation 5}$$
$$= x + \varepsilon$$

Likewise, in MLD-type detection, symbols are determined based on the received signal and channel estimate *H*. Ex.1020, [0014] [0015]; Ex.1003, ¶¶157-158.

It would have been obvious to implement the generic "parallel decoding" in Figure 7 of Tong or the "diversity decoder" 88 of Figure 5 of Tong, as examples, using the specific receiver techniques described in Jia. Doing so represents combining prior art elements according to known methods to yield the predictable result of implementing zero-forcing, MMSE, or MLD decoding techniques in Tong's receiver. Tong does not describe specific decoding methods, instead pointing to Jia for those details for implementation by a POSITA, motivating a POSITA to review Jia. Ex.1003, ¶159.

A POSITA would have had a reasonable expectation of success in implementing Jia's techniques in Tong. For example, Jia's techniques require channel estimates, and channel estimation is described as a step in Tong's

methods, just prior to decoding (see, e.g., Figure 7). The structure of Tong's receiver and its methods are unaltered and remain intact. Ex.1003, ¶160.

Thus, Tong's pilot symbols are used to generate channel estimates, and the channel estimates are fed to a decoder, for example, to detect and distinguish the data in the received signals from different UEs that are transmitted over the same subcarriers, and the decoder may, as examples and according to Jia, be a zero-forcing-type decoder or a MLD-type decoder, both of which use channel estimates in their computations, thereby disclosing or rendering obvious [1.4]. Ex.1003, ¶161.

4. Claim 2

The method of claim 1* [2.1] *wherein said providing a plurality of parameter channels comprises using channel-spreading technology.

As explained in the analysis of [1.2] and [1.3], Tong discloses the use of user-specific pilot subcarriers in an OFDM system. Figure 8A, 9A, and 10A illustrate example assignments of user-specific pilot subcarriers and transmission of pilot symbols in an OFDM system. Tong's assignment of pilot subcarriers to time-frequency blocks is a combination of TDMA and FDMA, which are each examples of "*channel-spreading technology*." Figure 8A, reproduced below, illustrates the different time and frequency resources (channels) assigned to different UEs for pilot signals. Ex.1003, ¶¶164-165.

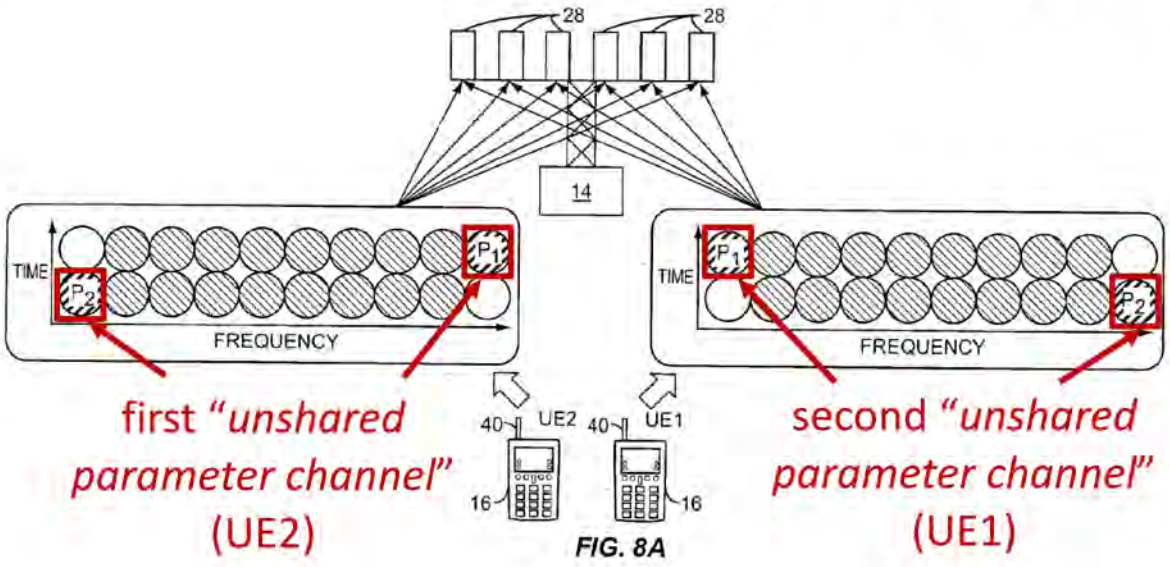


FIG. 8A

Ex.1011, Figure 8A; Ex.1003, ¶165

The assignment of different time frequency resources to different UEs for the transmission of pilot signals (TDMA and/or FDMA) discloses or renders obvious [2.1]. Ex.1003, ¶¶166-168.

5. **Claim 3**

The method of claim 2* [3.1] *wherein said channel spreading technology comprises at least one of FDMA, TDMA, CDMA, and SDMA

As discussed in the analysis of [2.1], Tong describes the use of TDMA and FDMA for pilot subcarriers, which discloses or renders obvious [3.1]. Ex.1003, ¶170.

6. Claim 4

The method of claim 1 [4.1] wherein requiring each transmitting node to transmit a parameter-estimating signal includes requiring each transmitting node to transmit the parameter-estimating signal while simultaneously transmitting information on the shared communication channel

In each of Figures 8A (reproduced below), 9A, and 10A, Tong discloses different mobile terminals ("*each transmitting node*") transmitting pilot signals, designated as P_1, P_2, P_3, P_4, ("*parameter estimating signal[s]*") on certain frequencies/subcarriers while simultaneously transmitting data on the remaining subcarriers in a given time slot ("*while simultaneously transmitting information on the shared communication channel[s]*"), thereby rendering obvious [4.1]. Ex.1003, ¶¶173-175.

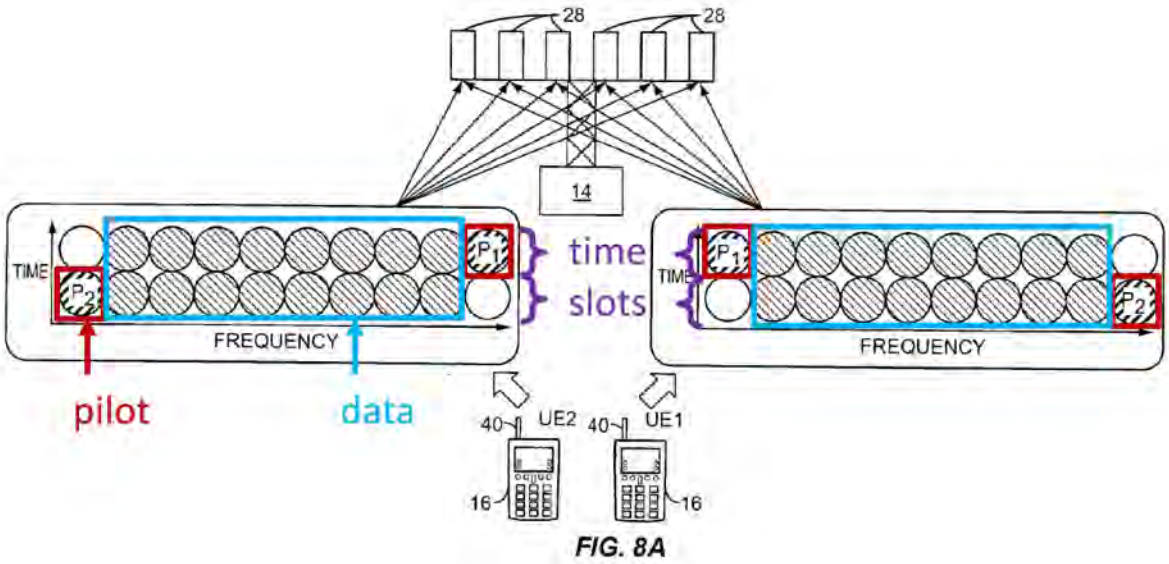


FIG. 8A

Ex.1011, Figure 8A; Ex.1003, ¶175

7. Claim 5

The method of claim 1* [5.1] *wherein the parameter-estimating signal is a parameter-estimating symbol pattern.

Tong describes the transmission of data in the form of "Quadrature Amplitude Modulation (QAM) or Quadrature Phase Shift Key (QPSK) modulation" digital "symbols." Ex.1011, [0032]. Just like data is transmitted in the form of symbols, a POSITA would have understood that pilot information is also transmitted in the form of symbols. For example, pilots are described as being assigned to OFDM subcarriers in the same way data symbols are assigned to subcarriers, with the term "pilot data" being used: "certain sub-carriers will be used as pilots, while others are used to transmit data. The pilot information is represented as P_x, which represents pilot data." Ex.1011, [0040]; Ex.1003, ¶¶178-179. This pilot information, being "previously assigned by the base station 14," was known by both base station and mobile terminals. Ex.1011, [0034]; Ex.1003, ¶180.

Thus, Tong's pilot signals would have been understood by a POSITA as representing pilot symbols, known to both base station and mobile terminals, therefore rendering obvious that Tong's pilot signals ("*the parameter-estimating signal*") are examples of "*a parameter-estimating symbol pattern*." Ex.1003, ¶180.

In addition, it would have been obvious for such a block of time and frequency resources to include a number of subcarriers sufficient to carry at least

two pilot symbols per UE. A POSITA would have understood the tradeoffs involved. For example, a POSITA would have understood that increasing the number of pilot symbols transmitted by a UE in a block of time and frequency resources to two or more increases the accuracy of channel estimation at the expense of decreased data rate as compared with the use of fewer pilot symbols, thereby further rendering obvious a "*parameter-estimating symbol pattern*." Ex.1003, ¶181.

8. Claim 10

The method of claim 1* [10.1] *further comprising requiring each transmitting node to transmit node identifying information on the unshared parameter channel

Tong discloses that **"[t]he base station 14**, which is discussed in detail below, **may use the pilot signals** for channel estimation and interference suppression, as well as **to identify the mobile terminal 16**." Ex.1011, [0034]. Similarly, Tong discloses that **"[t]he base station 14 will receive the transmitted signals** from the mobile terminals 16 at each of its M antennas 40 (block 208) **and extract the pilot signals for each of the mobile terminals 16 to help identify the mobile terminals 16 transmitting information** ..." Ex.1011, [0045].

Thus, Tong's known pilot symbols, which are assigned by a base station to a mobile terminal ("*transmitting node*"), used to identify each mobile terminal at a

base station, and transmitted over "*an unshared parameter channel*," discloses or renders obvious [10.1]. Ex.1003, ¶¶184-186

9. **Claim 16**

The method of claim 1* [16.1] *wherein the parameter channels are low in communication rate compared to the shared communication channel

As illustrated in Figure 8A, for example, the pilot signals occupy a smaller frequency band (two subcarriers) per time slot than the shared communication channel used for data symbols (eight subcarriers). In addition, multiple mobile terminals are allowed to transmit simultaneously over the data subcarriers (as shown in Figure 8A), making the data rate even higher for those shared resources on a per time interval basis. Thus, the communication rate of pilot symbols (in "*parameter channels*") per time interval is low compared to data symbols (in a "*shared communication channel*"), thereby disclosing or rendering obvious claim element [16.1]. Ex.1003, ¶189.

10. **Claim 21**

[21.0] ***A method for enabling a receiving node to distinguish information concurrently received from a plurality of transmitting nodes on a shared communication channel of a wireless digital network, the method comprising***

For the reasons given in the analysis of Ground 2A, claim element [1.0] (see comparison of [1.0] and [21.0] in Ground 1A), Tong discloses or renders obvious [21.0]. Ex.1003, ¶190.

[21.1] ***receiving a plurality of parameter-estimating signals each on an unshared parameter channel from a corresponding transmitting node***

[21.2] ***estimating at least one unique signal parameter for each of the received plurality of parameter-estimating signals***

Claim elements [21.1] and [21.2] have significant overlap with claim elements [1.1]-[1.3], so claim elements [1.1]-[1.3] are referenced below. Ex.1003, ¶¶191-192.

As explained in the analysis of Ground 2A, claim element [1.1], each of the different sets of pilot subcarriers assigned to different mobile terminal is an example of a "*parameter channel*." As explained in the analysis of Ground 2A, claim element [1.2], the pilot subcarriers assigned to different mobile terminals are also "*unshared*." Ex.1003, ¶192.

As explained in the analysis of Ground 2A, claim element [1.3], using known pilot symbols from different mobile terminals, transmitted over unshared time-frequency resources, ("*unshared parameter channels*") to estimate channels ("*at least one unique signal parameter*"), renders obvious estimating "*at least one unique signal parameter for each of the transmitting nodes*," as claimed. Ex.1003, ¶193.

[21.3] ***distinguishing information concurrently received from the transmitting nodes according to their corresponding estimated unique signal parameter.***

Claim element [21.3] is broader than claim element [1.4]. Thus, Tong renders obvious claim element [21.3] for at least the same reasons as presented in the analysis of claim element [1.4]. Ex.1003, ¶195.

C. Ground 2B: Claims 6 and 7 are unpatentable as obvious over Tong combined with Jia and further in view of Zhu.

1. Summary of Zhu – Pilot Symbols and Channel Estimation

Zhu explains that "channel estimation" in OFDM includes determining the "channel response," which reflects amplitude and phase, and explains how pilot symbols are used in channel estimation: "The variations in phase and amplitude resulting from propagation along the channel are referred to as the channel response… The determination of the channel response is called channel estimation. The inclusion of pilot symbols in each OFDM symbol allows the receiver to carry out channel estimation." Ex.1012, 2:2-14. Zhu explains that "[w]hen the receiver receives the OFDM symbol, the receiver compares the received value of the pilot symbols with the known transmitted value of the pilot symbols to estimate the channel response." Ex.1012, 2:14-18. Since the receiver knows the value of a pilot symbol, it can solve for the channel response, which includes amplitude and phase. Ex.1003, ¶42-44, 198.

2. Reasons to Combine Tong, Jia, and Zhu

Tong and Zhu are analogous art to the '071 Patent, as both documents are directed to the field of wireless communications networks. Ex.1001, 1:22-24; Ex.1011, [0023]; Ex.1012, 1:18-31; Ex.1003, ¶199.

It would have been obvious for a POSITA to combine Tong and Zhu to provide the obvious, beneficial, and predictable result of providing additional implementation details for channel estimation, according to the teachings of Zhu, using Tong's OFDM pilot symbols. Ex.1003, ¶200.

As discussed previously in the analysis of Ground 2A, claim element [1.3], Tong discloses using pilot signals received in a base station to form a channel estimate for channels from mobile terminals to a base station. Tong's OFDM data and pilot symbols were known or understood as being complex values, each having an amplitude and phase value. For example, Tong describes the transmission of data in the form of "Quadrature Amplitude Modulation (QAM)," which conveys binary data using amplitude and phase information. Ex.1011, [0032]; Ex.1003, ¶43, 178. The amplitude and phase introduced by the radio channel is typically estimated in order to compensate for the radio channel in receiving the QAM data symbols. Ex.1003, ¶201. However, to the extent that Tong does not convey to a POSITA implementation details as to what parameters would have been estimated using its pilot symbols, Zhu provides relevant details. Zhu discloses estimating the

amplitude and phase for each subcarrier, and the channel estimation is based on comparing a received pilot symbol against the known transmitted pilot symbol. Ex.1012, 2:6-18. Thus, Zhu teaches certain implementation details regarding channel estimation in OFDM that would have been understood by or obvious to a POSITA reading Tong. Ex.1003, ¶202.

A POSITA would have had a reasonable expectation of success of implementing Zhu's teachings regarding the use of pilot symbols for channel estimation in OFDM in Tong's OFDM system. Tong describes the use of pilot symbols in OFDM systems for channel estimation. Ex.1011, [0040]-[0041], [0044]-[0045], Figure 7. Consistent with Tong, Zhu (which shares many of the same inventors as Tong), describes estimation of "phase and amplitude of the channel response" using "pilot symbols" which are "known to the receiver." Ex.1012, 2:2-15. Zhu provides additional detail as to how the pilot symbols are used: "When the receiver receives the OFDM symbol, the receiver compares the received value of the pilot symbols with the known transmitted value of the pilot symbols to estimate the channel response." Ex.1012, 2:15-18. The application of Zhu's teachings in Tong represents combining prior art elements according to known methods (transmission of pilot symbols on specific subcarriers in OFDM) to yield predictable results (use of pilot symbols for channel estimation). Ex.1003, ¶203.

Zhu's teachings are also compatible with Tong in view of Jia. As explained in the analysis of Ground 2A, claim element [1.4], various types of MIMO detectors (as presented in Jia) use channel estimates to produce estimated symbols. The channel estimates can be represented by a matrix *H* of complex values. It was obvious that each of the complex values has an amplitude and phase, according to Zhu's teachings, which can be represented in using the phasor form of complex numbers, as $Ae^{j2\pi\theta/360}$, where A is amplitude and θ is phase, as was known in the art. Ex.1003, ¶43, 204.

3. Claim 6

The method of claim 1* [6.1] *wherein the at least one unique signal parameter comprises signal amplitude

As explained in Ground 2A, claim element [1.3], Tong discloses using pilot signals received in a base station to form a channel estimate for each of the channels from a mobile terminal to a base station. And as discussed in the analysis of Ground 2A, claim element [5.1], pilot symbols in Tong were known or understood as being complex values. It would have been obvious or understood by a POSITA that the amplitude and phase values of the complex pilot symbols are altered by the radio channel, as was known in the art and confirmed by Zhu's description of channel estimation. Ex.1003, ¶206.

Zhu explains that "channel estimation" involves estimating the amplitude and phase for each OFDM subcarrier , and the estimates are based on comparing a received pilot symbol against the known transmitted pilot symbol:

> The **variations in** phase and **amplitude** resulting from propagation along the channel **are referred to as the channel response**… The determination of the channel response is called channel estimation.

Ex.1012, 2:6-18. Thus, Zhu presents certain implementation details regarding channel estimation in OFDM, including that determination of channel amplitude is part of channel estimation, that a POSITA would have been motivated to use with Tong. Thus, Tong combined with Zhu renders obvious claim element [6.1]. Ex.1003, ¶206.

To the extent that the teachings of Zhu would be applied to Tong combined with Jia in the analysis of claim element [1.4], it would have been understood or obvious that each of the complex channel estimates *H* in Jia is represented by a complex number having an amplitude and phase value. Ex.1003, ¶207.

4. Claim 7

The method of claim 1* [7.1] *wherein the at least one unique signal parameter includes a signal phase

See analysis of [6.1], in which Zhu explains that estimation of "**phase** and amplitude" is referred to as "**channel estimation**." Ex.1012, 2:6-18. Thus, Zhu presents certain implementation details regarding channel estimation in OFDM, including that determination of phase is part of channel estimation, that a POSITA

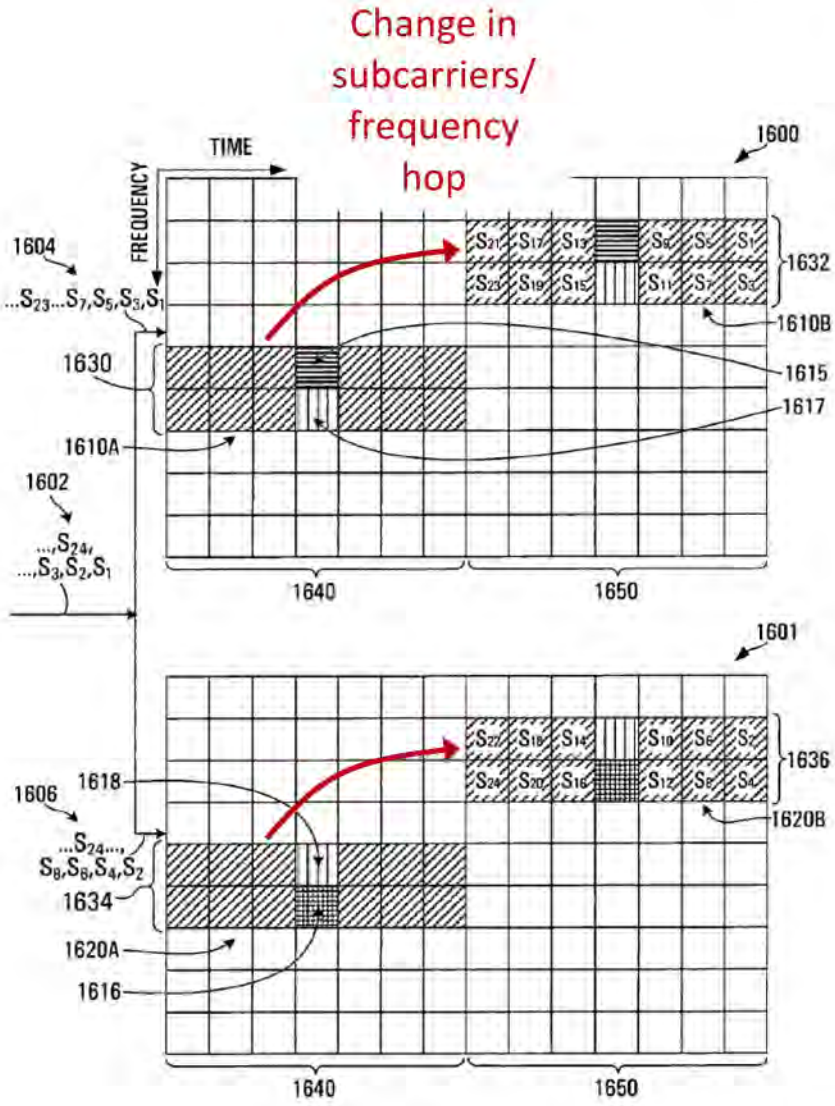
would have been motivated to use with Tong. Thus, Tong combined with Zhu renders obvious claim element [7.1], as does Tong combined with Zhu and Jia. Ex.1003, ¶¶209-210.

D. Ground 2C: Claims 13 and 14 are unpatentable as obvious over Tong combined with Jia, Zhu, and Dubuc.

1. Summary of Zhu – Frequency Hopping

Zhu relates to using data symbols and pilot symbols in OFDM transmission, and "utilizing frequency hopping patterns for the data symbols and/or the pilot symbols." Ex.1012, Abstract. Zhu discloses a benefit of frequency hopping: "[f]requency hopping is resistant to multi-path fading through the inherent frequency diversity mechanism." Ex.1012, 15:60-62. Zhu presents an embodiment in which two mobile stations, each with a single antenna, coordinate transmissions on the uplink to a base station to form a "virtual MIMO" channel, just like in Tong. Ex.1012, 22:49-53, 26:12-28; Ex.1003, ¶¶214-215.

For example, Zhu presents an embodiment of time-frequency patterns with data and pilot symbols for transmission from two mobile station antennas 1600, 1601 in Figure 14A using first and second "segments" of time and frequency 1640, 1650.



Ex.1012, Figure 14A; Ex.1003, ¶216

Figure 14A of Zhu illustrates an instance of frequency hopping with a period of two segments, but Zhu is not so limited, as any hopping period may be used. Ex.1012, 22:64-23:13; Ex.1003, ¶216.

2. **Summary of Dubuc**

Dubuc describes an example of OFDM data transmission in which "along the time-frequency plane for the OFDM spectrum, the mapping of user data to various sub-carriers is repetitive and consistent." Ex.1006, 1:51-53. Dubuc describes a problem with such an approach in that different users may have different signal-to-noise ratios, which "will lead to unequal degradation of performance for each user." *Id.*, 1:53-59. Figure 1 illustrates an example in which fixed subcarrier groups per user are used for all transmissions. Ex.1003, ¶217.

Frequency hopping in OFDM is a technique used to mitigate the effects that different subcarriers are attenuated differently: "In an effort to minimize the impact of the variations in the channel, frequency-hopping schemes have been employed." Ex.1006, 1:60-63. According to Dubuc, "[t]hus, a user does not necessarily transmit on the same sub-carrier group for every OFDM symbol, but will jump to a different sub-carrier after a period of time based on the defined hopping pattern. **The sub-carrier hopping scheme illustrated in FIG. 2 improves the performance over the fixed time-frequency allocation illustrated in FIG. 1**." Ex.1006, 2:3-7. For example, in Figure 2, signals for "USER 1" use different groups of subcarriers for different OFDM symbols. Dubuc presents "pseudo-random" frequency hopping sequences as example hopping sequences, having the

benefit of helping to distribute data across the available subcarriers. *See*, *e.g.*, Ex.1006, 3:5-8; Ex.1003, ¶¶219-220.

3. Reasons to Combine Tong with Zhu and/or Dubuc

Dubuc is analogous art to the '071 Patent, as both documents are directed to the field of wireless communications networks. Ex.1001, 1:22-24; Ex.1006, 1:10-12; Ex.1003, ¶221.

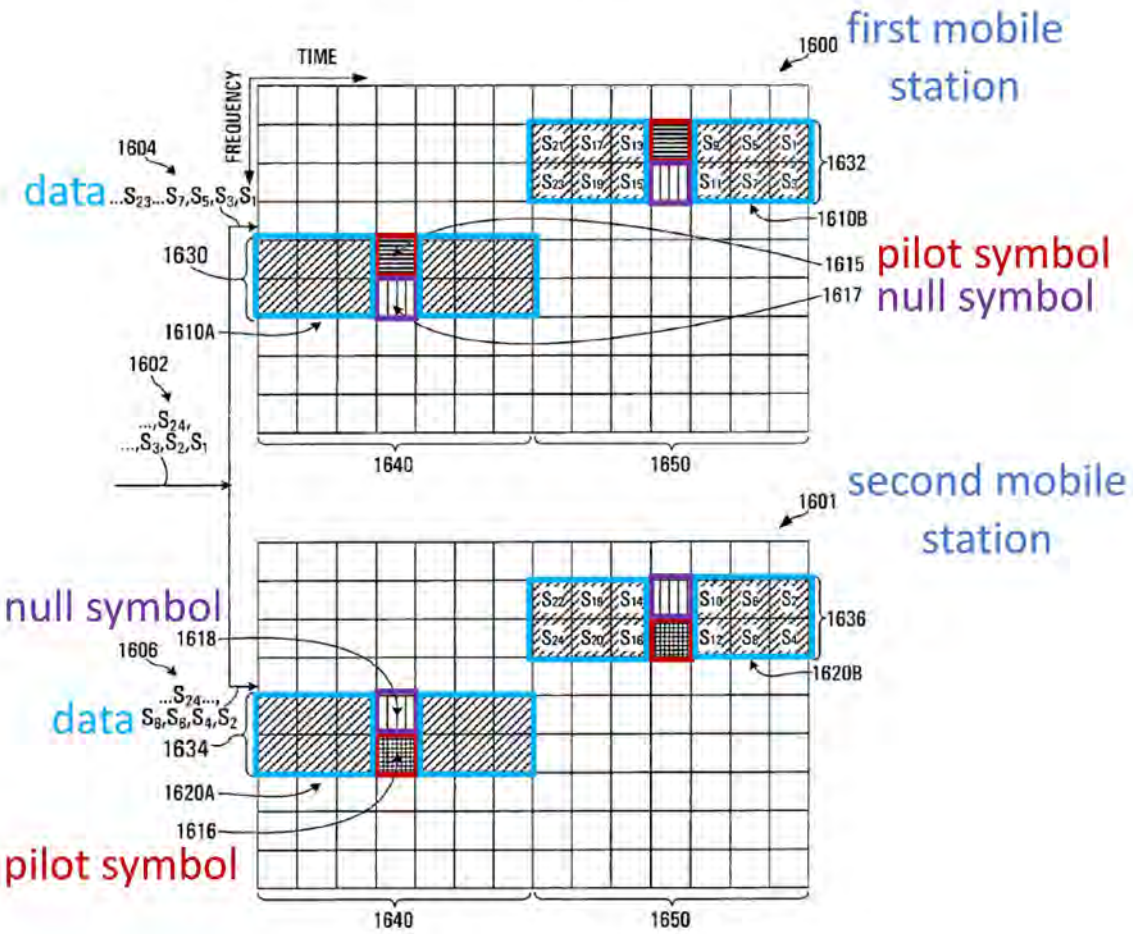
Frequency hopping

It would have been obvious for a POSITA to combine Tong and Zhu or Tong, Zhu, and/or Dubuc to provide the obvious, beneficial, and predictable result of improving reliability via the use of frequency hopping (as taught in Zhu and Dubuc) in Tong's system. Ex.1003, ¶222.

To the extent that Tong does not expressly discuss the use of frequency hopping, Zhu describes the use of frequency hopping in OFDM and its benefits, e.g., "[f]requency hopping is resistant to multi-path fading through the inherent frequency diversity mechanism." Ex.1012, 15:60-62. Dubuc likewise explains the benefits of frequency hopping in OFDM, as "mimimiz[ing] impact of the variations in the channel." Ex.1006, 1:60-63; Ex.1003, ¶223.

Zhu presents an embodiment of time-frequency patterns with data and pilot symbols for transmission from two mobile station antennas 1600, 1601 in Figure 14A. Zhu presents an embodiment in which two mobile stations, each with a single

antenna, coordinate transmissions on the uplink to a base station to form a virtual MIMO channel, just like in Tong. Ex.1012, 22:49-53 (describing mobile stations transmitting in a "synchronized, cooperative manner"), Title ("Virtual MIMO Communication System"). Figure 14A is presented below.



Ex.1012, Figure 14A; Ex.1003, ¶224

A "null symbol" represents the "absence of a symbol" in a particular location. Ex.1012, 20:1-2. All of the remaining cross-hatched symbols in Figure 14A represent data or pilot symbols as shown. Ex.1012, 22:47-55, 23:24-35; Ex.1003,

¶224. Thus, in the patterns of Figure 14A, the pilot symbols from each mobile station do not overlap but the data symbols overlap. The segments 1640 and 1650 represent the same time and frequency segments for two different mobile stations. Zhu is not limited to a hopping period of two segments, as any hopping period may be used. Ex.1012, 22:64-23:13; Ex.1003, ¶225.

Applying the principles of Zhu to the pilot-and-data subcarrier groupings (time frequency resources) of Tong, a POSITA would have found it beneficial for the subcarriers used by each UE/mobile station to change, or hop, from time to time using a hopping sequence. Ex.1003, ¶226.

"Random" frequency hopping

To the extent that Zhu does not explicitly disclose a hopping sequence as pseudo-random, a POSITA implementing frequency hopping would have understood from Dubuc that pseudo-random frequency hopping sequences are an example, and pseudo-random sequences help to distribute the data across sub-carriers. *See*, *e.g.*, Ex.1006, 3:5-8 ("[a] pseudo-random pattern may be employed for sub-carrier mapping from one OFDM symbol window to the next to effectively distribute the sub-bands across the selected band of subcarriers for the group."); *see also* Ex.1006, Abstract, 2:16-17. A pseudo-random pattern was well known as a pattern created by a definite calculation process while at the same time satisfying a statistical test for randomness. Ex.1003, ¶227 (citing Ex.1008).

A POSITA would have had a reasonable expectation of success of implementing frequency hopping in Tong's system. Frequency hopping was a well-known technique to "increase[] frequency diversity" in OFDM systems, and it was known to be a "relatively easy change to allow hopping of the subcarriers per timeslot" in OFDM. Ex.1003, *** (quoting Ex.***). The implementation of Dubuc's pseudo-random frequency hopping as the frequency hopping pattern of Zhu, as applied to Tong's system, represents combining prior art elements according to known methods to yield predictable results (the implementation of pseudo-random frequency hopping in Tong's OFDM system). Ex.1003, ¶¶228-229.

4. **Claim 13**

The method of claim 1* [13.1] *wherein the parameter channels are randomly shifted over time between a plurality of wireless frequencies.

As explained in the Reasons to Combine Tong with Zhu and/or Dubuc (Section IX.D.3), applying the teachings regarding frequency hopping in Zhu to Tong would have led a POSITA to implement Tong's "virtual MIMO" communication system using frequency hopping to increase frequency diversity, thereby improving performance. For example, the time frequency resources (subcarrier and time slot groupings) illustrated in Figure 8A of Tong would have hopped from one pair of subcarriers to another over the available frequency band using frequency hopping, thereby disclosing that the pilot subcarriers ("*parameter*

channels") hop over time among different frequencies ("*shifted over time between a plurality of frequencies*"). Ex.1003, ¶232.

To the extent that Zhu does not explicitly disclose that the frequency hopping is "random," Dubuc discloses that pseudo-random frequency hopping was a well-known type of frequency hopping that also provides benefits, Dubuc, Abstract, 2:16-17, 3:5-8. Thus, it would have been obvious that Zhu's frequency hopping would have been implemented as "*random*," thereby rendering obvious [13.1]. Ex.1003, ¶233.

It would have been understood by a POSITA that the claimed "*randomly shifted*" parameter channels of the '071 Patent are pseudo-randomly shifted, as in Dubuc, in the sense that the frequency shifts are done in a defined way such that terminals (transmitters and receivers) collectively understand which channels are used for "*parameter channels*" but that the channels are statistically "random." The teachings of the references are consistent with this understanding. Ex.1003, ¶234 (citing Ex.1008).

5. Claim 14

The method of claim 13* [14.1] *wherein the parameter channels are shifted according to a random hopping pattern.

Tong combined with Zhu and/or Dubuc render claim element [14.1] obvious for the reasons presented in the analysis of claim element [13.1]. Tong combined with Zhu and/or Dubuc renders obvious mobile stations transmitting pilot symbols

using frequency hopping patterns, with a well-known example being a pseudo-random hopping pattern (per Dubuc), thereby rendering obvious claim element [14.1]. Ex.1003, ¶236.

E. Ground 3A: Claims 1, 4, and 8-10 are unpatentable as obvious over Baum.

1. Summary of Baum

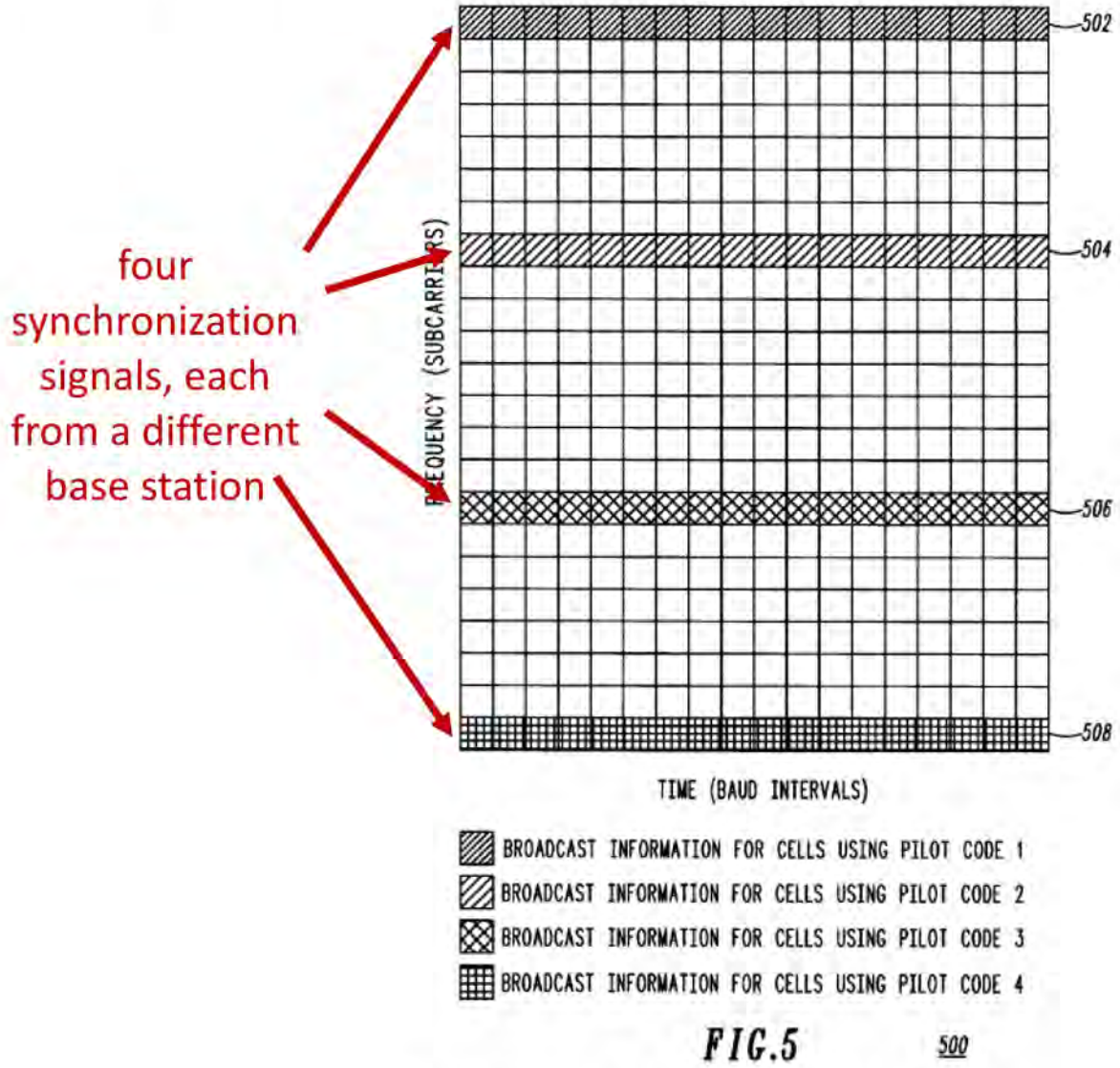
Baum relates to reducing the impact of interference in OFDM wireless communication systems. Ex.1005,1:7-10. For example, the detector in a "receiver" may use "joint detection." Ex.1005, 5:17-47, 18:1-8; Ex.1003, ¶¶239-240.

Baum's system uses synchronization signals for estimating various parameters. Ex.1005, 9:27-33. Baum teaches that "an OFDM receiver estimates the adjacent-subcarriers phase difference and compensates for the estimated adjacent-subcarriers phase difference in the detection process," and "[t]he estimate…can be obtained…based on a received signal containing known data such as the broadcast synchronization signal." *Id.*, 19:3-59. Ex.1003, ¶242.

Synchronization signals from different base stations occupy different regions of time and/or frequency in a frame. Ex.1005, 9:14-21 (describing different "orthogonal regions" in "time" and/or "frequency" assigned to each base station for "transmitting its synchronization signal"); *see also id.*, 24:39-50. Thus, a subscriber unit is able to measure or monitor each synchronization signal without co-channel interference. Ex.1003, ¶243.

For example, Figures 5 and 6 illustrate different embodiments of coordinating synchronization signals among base stations. In Figure 5 (reproduced below), a synchronization signal occupies only one subcarrier per frame but spans multiple time/baud intervals. In Figure 6, a synchronization signal occupies only a fraction of available subcarriers and is contained within a single time/baud interval.

Ex.1003, ¶¶244-246.



Ex.1001, Figure 5; Ex.1003, ¶245

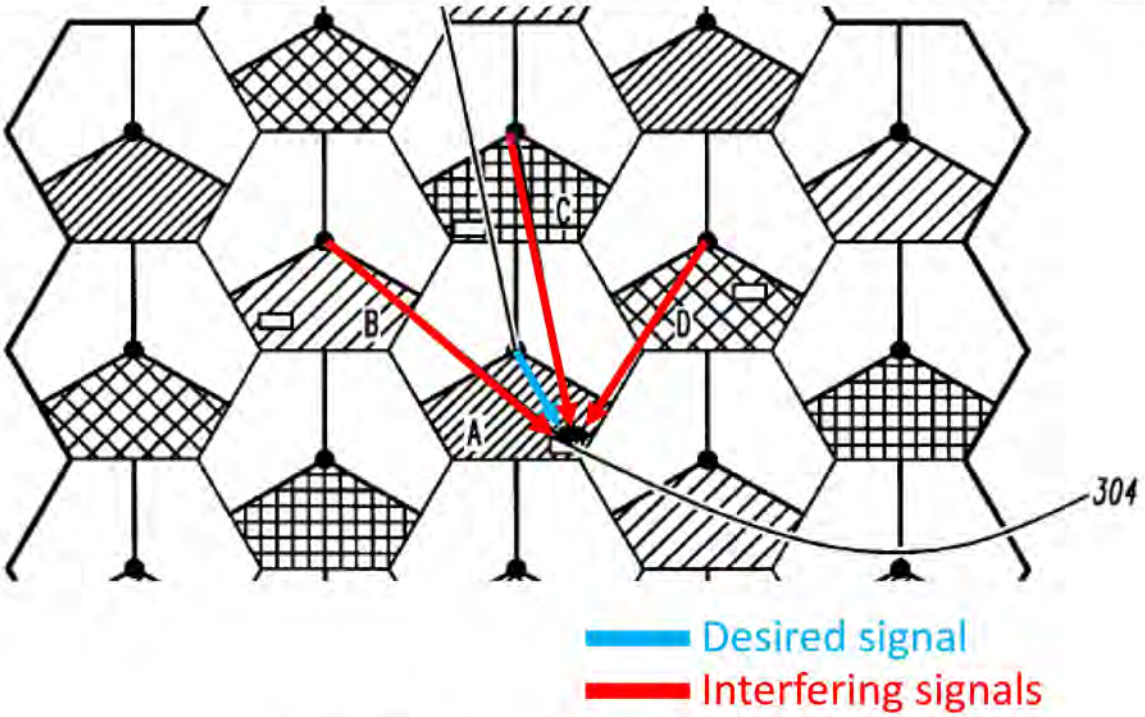
2. Claim 1

[1.0] ***A method for enabling a receiving node to distinguish information simultaneously received from a plurality of transmitting nodes on a shared communication channel of a wireless digital network, the method comprising:***

In connection with Figure 3 (reproduced below), Baum presents a cellular network with four base units in sectors A, B, C, D, respectively, which are transmitting ("*a plurality of transmitting nodes*"). Baum's cellular network uses digital modulation ("*wireless digital network*" "), such as a QAM or QPSK. Ex.1005, 4:16-27, 13:49-54; Ex.1003, ¶¶248-249.

The four base units generate one desired signal for a given mobile terminal and three co-channel interfering signals. *Id.*, 6:21-23. Therefore, the four base units are transmitting on the same channel ("*shared communication channel*"), leading to "co-channel" interference. Ex.1003, ¶250.

Baum presents a subscriber unit 304 in sector A, Ex.1005, 6:7-8, an example of the claimed "*a receiving node*." The subscriber unit 304 receives "*simultaneously*" from the four base units. *Id.*, 6:26-32. Baum refers the signal from base unit A as the "desired" signal and the signals from other base units B, C, D as "interfering signal[s]." *Id.*, 6:9-21.



Ex.1005, Figure 3; Ex.1003, ¶252

Baum also indicates the reception scheme can be "joint detection," in which co-channel interfering signals are also joint desired signals in the detection process. Ex.1005, 18:1-15. Thus, the multiple signals that are received simultaneously (e.g., the "joint desired signal," or the sum of the desired and the interfering signal components) are distinguished in the detection process. Ex.1003, ¶252.

Thus, Baum's teachings of a subscriber unit in an OFDM cellular system performing joint detection to distinguish various signals transmitted simultaneously from different base units renders obvious claim element [1.0]. Ex.1003, ¶253.

[1.1] ***providing a plurality of parameter channels on the network in addition to the shared communication channel***

As explained in the Summary of Baum (Section IX.E.1), Baum discloses the use of synchronization signals. Because the synchronization signals from different base stations occupy different regions of time and/or frequency in a frame, a subscriber unit is able to measure or monitor each synchronization signal without co-channel interference. Each of the different regions of time and/or frequency in a frame dedicated to a synchronization signal is an example of a "*parameter channel*." Ex.1003, ¶255.

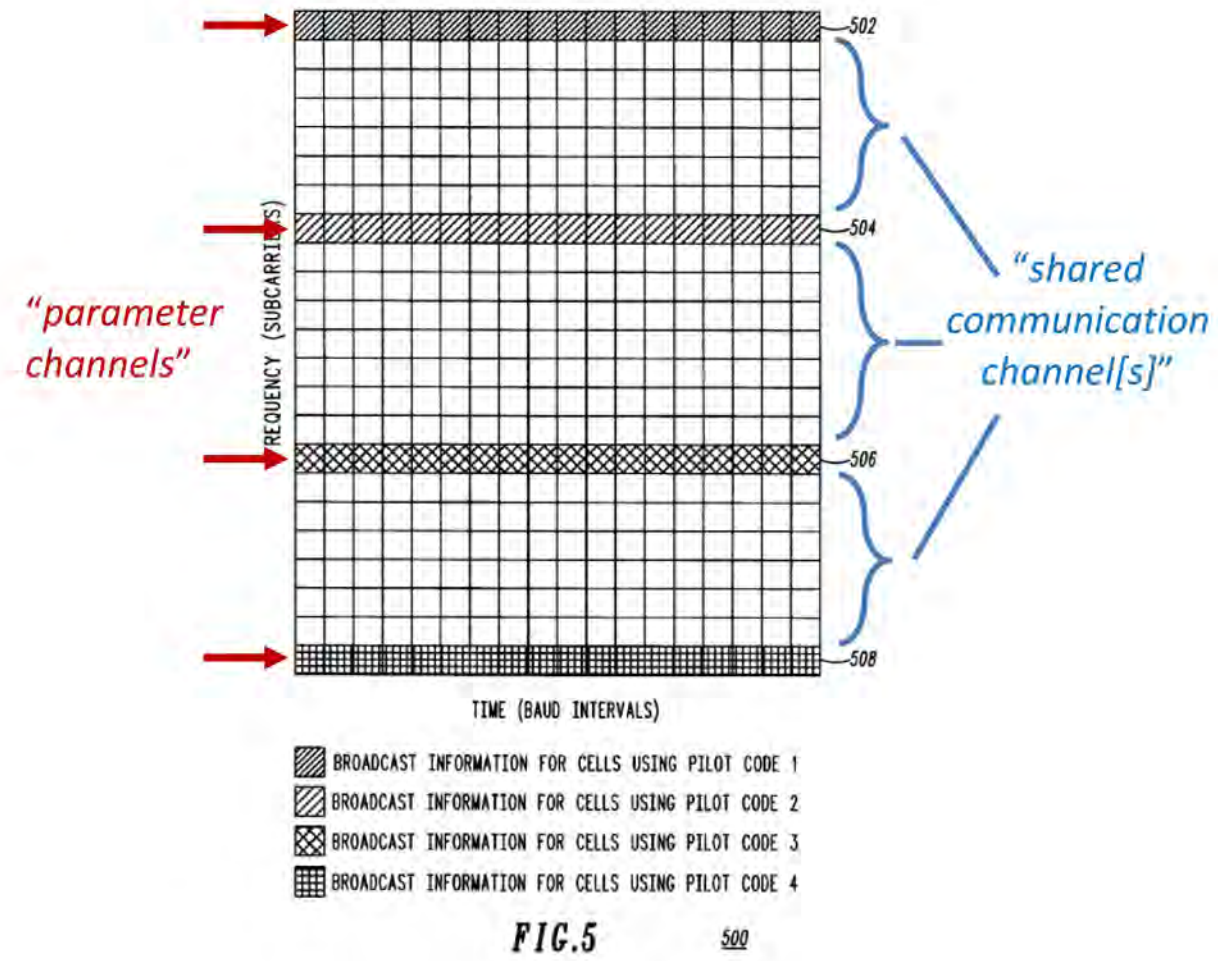
For example, within a frame is a region (e.g., designated by "time and/or frequency") dedicated to a "synchronization or identification signal." Ex.1005, 9:11-21 ("a frame includes time and/or frequency regions for base units in the SC-OFDM system to transmit a synchronization or identification signal"), 8:53-57, 24:39-50 (describing a synchronization signal from one transmitter being transmitted "at a different time/frequency/[]" than the synchronization signal transmitted by the other transmitter). Ex.1003, ¶256.

Baum explains that synchronization signals are used to estimate phase differences across subcarriers in each signal demodulated in joint detection so that the receiver can compensate for these phase differences. The estimate of "adjacent-subcarriers phase difference" is "based on a received signal containing known data such as the broadcast synchronization signal." Ex.1005, 19:3-59. Thus, Baum

discloses that as part of the demodulation of a received OFDM signal a subcarrier phase difference is estimated based on a synchronization signal for both the desired signal and the interfering signals. Ex.1003, ¶257.

Thus, synchronization signals are used to estimate parameters. Accordingly, the different time and/or frequency regions used to carry synchronization signals are examples of "*parameter channels*." In Figure 5 (below), each of the subcarriers that carries a synchronization signal is an example "*parameter channel*," and the other subcarriers represent at least one "*shared communication channel*." Ex.1003,

¶¶258-262.



Ex.1005, Figure 5; Ex.1003, ¶261

In Figure 6, as another example, there are also four "*parameter channels*" and a "*shared communication channel*."

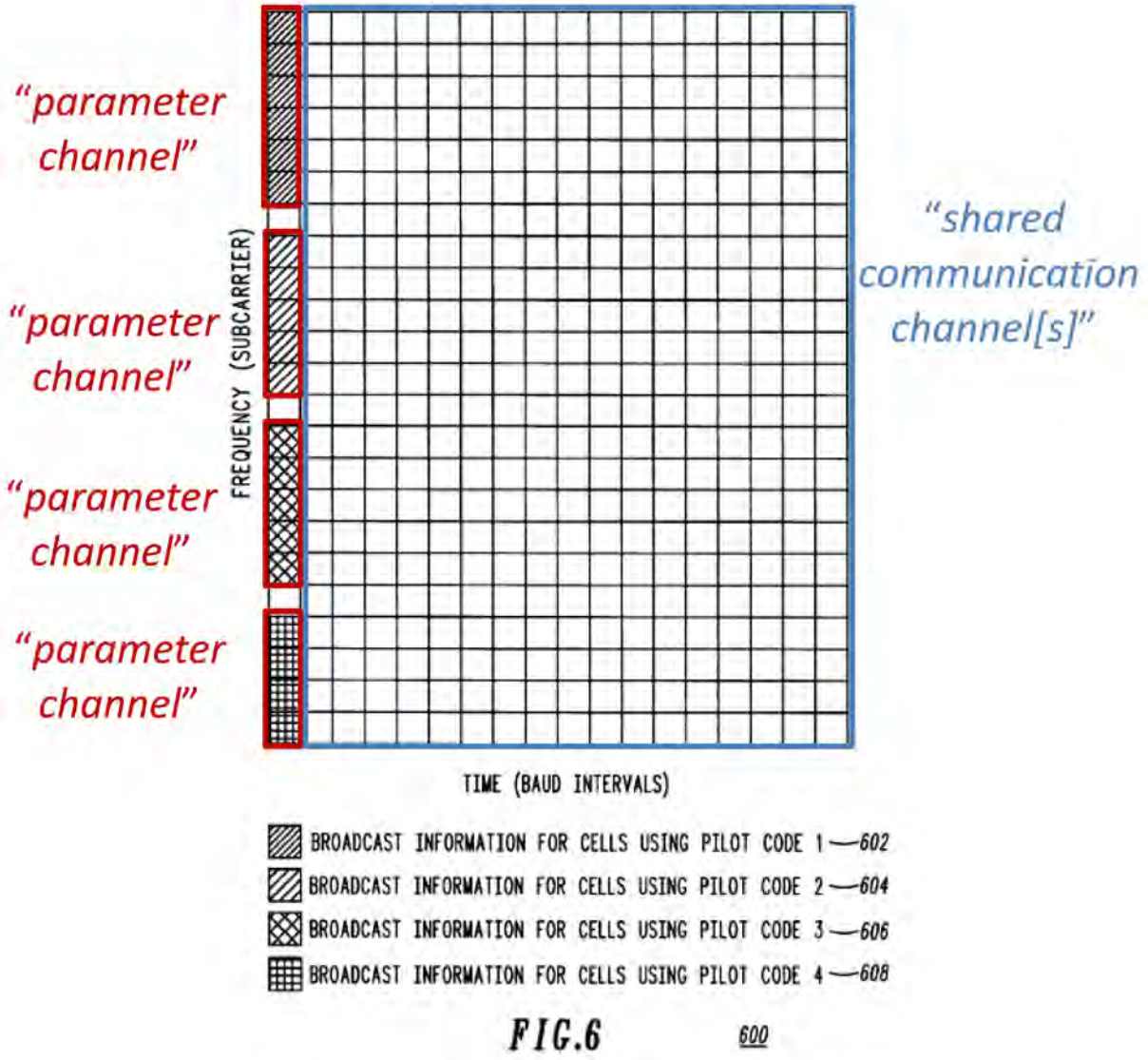


FIG.6 600

Ex.1005, Figure 6; Ex.1003, ¶262

Accordingly, Baum's disclosure of coordination of different time and/or frequency regions ("*parameter channels*") among different base units for the transmission of corresponding synchronization signals and the sharing of the

remaining OFDM time and frequency region in a frame ("*shared communication channel*") for data transmission discloses or renders obvious claim element [1.1]. Ex.1003, ¶263.

[1.2] *requiring each transmitting node to transmit a parameter-estimating signal on an unshared said parameter channel*

First, a synchronization signal in Baum is an example "*parameter-estimating signal*." For example, Baum teaches monitoring synchronization signals to measure parameters

> the subscriber unit is able to measure/monitor the synchronization signal from the dominant co-channel interfering sectors of the surrounding cells. This capability enables the subscriber unit to measure the relative propagation delay of the interfering signals, which directly affects the amount of phase change per subcarrier on the interfering signals after demodulation.

Ex.1005, 9:27-33. The OFDM receiver also "estimates the adjacent-subcarriers phase difference and compensates for the estimated adjacent-subcarriers phase difference in the detection process" based on "the broadcast synchronization signal." Ex.1005, 19:3-59. Accordingly, because synchronization signals are used to estimate relative propagation delays and adjacent-subcarriers phase differences, each synchronization signal is an example of the claimed "*parameter-estimating signal*." Ex.1003, ¶265.

Second, Baum teaches that synchronization signals from two different base stations are "non-interfering" because they are transmitted using different "time/frequency" resources: "synchronization signals…may typically be one of: A) **non-interfering** with a synchronization/identification signal from another SC-OFDM transmitter... Where selected, **the SC-OFDM transmitter may transmit** at least one of **the synchronization signal** and the identification signal **at a different time/frequency/[] than the synchronization/identification signal transmitted by the other SC-OFDM transmitter**." Ex.1005, 24:39-50; *see also* 10:5-11. These different, non-interfering, time and/or frequency regions for transmitting synchronization signals ("*parameter-estimating signal*") are examples of the claimed "*unshared said parameter channel*," thereby disclosing or rendering obvious [1.2]. Ex.1003, ¶¶266-270.

[1.3] ***detecting the parameter-estimating signals on the unshared parameter channels and estimating therefrom at least one unique signal parameter for each of the transmitting nodes***

Baum teaches that a synchronization signal is used to estimate "the relative propagation delay" and "subcarrier phase difference information" (derived from the relative propagation delay) of various signals. Ex.1005, 9:24-36. The subcarrier phase difference for different signals, derived from the relative propagation delay of the signals, as measured from synchronization signals ("*parameter-estimating signals*") transmitted from different base stations, is an example of the claimed

"*signal parameter for each of the transmitting nodes*." Because the subcarrier phase difference is related to the "relative propagation delay" of different interfering signals, the phase differences for each of the base stations are "*unique*." Ex.1003, ¶¶272-274.

Accordingly, Baum discloses or renders obvious claim element [1.3]. Id., ¶275.

[1.4] ***detecting and distinguishing the information simultaneously received from each of the transmitting nodes according to their respective said unique estimated signal parameters***

First, as discussed in [1.0], Baum indicates the reception scheme is **joint detection.** Joint detection distinguishes information simultaneously received from multiple transmitters. For example, "**co-channel interfering signal components can be treated as joint desired signals in the detection process**." Ex.1005, 18:1-15; Ex.1003, ¶277.

Second, Baum teaches that the subcarrier phase difference is "accounted for in the detection algorithms in the receiver." Ex.1005, 9:11-36. Baum further explains how to implement joint detection with the subcarrier phase difference estimated from a synchronization signal: "an OFDM receiver estimates the adjacent-subcarriers phase difference and compensates for the estimated adjacent-subcarriers phase difference in the detection process…The estimate…can be

obtained…based on…the broadcast synchronization signal." Ex.1005, 19:50-62; Ex.1003, ¶278.

Baum discloses estimating the "adjacent-subcarriers phase difference" for each "component"/signal in a "composite" received signal and using these phase differences in the "detection process," including "interpolation filtering." Ex.1005, 21:3-21. Details of generation of interpolation filtering coefficients for a given signal received from a transmitter are provided at column 20, lines 1-41. The equation employs the adjacent-subcarriers phase difference term $\Delta\hat{\theta}_{adj}$ (Ex.1005, 20:10-14):

$$\hat{g}(m, n) = \sum_{p=1}^{P} h_p(m, n)\hat{g}_p(m_p, n_p)\exp(-j(m_p - m)\Delta\hat{\theta}_{adj})$$

Ex.1003, ¶¶279-281.

Thus, Baum discloses estimating the "adjacent-subcarriers phase difference" for each "component" of a "composite" received signal and compensating for the phase differences during the interpolation filtering process, which is part of the "detection process" for joint detection of the composite received signal and for distinguishing the information received, thereby disclosing or rendering obvious claim element [1.4]. Ex.1003, ¶282.

3. Claim 4

The method of claim 1* [4.1] *wherein requiring each transmitting node to transmit a parameter-estimating signal includes requiring each transmitting node to transmit the parameter-estimating signal while simultaneously transmitting information on the shared communication channel.

As shown in Figure 5, synchronization signals are transmitted in a frame using subcarriers identified as 502, 504, 506, 508. The remaining subcarriers are used to transmit data and other information. "[A]n OFDM slot may span a plurality of baud intervals and a plurality of subcarriers." Ex.1005, 3:32-34. Data from different base units/stations in a slot is "not related" or coordinated. Ex.1005, 7:48-58. Because slots are shared, "the received signal consists of received signals from a plurality of SC-OFDM transmitters." Ex.1005, 14:54-61.

Figure 5 of Baum illustrates "*parameter channels*" that use certain frequencies/subcarriers within a time interval, with the remainder of the frequencies/subcarriers available for data transmission from the base units in the same time interval. In order to use the frequencies available for data transmission ("*shared communication channel[s]*"), a base unit necessarily transmits data at the same time ("*simultaneously*") as a synchronization signal ("*parameter-estimating signal*"). Ex.1003, ¶¶285-286.

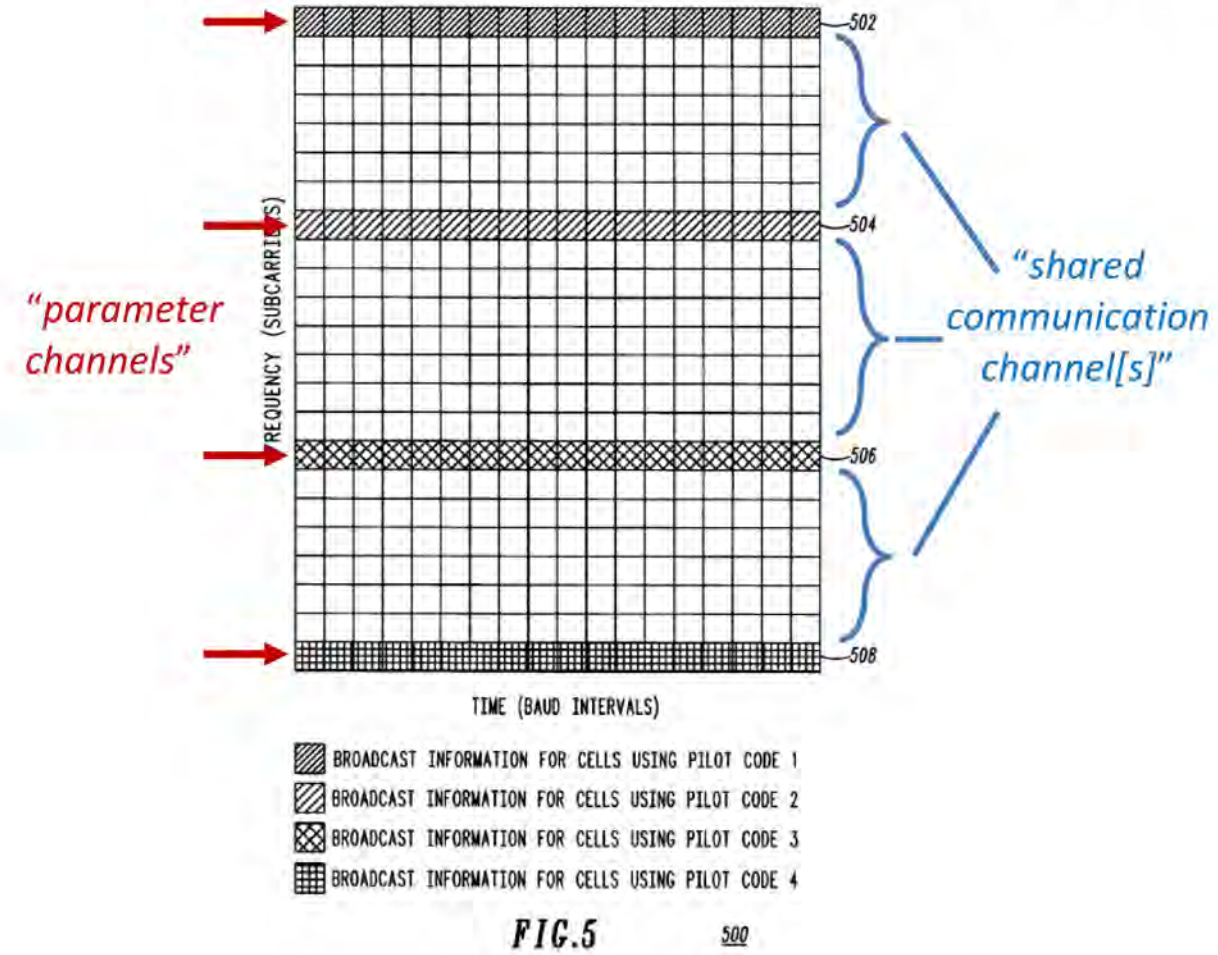


FIG.5 500

Ex.1005, Figure 5; *see also* Figure 6; Ex.1003, ***

Thus, Baum discloses different base units ("*each transmitting node*") transmitting synchronization signals (*"parameter-estimating signal[s]"*) on certain frequencies/subcarriers while simultaneously transmitting data on the remaining subcarriers (*"while simultaneously transmitting information on the shared communication channel[s]*"), thereby disclosing or rendering obvious [4.1]. Ex.1003, ¶286.

4. Claim 8

The method of claim 1* [8.1] *wherein the at least one unique signal parameter includes a signal carrier frequency offset

Baum discloses that synchronization signals are used to "acquire…frequency synchronization," Ex.1005, 9:11-17, and frequency synchronization "can be accomplished using one of the OFDM synchronization algorithms known in the art," Ex.1005, 14:46-50. "Frequency synchronization" in OFDM was understood as a term that included frequency offset estimation. Ex.1003, ¶288 (citing Ex.1009, in which "synchronization" for OFDM illustrated and described as incorporating "frequency offset estimation"). Accordingly, Baum discloses or renders obvious [8.1]. *Id.*

5. Claim 9

The method of claim 1* [9.1] *wherein the at least one unique signal parameter includes a signal relative time delay

Baum discloses that the synchronization signals are used to measure relative propagation delays, which are examples of a "*relative time delay*":

> [A] subscriber unit is able to **measure the synchronization signal** from the base unit in its own cell without the detrimental effects of strong co-channel interference… [and] **measure/monitor the synchronization signal from the dominant co-channel interfering sectors** of the surrounding cells… **to measure the relative propagation delay** of the interfering signals.

Ex.1005, 9:24-36. In order to determine time delays of interfering signals "relative" to the desired signal, the time delay of the desired signal is also estimated. Accordingly, Baum discloses or renders obvious [9.1]. Ex.1003, ¶¶290-291.

6. Claim 10

The method of claim 1* [10.1] *further comprising requiring each transmitting node to transmit node identifying information on the unshared parameter channel

Baum teaches that the scheme of transmitting synchronization signals can also be used to transmit "identification" signals:

> The SC-OFDM transmitter may, where selected, transmit **at least one of: synchronization signals and identification signals**… Where selected, the SC-OFDM transmitter **may transmit at least one of the synchronization signal and the identification signal** at a different time/frequency/[] than the synchronization/identification signal transmitted by the other SC-OFDM transmitter.

Ex.1005, 24:39-50. The teaching that "at least one of" a synchronization signal and the identification signal may be transmitted by a transmitter teaches that the synchronization signal and an identification signal both may be transmitted from a transmitter. Furthermore, the identification signals do not interfere with each other because they are sent on at different times and/or frequencies ("unshared parameter channel[s]") (and/or using different codes), thereby disclosing or rendering obvious "*node identifying information*." Ex.1003, ¶294.

It was obvious that Baum's "identification signal" includes node identifying information. For example, other references prior to the '071 Patent describe OFDM systems in which base station identification information includes address information that may be communicated by beacon signals. Ex.1003, ¶295 (citing Ex.1007, ¶335 ("Base station identification information also includes base station address information.")).

In addition, Baum discloses that synchronization signals from different base units are monitored to determine which provides the "best signal quality" to identify a serving base unit. Ex.1005, 14:24-33. Because the different synchronization signals are unique to their associated base units, the synchronization signals identify different base units ("*node identifying information*"). Ex.1003, ¶296.

Thus, Baum's synchronization and/or identification signals (having "*node identifying information*") transmitted on a different time and/or frequency ("*unshared parameter channel*") than signals from other transmitters discloses or renders obvious [10.1]. Ex.1003, ¶297.

IX. MANDATORY NOTICES

A. Real Party-in-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Ericsson Inc. ("Ericsson") and corporate parent Telefonaktiebolaget LM Ericsson are each a real party-in-interest, as is

Nokia of America Corporation ("Nokia") and Nokia Solutions and Networks Oy. Ericsson and Nokia are designated as Petitioner.

B. Related Matters

Pursuant to 37 C.F.R. § 42.8(b)(2), to the best knowledge of the Petitioner, the '071 Patent is involved in the following cases ("parallel district court lawsuits"):

- *Collision Communications, Inc. v. Nokia Corp. et al.*, 2-21-cv-00308 (E.D.Tex.) (complaint filed on August 10, 2021)
- *Collision Communications, Inc. v. Telefonaktiebolaget LM Ericsson et al.*, 2-21-cv-00327 (E.D.Tex.) (complaint filed on August 27, 2021)

C. Lead and Back-up Counsel and Service Information

Pursuant to 37 C.F.R. § 42.8(b)(3), Petitioner identifies the following counsel. Powers of attorney accompany this Petition.

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Please address all correspondence to lead and back-up counsel. Petitioner consents to electronic service.

X. THE *FINTIV* FACTORS FAVOR INSTITUTION

The Board balances six factors in considering discretionary denial under 35 U.S.C. § 314(a) when parallel litigation exists. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). Here, these factors ("*Fintiv* factors") favor institution, particularly under Director Vidal's recent clarification and reweighing of various *Fintiv* factors. *See* Director Vidal, Memorandum, "Interim Procedure for Discretionary Denials in AIA Post-Grant

Proceedings with Parallel District Court Litigation," dated June 21, 2022 ("Director-Memo"). As explained further below, based on the strength of the unpatentability challenges alone, institution should not be discretionarily denied. For example, multiple single-reference obviousness grounds are presented (Kim and Baum grounds) and another ground involving only two references – Tong and Jia – is presented in which Tong alone demonstrates unpatentability of all claims in the ground and Tong combined with Jia provides an additional basis of unpatentability for one of the claim elements.

Fintiv factor 1 (possibility of a stay) is neutral. Because a stay motion has not yet been filed, the Board should not speculate as to the outcome of that motion, and typically does not do so. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 15 at 12 (PTAB May 13, 2020) (informative); *HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9 (PTAB Jan. 14, 2021).

Fintiv factor 2 (proximity of trial date to final written decision) is neutral. Jury selection is currently scheduled for January 2, 2023. Ex.1017, 1. However, the district court currently has at least six other trials scheduled to begin on either January 2 or 3, 2023. Ex.1019. Additionally, the Director-Memo recognizes that the "median time-to-trial for civil actions" in a district is an appropriate metric for this factor. Director-Memo, 3, 8-9. Here, the median time to trial in the Eastern District of Texas is 24.2 months, Ex.1021, 35, yielding a trial date of

approximately August 2023. Given the uncertainty in the trial date, factor 2 does not favor denial. Nor would proximity to trial alone outweigh the other factors favoring institution. Director-Memo, 8.

Fintiv factor 3 (investment in parallel proceedings) favors institution. Petitioner promptly filed this Petition less than nine months after receiving infringement contentions and well-ahead of the one-year statutory time bar for filing an IPR, favoring institution. *Fintiv*, Paper 11 at 11. Nonetheless, it is premature to argue regarding the timing of respective milestones in the proceeding versus the litigation, as the schedule may shift in the coming several months. Thus, if Patent Owner raises § 314(a) arguments in a Preliminary Response, Petitioner respectfully requests the opportunity to reply prior to institution to address expected schedules.

Fintiv factor 4 (overlap in issues) favors institution. Four of the six references used herein –Kim, Tong, Dubuc, and Jia – are not used in any way in the parallel district court lawsuits involving Petitioner (e.g., these references do not form the basis for any invalidity position), so the overlap is minimal. Indeed, only one of the five grounds herein can even potentially be raised in the litigation. And Petitioner addresses all claims asserted in district court.

Fintiv factor 5 (overlap in parties) is neutral. Although each Petitioner is a defendant in litigation, this is true of most Petitioners in IPR proceedings, making

this factor neutral. *See HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9.

Fintiv factor 6 (other circumstances, including the merits) favors institution because the merits of Petitioners' invalidity arguments are particularly strong. For example, many of the claims are unpatentable based on at least three separate grounds. In fact, the evidence here represents a "compelling unpatentability challenge" for "one or more claims" such that, **based on this fact alone**, the Board should not discretionarily deny the petition. Director-Memo, 4-5; *see also*, *e.g.*, *Hewlett Packard Enterprise Co. et al. v. BillJCo, LLC*, IPR2022-00420, Paper 17, 5-7 (PTAB July 12, 2022). For example, in all grounds for independent claims 1 and 21, unshared channels are assigned to pilot symbols (Kim and Tong) or synchronization signals (Baum) and parameters from those symbols/signals are used in demodulating data symbols that are transmitted over shared channels. The evidence herein, "if unrebutted at trial, would plainly lead to a conclusion that one or more claims are unpatentable." *Id.*, 4.

In sum, based on the current framework for considering discretionary denials and the particular facts of this petition and the parallel district court lawsuits, institution should not be discretionarily denied.

XI. CONCLUSION

For the reasons detailed above, institution of *inter partes* review is requested.

Dated: July 20, 2022

Respectfully submitted,

By: /Clint Wilkins/
Clint Wilkins
Registration No.: 62,448
Customer No. 27683
Attorney Docket No. 26069.57
Lead Counsel for Petitioner

XII. CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned attorney for the Petitioner, declares that the argument section of this Petition (Sections I-VIII, X-XI) has a total of 13,265 words according to the word count tool in Microsoft Word™.

/Clint Wilkins/
Clint Wilkins
Registration No. 62,448
Lead Counsel for Petitioner

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent of: Collision Communications, Inc.	§	Petition for *Inter Partes* Review
	§	
	§	Attorney Docket No.: 26069.130
U.S. Patent No. 9,814,071	§	
	§	Customer No.: 27683
Issued: November 7, 2017	§	
	§	Real Parties in Interest:
Title: Media Access Control Protocol for Multiuser Detection Enabled Ad-hoc Wireless Communications	§	Ericsson Inc.; Telefonaktiebolaget LM Ericsson; Nokia of America Corporation; Nokia Solutions and Networks Oy

CERTIFICATE OF SERVICE

The undersigned certifies, in accordance with 37 C.F.R. § 42.205, that service was made on the Patent Owner as detailed below.

Date of service July 20, 2022

Manner of service FEDERAL EXPRESS

Documents served Petition for *Inter Partes* Review Under 35 U.S.C. § 312 and 37 C.F.R. § 42.104; Petitioner's Exhibit List; Certificate of Word Count; Exhibits: Ex.1001 through Ex.1014 and Ex.1016 through Ex.1021

Persons served Collision Communications, Inc.
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Peterborough, NH 03458

The undersigned further certifies that a courtesy copy of the complete and entire Petition was provided by electronic service to counsel retained by Patent Owner in the Related Matters identified herein:

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