

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC., and
NOKIA OF AMERICA CORPORATION
Petitioners,

v.

ACTIVE WIRELESS TECHNOLOGIES LLC
Patent Owner.

U.S. PATENT NO. 10,601,566
Title: MULTIPLE SLOT LONG PHYSICAL UPLINK CONTROL CHANNEL
(PUCCH) DESIGN FOR 5TH GENERATION (5G) NEW RADIO (NR)

Inter Partes Review No.: IPR2024-00985

PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 10,601,566

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Petitioners' Exhibit List

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 10,601,566 (the "'566 Patent")
1002	Select portions of prosecution history of the '566 Patent ("File History")
1003	Declaration of Petitioners' Expert Mark Mahon, PhD.
1004	U.S. Patent Application Publication No. 2019/0159191 ("Kim")
1005	U.S. Patent No. 10,951,350 ("Gao")
1006	Certified English translation of Chinese Patent Application No. 2017/10527934.4 ("Gao Provisional")
1007	Chinese Patent Application No. 2017/10527934.4
1008	Certified English translation of Chinese Patent Application No. 2017/10457951.5 ("Gao Provisional")
1009	Chinese Patent Application No. 2017/10457951.5
1010	3GPP, "Support of long-PUCCH over multiple slots" (R1-1710013)
1011	3GPP, "Long PUCCH Over Multiple Slots" (R1-1710555)
1012	U.S. Patent No. 9,391,736 ("Nazar")
1013	U.S. Patent No. 9,716,575 ("Ahn")
1014	3GPP, "Editorial correction to the calculation of Rate Matching parameters" (R1-000426) (TS25.212 CR 059r1 V3.1.0)
1015	U.S. Patent No. 8,705,339 ("Takaoka")
1016	U.S. Patent No. 10,873,435 ("Huang")
1017	U.S. Provisional Application No. 62/501,681 ("Huang Provisional")
1018	WO 2018/228194

I. INTRODUCTION

Pursuant to 35 U.S.C. §§ 311 *et seq.* and 37 C.F.R. §§ 42.1 *et seq.*, Ericsson Inc. and Nokia of America Corporation (“Petitioners”) hereby petition for an *inter partes* review of U.S. Patent No. 10,601,566 (the “’566 Patent”). Petitioners respectfully submit that claims 8-14 and 16 (the “Challenged Claims”) of the ’566 Patent are unpatentable under 35 U.S.C. §103 in view of the prior art herein.

II. OVERVIEW

The Challenged Claims are directed to techniques for improving communication flexibility and/or efficiency for multiple slot long physical uplink control channel (PUCCH) design for 5G wireless systems. EX-1001 1:18-21, 1:43-45. Almost everything described in the claims was known from prior 4G systems with some minor improvements for 5G.

The PUCCH is used to transmit uplink control information (“UCI”) from the user equipment (UE) such as a phone to the base station (also referenced as a “eNB” or “gNB”). The gNB configures the PUCCH format used by the UE for transmitting control information. EX-1001 5:40-55.

As detailed in Section V.F, in 5G systems, data transmissions use “frames” that are broken down into “sub-frames” which can be further broken down into variable number of “slots” as depicted in Fig. 5 of the ’566 patent:

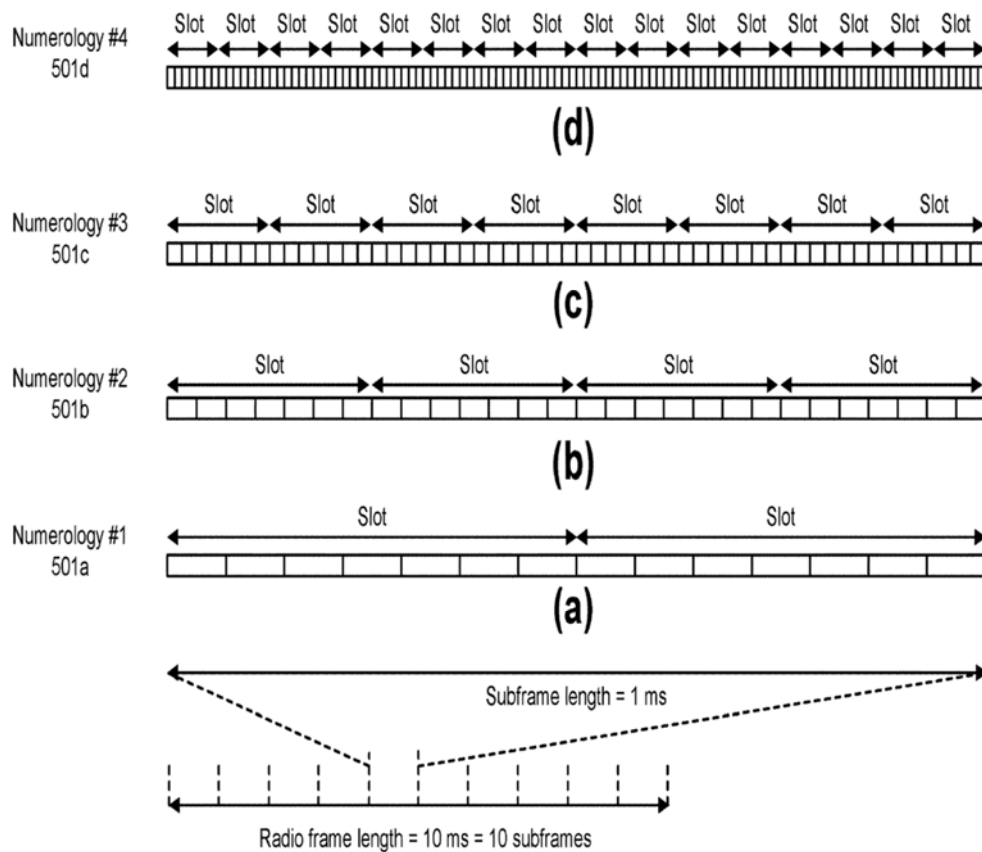


FIG. 5

EX-1001 Fig. 5. Each “slot” can have multiple “symbols.” The symbols carry data for particular channels. So, as shown in Figure 7, a slot may carry symbols that have data for different channels.

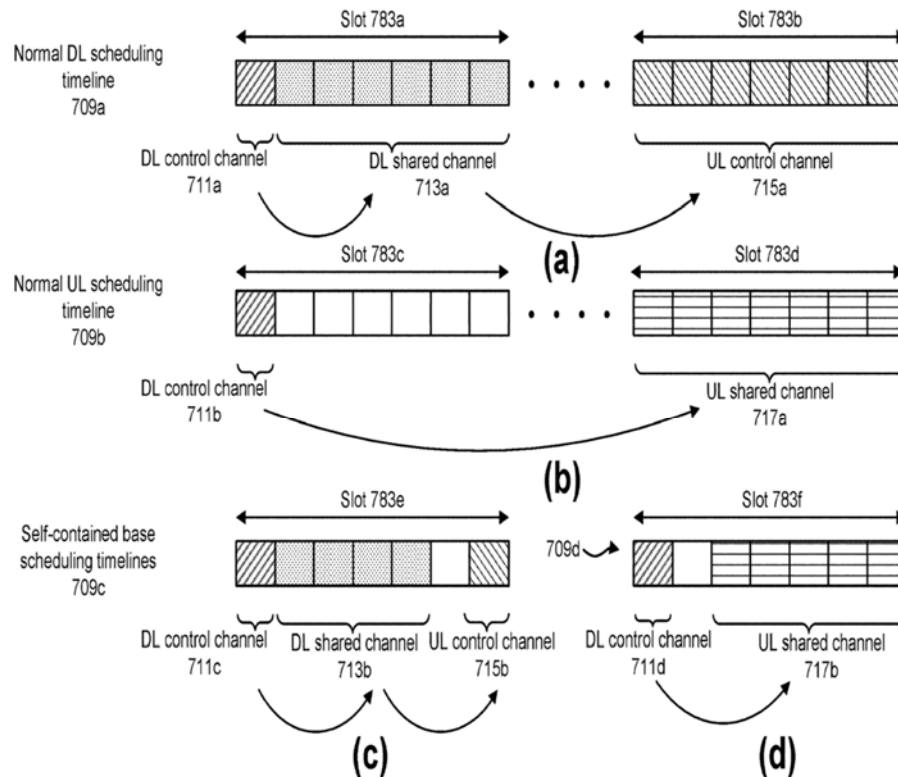


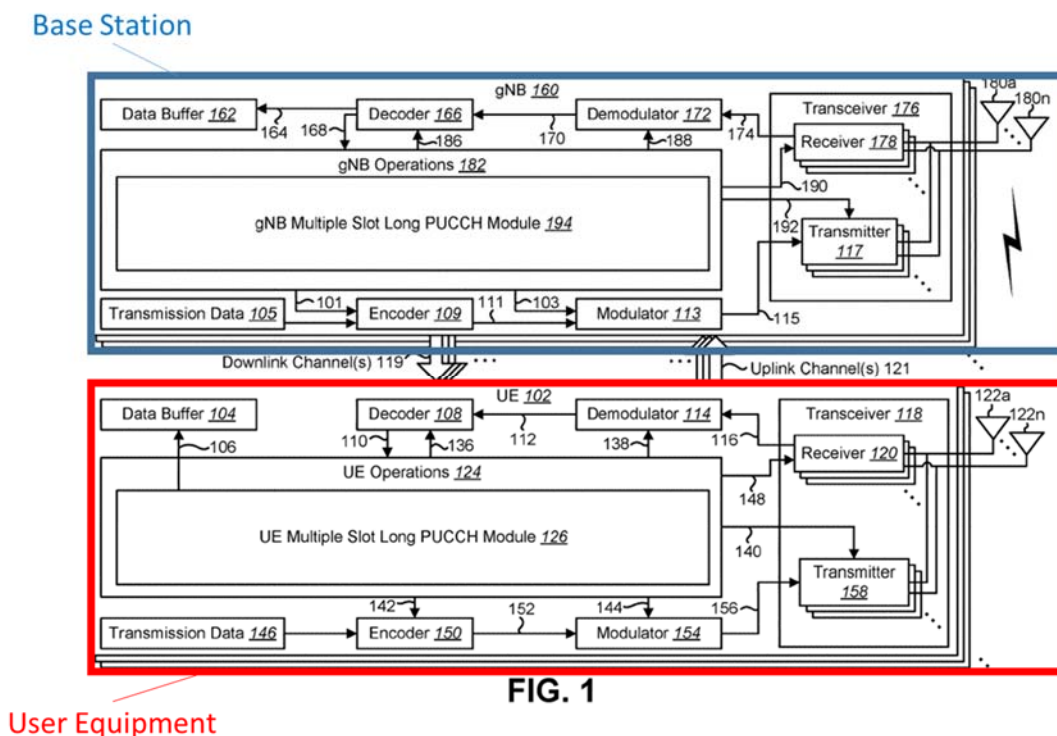
FIG. 7

EX-1001 Fig. 7. This architecture was well-known and part of the 3GPP standard prior to the '566 Patent.

The '566 Patent relates to a particular configuration of which slots and symbols that are used for the PUCCH. As was known prior to the '566 Patent, 5G systems could have a “short PUCCH” format or a “long PUCCH” format. EX-1001 5:44-46. The “long” format may span over multiple slots. EX-1001 5:47-49.

The systems and methods disclosed in the '566 Patent detail specific formats for long PUCCH design over multiple slots. EX-1001 5:50-51. Figure 1 of the '566 patent shows the gNB and UE exchanging information across various uplink

(to the gNB) and downlink (to the UE) channels.



EX-1001 FIG. 1 (annotated).¹

The Challenged Claims require the base station (**blue**) to transmit a *signaling* to the UE (**red**). EX-1001 5:48-52. The signaling is used to configure the resource assignment for the UE to transmit control information and data over the various uplink channels to the base station including the “uplink control information” (UCI) transmitted over the PUCCH.

The '566 Patent teaches that the gNB will “configure” the UE to know how to transmit uplink control information on the PUCCH. EX-1001 26:19-37. The

¹ All emphasis and annotations herein added unless otherwise stated.

Challenged Claims recite the gNB receiving the UCI. In other words, the gNB will configure the UE to transmit the UCI on particular slots and symbols and the gNB then receives that UCI on the configured slots / symbols.

The Challenged Claims recite three distinct aspects of the long PUCCH: (1) the number of PUCCH symbols must be the same between slots; (2) the location of the PUCCH symbols must be the same between slots; and (3) there must be “frequency hopping” (explained below) between slots. The ’566 Patent includes Figures describing each of these claimed aspects.

FIG. 37 of the ’566 Patent (reproduced below) teaches examples of how the “number” and “location” (aspects 1 and 2 above) may be the same or different.

EX-1001 43:16-24.

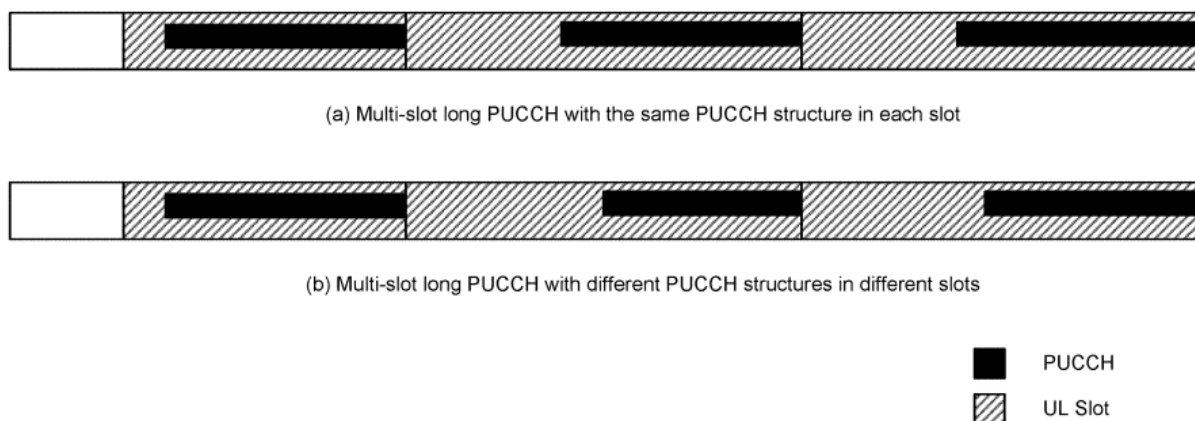


FIG. 37

EX-1001 FIG. 37. As shown above, Fig. 37(a) shows an example in which the number and location of the PUCCH symbols is the same between slots. Fig. 37(b)

shows a counter-example in which the location and number of PUCCH symbols is different between, for example, the left slot and the other two slots.

The third claimed aspect is that there must be “frequency hopping” between the slots for the PUCCH. Frequency hopping occurs when a signal is transmitted over different carrier frequencies, and if configured, the PUCCH symbols can be transmitted at different PUCCH regions of the slot. EX-1001 17:4-10.

Frequency hopping can be performed between slots (“inter-slot”) in which the frequencies change between slots. Alternatively, frequency hopping can be performed within a single slot (intra-slot) in which frequencies change within a slot. EX-1001 6:32-36, 17:5-6, 21:65-66. FIG. 38(a) of the ’566 Patent illustrates inter-slot frequency hopping. FIG. 38(b) discloses another intra-slot frequency hopping.

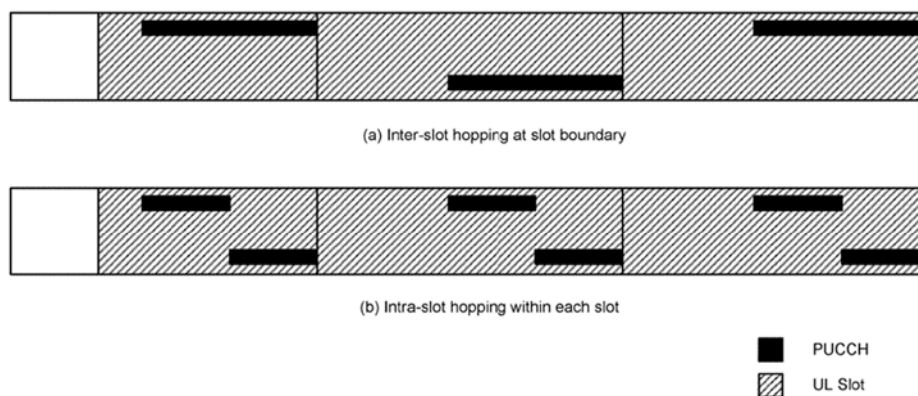
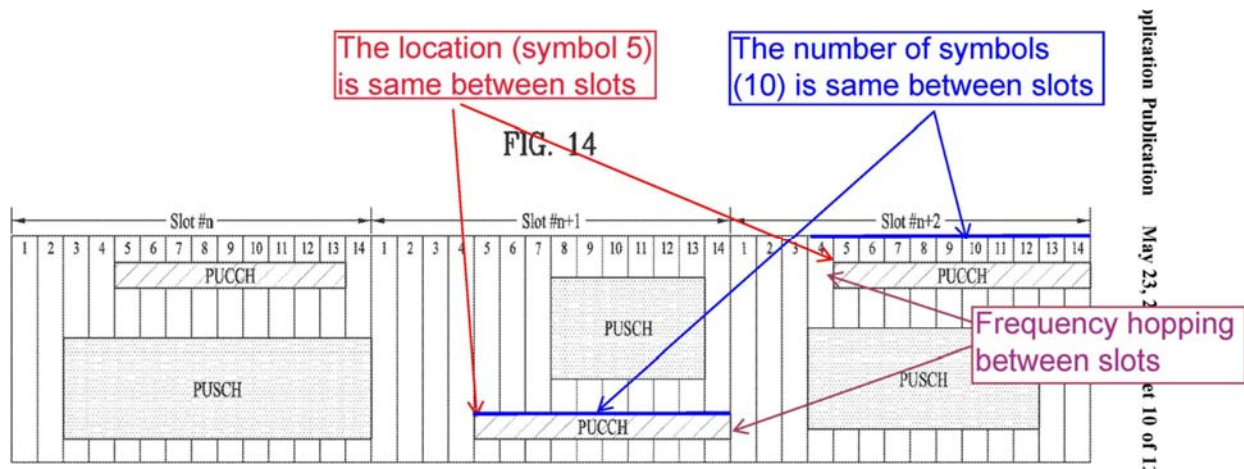


FIG. 38

EX-1001 FIG. 38, 43:32-49. The frequency hopping is depicted by the vertical change in FIG. 38 (the vertical axis represents different frequencies).

As detailed below, everything in the Challenged Claims was known prior to the '566 patent filing. For example, the Kim reference² describes the configuration of the PUCCH as claimed in a single diagram.



EX-1004, Fig. 14.³ Kim shows a “long PUCCH transmission is configured over a total of two TTIs or slots, i.e., slot #n+1 and slot #n+2 as shown in FIG. 14.” EX-1004, ¶234. The **“location” (red)** is the same as both slot#n+1 and slot#n+2 start at symbol 5. The **number (blue)** of symbols is the same (10 symbols) going from symbols 5-14. **Frequency hopping** between slots is shown in purple by the symbols being at different locations on the vertical axis (which represents different frequencies).

² U.S. Patent Application Publication No. 2019/0159191 A1 to Kim et al. (“Kim”) (EX-1004).

³ All annotations added unless otherwise stated.

Kim's specification expressly discloses each of these concepts. First, the "number" and "location" of symbols may be the same. "[I]n the two slots, the last ten symbols among the twelve symbols are set as a long PUCCH region." EX-1004 ¶234 (showing both the number ["ten"] and location ["last ten"] are the same between slots). See also EX-1004 ¶233 ("[T]he number of symbols allocated for the PUCCH transmission within one TTI may be constant for all TTIs.") Kim describes the frequency hopping as either inter-slot or intra-slot:

information about a frequency hopping interval may be configured/indicated via DCI or higher layer signaling. In this case, the frequency hopping may be hopping in a single TTI (or slot), inter-TTI (or inter-slot) hopping as shown in FIG. 14, EX-1004 ¶235.

Thus, the Challenged Claims recite nothing more than configuring the PUCCH in a manner that is well-known in the prior art. Thus, Petitioners respectfully request that the Board institute IPR and cancel the Challenged Claims.

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

Petitioners certify that the '566 Patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR of the Challenged Claims on the grounds identified herein. 37 C.F.R. § 42.104(a).

IV. REASONS FOR THE REQUESTED RELIEF

As explained below and in the attached Declaration of Petitioners' Expert

(EX-1003), the Challenged Claims of the '566 Patent were obvious over the prior art to a person of ordinary skill in the art ("POSITA") at the time of the invention.

V. BACKGROUND

A. Summary of the '566 Patent

As shown in the Introduction, the '566 Patent claims the admittedly well-known concept of configuring a PUCCH format of multiple slots based on signaling from a base station and the base station processing received uplink control information transmitted in the PUCCH with frequency hopping.

B. Prosecution History

The '566 Patent issued from U.S. Patent Application No. 16/059,926, which was filed on August 9, 2018 as a continuation of International Patent Application No. PCT/US2018/045836, filed on August 8, 2018 claiming priority to U.S. Provisional Patent Application No. 62/543,795, filed August 10, 2017 ("795 Provisional").

During prosecution, the Examiner rejected the originally pending claims as being obvious from Huawei, HiSilicon, "Long Duration PUCCH structure", 3GPP TSG RAN WG1 Meeting #89, Hangzhou, China, R1-1706953, 19 May 2017, and in further view of NTT DOCOMO, INC., "Long-PUCCH for more than one slot", 3GPP TSG RAN WG1 NR Ad-Hoc#2, Qingdao, China, R1-1711102, 30 June 2017. EX-1002 ('566 Patent File History), 42. In response, Applicant did not challenge these 3GPP submissions as being prior art and instead amended the

claims to incorporate the claim limitations shown in the excerpt below.

8. (Currently Amended) A base station (gNB), comprising:
a processor; and
memory in electronic communication with the processor, wherein instructions stored in the memory are executable to:
- ~~determine an uplink control channel (PUCCH) spans over multiple slots;~~
 - ~~determine a demodulation reference signals (DMRS) structure in the configured multi slot PUCCH;~~
 - ~~determine a frequency hopping method of the configured multi slot PUCCH;~~
 - ~~determine UCI encoding and loading methods on the configured multi slot PUCCH;~~
 - ~~determine a resource of a control channel for UCI feedback; and~~
 - transmit, to a user equipment (UE), a signaling, an uplink control channel (PUCCH) spans over multiple slots being determined based on the signaling; and
 - receive uplink control information (UCI) on a selected channel with the frequency hopping for the configured multiple slots PUCCH, wherein
the number of symbols of the PUCCH is the same in each slot of the multiple slots, and
the location of the symbols for the PUCCH is the same in the each slot of the multiple slots.

EX-1002 ('566 Patent File History), 30-31.

Applicant admitted that “[t]he cited reference R1-1706953 discusses the structures of an NR long PUCCH in multiple slots.” EX-1002 ('566 Patent File History), 34. The Applicant argued that [the cited references] do not teach or suggest to “transmit uplink control information (UCI) with the frequency hopping,

wherein the number of symbols of the PUCCH is the same in each slot of the multiple slots, and the location of the symbols for the PUCCH is the same in each slot of the multiple slots. R1-1711102 does not make up for the deficiencies of R1-1706953.” EX-1002 (’566 Patent File History), 34-35.

Subsequently, a Notice of Allowance issued on December 18, 2018. The Examiner did not set forth any additional substantive reasons for allowance. EX-1002 (’566 Patent File History), 14-15. As demonstrated below, the features added by amending the claims were well-known in LTE and NR technologies at the time of the purported invention recited in the Challenged Claims.

C. Priority Date

For purposes of this Petition, Petitioners do not challenge that the Challenged Claims are entitled to the priority date established by the ’795 Provisional because each of the cited prior art references is prior art to the Challenged Claims of the ’566 Patent regardless of whether the Challenged Claims are entitled to the filing date of the ’795 Provisional.

D. Claim Construction

Petitioners propose that each claim term be given its plain and ordinary meaning herein. The prior art herein meets each claim limitation under any reasonable construction.

E. Person of Ordinary Skill in the Art

With respect to the ’566 Patent, a POSITA in August 2017 would have been

familiar with wireless communications networks, equipment, and integrated circuit chips, and would have had at least a working knowledge of the communication protocols used in LTE and 5G radio access networks (RAN). A POSITA would have had at least a Bachelor's degree in Electrical Engineering or related field, and at least four years of work experience in design, development, and/or testing wireless telecommunication systems. A POSITA would have had familiarity with the wireless standards and protocols related to data transmission and network management. To the extent a POSITA would have had a more advanced degree, such as a Master's degree in Electrical Engineering or related field, then a POSITA may have had less work experience. EX-1003 ¶¶ 37-39.

F. State of the Art

The following section describes the relevant state of the art as of the priority date. The prior art references, and the discussions of what was known to a POSITA, provide the factual support for the general description of the state of the art, assist in understanding how a POSITA would have understood the prior art, and provide the motivation to modify or combine the teachings of references.

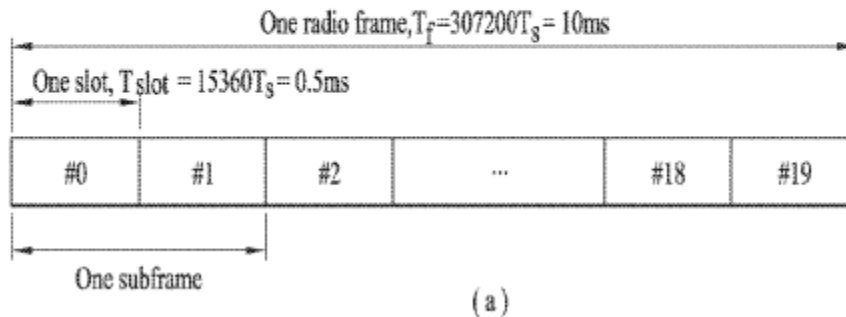
1. Frequency Hopping

By August 2017, frequency hopping was well-known for wireless access communication networks. Frequency hopping is a method of transmitting wireless signals by changing the carrier frequency of the signal to be transmitted.

Orthogonal frequency division multiplexing (“OFDM”) is a technique to encode data onto a plurality of subcarriers in a radio frame structure. EX-1004 ¶71; EX-1003, ¶ 44.

A radio frame can be divided into multiple subframes (as shown in FIG. 2 from Kim below), where the time required for transmitting one subframe is defined as the Transmission Time Interval (TTI). EX-1004 ¶71; EX-1003, ¶¶ 45. The subframe can be further divided into a plurality of slots, with each slot having a plurality of OFDM symbols. EX-1004 ¶¶71, 72; EX-1003, ¶¶ 45.

FIG. 2



EX-1004 FIG. 2.

Kim discloses that the radio frame structure can vary, stating the “radio frame structure is purely exemplary. Thus, the number of subframes in a radio frame, the number of slots in a subframe, and the number of OFDM symbols in a slot may be changed.” EX-1004 ¶¶74, 150, 151, 152. Kim further describes TTIs

of different sizes, including a TTI being equal to less than 1 ms, i.e., less than one subframe. EX-1004 ¶152. Kim further discloses examples of the radio frame structure where a TTI represents one slot. EX-1004 ¶227.

Frequency hopping maps the OFDM symbols to the different subcarriers used for transmitting the data. EX-1003, ¶ 47. The 3GPP submission, “Support of long-PUCCH over multiple slots” (“R1-1710013”) discloses various patterns of frequency hopping that can be used in transmitting long-PUCCH over multiple slots. EX-1010 (“R1-1710013”), 2-4. For example, FIG. 2(a) of R1-1710013 discloses the hopping pattern of PUCCH channel where slot 1 has the same arrangement as slot 2, and FIG. 2(b) discloses the hopping pattern of the PUCCH channel where the arrangement of slot 2 is switched from the arrangement of slot 1. EX-1010 (“R1-1710013”), 2-3. The x-axis of the slot corresponds to length of time and the y-axis corresponds to the frequency. EX-1010 (“R1-1710013”) FIG. 2; EX-1003 ¶47.

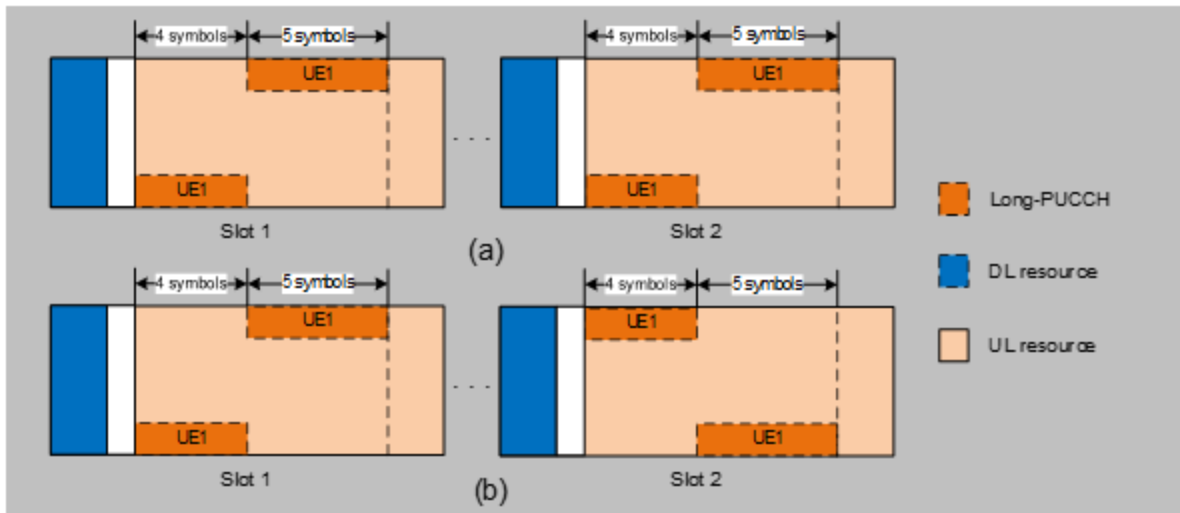


Figure 2. An example of 18 symbols in two slots for Option 1

EX-1010 (“R1-1710013”) FIG. 2; EX-1003 ¶47.

U.S. Patent No. 8,705,339 (“Takaoka”; EX-1015) is another example of a reference disclosing frequency hopping, which a POSITA would have understood as being a well-known technique. EX-1003 ¶48. Takaoka discloses:

As described above, the frequency resource allocation and mapping method in an LTE UL physical channel (1) maps a signal to a continuous frequency band in a localized manner to thereby maintain a low PAPR characteristic of a UL SC-FDMA signal and (2) use *inter-slot frequency hopping*, and can thereby improve a frequency diversity effect and an effect of suppressing other cell interference.

EX-1015 (“Takaoka”) 1:57-63.

2. Rate Matching and Puncturing

By August of 2017, rate matching and puncturing of resources in wireless access systems were well-known. EX-1003 ¶49. The 3GPP submission, “Editorial

correction to the calculation of Rate Matching parameters” (“R1-00426”), defines rate matching as “Rate matching means that bits on a transport channel are repeated or punctured.” EX-1014 (“R1-00426”), 1; EX-1003 ¶49. R1-00426 further provides:

The number of bits on a transport channel can vary between different transmission time intervals. In the downlink the transmission is interrupted if the number of bits is lower than maximum. *When the number of bits between different transmission time intervals in uplink is changed, bits are repeated or punctured to ensure that the total bit rate after TrCH multiplexing is identical to the total channel bit rate of the allocated dedicated physical channels.*

EX-1014 (“R1-00426”), 2; EX-1003 ¶49.

U.S. Patent No. 9,391,736 (“Nazar”; EX-1012) discloses a rate matching module that is configured to perform rate matching on encoded uplink control bits (HARQ ACK/NACK). EX-1012 (“Nazar”) 31:17-35, FIG. 11; EX-1003 ¶50.

Rate matching can be used to make the information occupy the resources within a PUCCH resource block, e.g., 48 bits. EX-1012 (“Nazar”) 31:17-35; EX-1003 ¶50.

U.S. Patent No. 9,716,575 (“Ahn”; EX-1013) describes implementing rate matching/puncturing of a signal in an uplink control channel to address issues with the transmission of misaligned resources in the network. EX-1013 (“Ahn”) 14:19-32; EX-1003 ¶51. Ahn discloses, “[i]f the subframe timing is misaligned by more than the threshold, some of the UL signals may be subjected to

dropping/puncturing/*rate-matching*, and if the subframe timing is misaligned by less than the threshold, a transmit power of some signals may be reduced.” EX-1013 (“Ahn”) 14:19-32; EX-1003 ¶51.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

This Petition challenges claims 8-14 and 16 of the ’566 Patent.

B. Statutory Grounds for Challenges

The Challenges are detailed below and summarized as follows:

Ground	Claims	Basis	Reference
1	8-11, 13, 14, and 16	§ 103	Kim, alone or in combination with Gao
2	12	§ 103	Kim, alone or in combination with Gao in view of R1-1710555
3	12	§ 103	Kim, alone or in combination with Gao in view of Huang

Ground 1:

U.S. Patent Application Publication No. 2019/0159191 A1 to Kim et al. (“Kim”) (EX-1004) is a continuation of PCT/KR2017/006813 filed June 28, 2017 and qualifies as prior art under 35 U.S.C. §102(a)(2).

U.S. Patent No. 10,951,350 to Gao (“Gao”) (EX-1005) is a U.S. National Phase Application of Application No. PCT/CN2018/089019 filed on May 30, 2018 which claims priority to the Chinese Patent Application No. 2017/10457951.5 filed in China on January 16, 2017 (EX-1009 (Original); EX-1008 (English translation)) and priority to the Chinese Patent Application No. 2017/10527934.4 filed in China

on June 30, 2017 (EX-1007 (Original); EX-1006 (English translation)). As demonstrated below in VII.A.2, Gao qualifies as prior art under 35 U.S.C. 102(a)(2) because Chinese Patent Applications fully support the invalidating disclosure and are dated prior to the Priority Date.

Ground 2:

The 3GPP submission, “Long PUCCH Over Multiple Slots” (“R1-1710555”) (EX-1011), which was submitted for discussion during the 3GPP meeting was held in Qingdao, China on June 30, 2017, was publicly available as of June 2017. EX-1003 ¶¶ 148-161. R1-1710555 therefore qualifies as prior art under 35 U.S.C. 102(a)(1).

Ground 3:

U.S. Patent No. 10,873,435 (“Huang”) (EX-1016) to Huang et al. was filed on May 3, 2018 claiming priority to a Provisional Application No. 62/501,681 filed on May 4, 2017 (EX-1017). As discussed below in **Error! Reference source not found.**, Huang qualifies as prior art under 35 U.S.C. §102(a)(2).

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 8-11, 13, 14, and 16 are unpatentable over Kim, alone, or in combination with Gao

Ground 1 is that Kim, alone, or in view of Gao renders Challenged Claims 8, 10, 12-14, and 16 obvious.

1. Overview of Kim

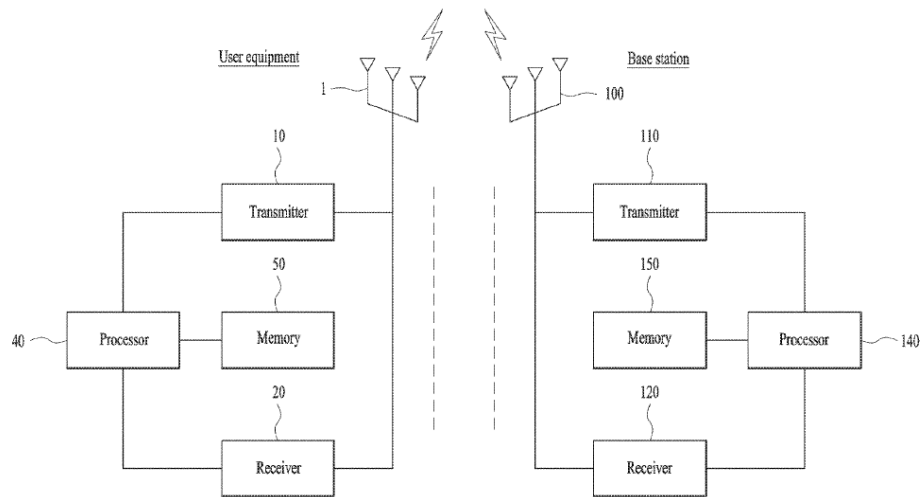
Kim discloses methods for transmitting/receiving an uplink signal between a base station and a terminal. EX-1004 Abstract. Kim states:

In a wireless access system, a UE receives information from an eNB on a DL and transmits information to the eNB on a UL. The information transmitted and received between the UE and the eNB includes general data information and various types of control information. There are many physical channels according to the types/usages of information transmitted and received between the eNB and the UE.

EX-1004 ¶59.

In Kim, one such physical channel is the PUCCH, which is used to carry uplink control information (UCI) to the base station. FIG. 18 of Kim depicts a system including a UE and a base station configured to implement embodiments of the method for transmitting and receiving PUCCH between the UE and the base station (eNB or gNB) 100. EX-1004 ¶¶306, 360, Abstract.

FIG. 18



EX-1004 FIG. 18.

Kim states, “The UCI includes a Hybrid Automatic Repeat and reQuest Acknowledgement/Negative Acknowledgement (HARQ-ACK/NACK), a Scheduling Request (SR), a Channel Quality Indicator (CQI), a Precoding Matrix Index (PMI), a Rank Indicator (RI), etc.” EX-1004 ¶¶67. The UCI is used for configuring the base station so that it knows what data/information should be received from the UE. EX-1004 ¶¶67, 111-117, 225, 286, 287.

Kim discusses the information transmitted over the wireless network is arranged and sent over a Transmission Time Interval (TTI), stating “[a] time required for transmitting one subframe is defined as a Transmission Time Interval (TTI).” EX-1004 ¶71. Kim provides that “if the number of symbols within one TTI used for transmitting a UL control channel is equal to or more than a predetermined value (e.g., 4), the *UL control channel is defined as a long*

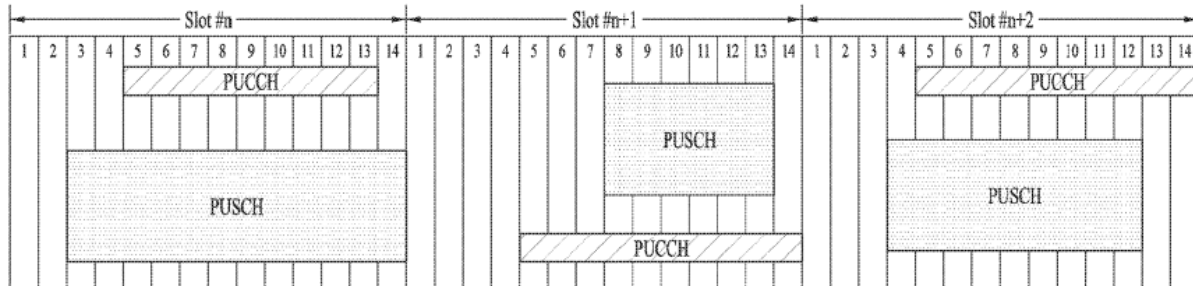
PUCCH.” EX-1004 ¶¶67, 71. Kim provides methods that can be applied when the UL control information is transmitted across multiple TTIs (slots or subframes). EX-1004 ¶¶224, 225. “The UL control information (e.g., UCI, HARQ-ACK/CSI/SR (scheduling request)) can be transmitted over most or all of the multiple TTIs. Such a signal transmission and reception method has an advantage in that a UE located at a cell boundary (e.g., cell edge UE) can solve the coverage problem.” EX-1004 ¶225.

As part of the PUCCH configuration, the OFDM symbol position and location within the PUCCH can be configured to offer flexibility in communication, as Kim discloses, “[s]ymbol allocation in one TTI can be equally applied to a plurality of TTIs used/allocated for transmitting one long PUCCH. In this case, the number of symbols allocated for the PUCCH transmission within one TTI may be constant for all TTIs or vary per TTI.” EX-1004 ¶233.

In order to increase the flexibility and efficiency of the PUCCH in the multiple slots, the symbols can be transmitted using different frequency resources (frequency hopping). EX-1004 ¶239. Frequency hopping prevents performance degradation in the continuously transmitted long PUCCH, which is caused by a power transient period. EX-1004 ¶239. Kim also describes configuring the frequency hopping of the PUCCH using downlink signaling, stating that “information about a time when frequency hopping is applied to such a long

PUCCH and/or information about a frequency hopping interval may be configured/indicated via DCI or higher layer signaling.” EX-1004 ¶235.

FIG. 14



EX-1004 FIG. 14.

The frequency hopping and symbol location are the resources that are configured by the base station. EX-1004 ¶¶228-230, 235, 287; EX-1003 ¶81. The base station of Kim configures the PUCCH in various ways, including providing signaling to the UE. For example, Kim states “information about a time when frequency hopping is applied to such a long PUCCH and/or information about a frequency hopping interval may be configured/indicated via **DCI or higher layer signaling.**” EX-1004 ¶¶235, 287. The configuration of the transmission region in a time domain can be applied to a single slot or multi-slot based long PUCCH, a PUSCH, or a PDSCH. EX-1004 ¶¶235, 242.

2. Overview of Gao

Gao is an AIA reference and meets the ministerial requirements of 35 U.S.C. §§ 119 and 120. On its face, Gao claims priority to PCT/CN2018/089019,

CN 2017/10457951.5, and CN 2017/0527934.4. PCT/CN2018/089019, which published as WO 2018/228194 (EX-1018), was filed within 12 months of the filing date of CN 2017/10457951.5 and CN 2017/0527934.4, and U.S. Patent Application No. 16/622,880, which issued as Gao, was filed within 30 months of CN 2017/10457951.5. Thus, all of the various applications in the Gao priority claim were co-pending with one another. Each of Gao, PCT/CN2018/089019, CN 2017/10457951.5, and CN 2017/0527934.4 identify Xuejuan Gao as the sole inventor. EX-1005 (Gao); EX-1006 (Gao Prov.); EX-1018 (Gao PCT).

Accordingly, Gao is entitled to the priority date afforded to it by the two Chinese priority applications. *Penumbra, Inc. v. RapidPulse, Inc.*, IPR2021-01466, Paper 34 (March 10, 2023). Petitioners cite to the both the Gao patent (EX-1005) and to the certified English translation of CN 2017/10527934.4 (EX-1006) demonstrating that the subject matter upon which Petitioner relies is prior art to the '566 Patent.

Gao discloses methods and systems for configuring and transmitting uplink control information in multiple slots of a long physical uplink control channel (PUCCH). EX-1005 (Gao) 2:1-10, 29:56-65, 30:42-40, Abstract; EX-1006 (Gao Prov.) 1:6-8; 2:3-5; 35:17-22, 36:13-18. FIG. 4 of Gao illustrates a method of receiving a PUCCH. EX-1005 (Gao) 20:66-21:3, FIG. 4; EX-1006 (Gao Prov.) 52:4-6, FIG. 4. At step 41, the UE determines the target slots for transmitting the UCI using the PUCCH. EX-1005 (Gao) 21:4-10, 21:39-48; EX-1006 (Gao Prov.)

25:7-11, 25:29-26:1.

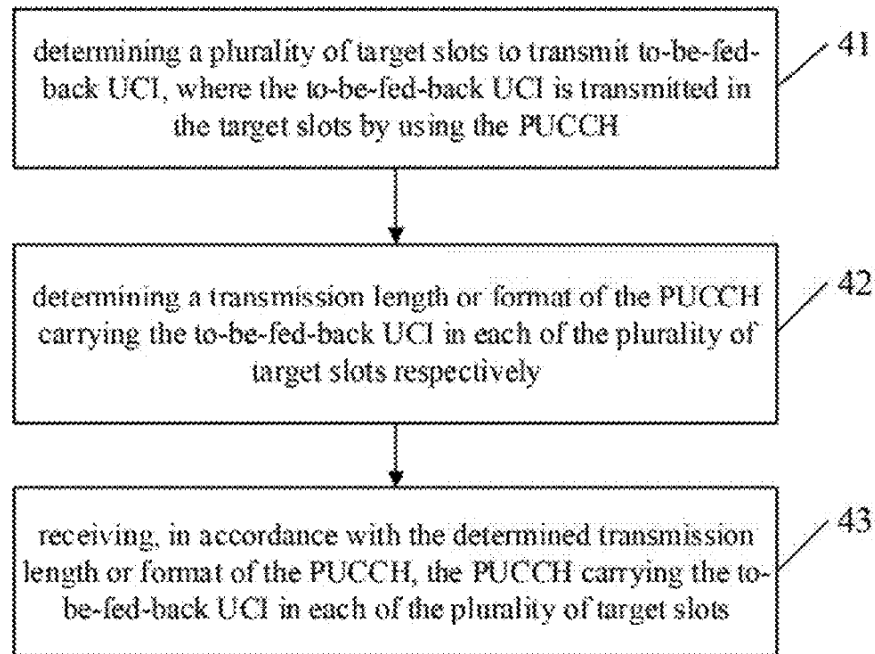


Fig. 4

EX-1005 (Gao) FIG. 4; EX-1006 (Gao Prov.) FIG. 4.

The base station can transmit the configuration information of the plurality of target slots of the PUCCH to the UE by means of a higher layer signaling. EX-1005 (Gao) 21:39-42, 22:7-16, 31:57-63; EX-1006 (Gao Prov.) 25:29-26:1, 26:18-24, 37:29-33. Upon configuring the PUCCH, the UE provides the control information to the base station over the PUCCH. EX-1005 (Gao) 29:56-65, 31:57-63; EX-1006 (Gao Prov.) 32:12-17, 35:17-22. The PUCCH comprises a plurality of symbols, and in Gao, the UCI is transmitted to the base station using a UCI+RS (Reference Symbol) structure (*pattern*) for a long PUCCH format (e.g., 4 symbols or greater). EX-1005 (Gao) 32:6-10; EX-1006 (Gao Prov.) 37:29-33; 37:38-38:1.

The “UCI+RS structure” is a structure that provides a mapping of the UCI and RS in the PUCCH, where the mapping indicates which symbols are used to transmit the UCI and which symbols are used to transmit the RS. EX-1005 (Gao) 24:21-45; EX-1006 (Gao Prov.) 3:18-24, 17:37-18:9, 28:34-38. Gao also makes a note that different structures of UCI and RS are possible on account of different transmission durations and whether there is frequency hopping between symbols. EX-1005 (Gao) 15:6-12, 24:46-52; EX-1006 (Gao Prov.) 18:10-14, 29:7-11. Prior to transmission of the UCI+RS structure to the base station, Gao discloses the UCI bits can be coded and the coded UCI bits can be rate matched. EX-1005 (Gao) 32:25-33; EX-1006 (Gao Prov.) 38:7-15.

At step 43 of the method shown in FIG. 4 referenced above, the PUCCH carrying the UCI feedback is received by the base station according to the configured transmission duration or format. EX-1005 (Gao) 21:19-22; EX-1006 (Gao Prov.) 25:17-21.

Gao addresses the need to configure the transmit uplink control information in multiple slots due to the varying size of the uplink regions of different slots. EX-1005 (Gao) 2:7-10; EX-1006 (Gao Prov.) 1:33-2:1. The disclosed methods of Gao provide for improved communication efficiency. EX-1005 (Gao) 2:1-10; EX-1006 (Gao Prov.) 1:33-2:1.

3. Reasons to combine Kim and Gao

A POSITA would have been motivated to combine the teachings of Kim and Gao for multiple reasons. EX-1003 ¶87.

First, Kim and Gao are analogous art, pertaining to the same field of endeavor as the '566 Patent, wireless network access systems. EX-1003 ¶88. Both in Kim and Gao, the PUCCH can be configured for carrying various types of UCI by higher layer signaling from the base station. EX-1004 ¶65; EX-1005 (Gao) 21:39-48; EX-1006 (Gao Prov.) 25:29-26:1; EX-1003 ¶88.

Kim addresses the problem of configuring the PUCCH and communication structure for devices using the same resource in the communication system. EX-1004 ¶¶24, 25; EX-1003 ¶89.

Like Kim, Gao relates to methods and systems for transmitting and receiving a PUCCH in a wireless communication network. EX-1005 (Gao) 1:21-26; EX-1006 (Gao Prov.) 1:6-8; EX-1003 ¶90. Gao provides a solution for transmitting uplink information in multiple slots by dynamically configuring a long PUCCH when the uplink regions of different slots vary in size. EX-1005 (Gao) 2:7-10; EX-1006 (Gao Prov.) 1:37-2:1; EX-1003 ¶90.

Thus, a POSITA would have found Gao's teachings reasonably pertinent to addressing the problem identified by Kim of having limited communication structures for communicating between the base station and UE. EX-1004 ¶¶24, 25;

EX-1005 (Gao) 2:7-10; EX-1006 (Gao Prov.) 1:33-2:1; EX-1003 ¶91.

Second, a POSITA would have had reasonable expectation of success combining the teachings of Kim with Gao, because Kim’s teachings are compatible with Gao’s teachings of communicating over a wireless communications network according to the 3GPP standards to configure the PUCCH. EX-1003 ¶92.

A POSITA would have been motivated to combine the teachings of Kim and Gao because the combination involves merely using known techniques (e.g., higher level signaling) in a known way (e.g., configuring the communication resources such as PUCCH, frequency hopping of the UCI, etc.) to yield a predictable result (e.g., providing additional communication structures for communicating between the base station and UE). EX-1003 ¶93. Indeed, as discussed above in V.F.2, various configurations for PUCCH and frequency hopping was used in wireless communications systems. EX-1003 ¶93.

Further, a POSITA would be motivated to combine the teachings of Kim and Gao because the POSITA would have understood that configuring the PUCCH and implementing various frequency hopping methods provide the benefits of increasing frequency diversity resulting in improved reliability of the transmission in the network, and the benefits of “prevent[ing] performance degradation caused by power transient period.” EX-1004 ¶239; EX-1003 ¶94.

Therefore, incorporating the PUCCH configuration techniques of Gao into the PUCCH of Kim would thus involve nothing more than routine skill of a POSITA, and a POSITA would have a reasonable expectation of success. EX-1003 ¶95.

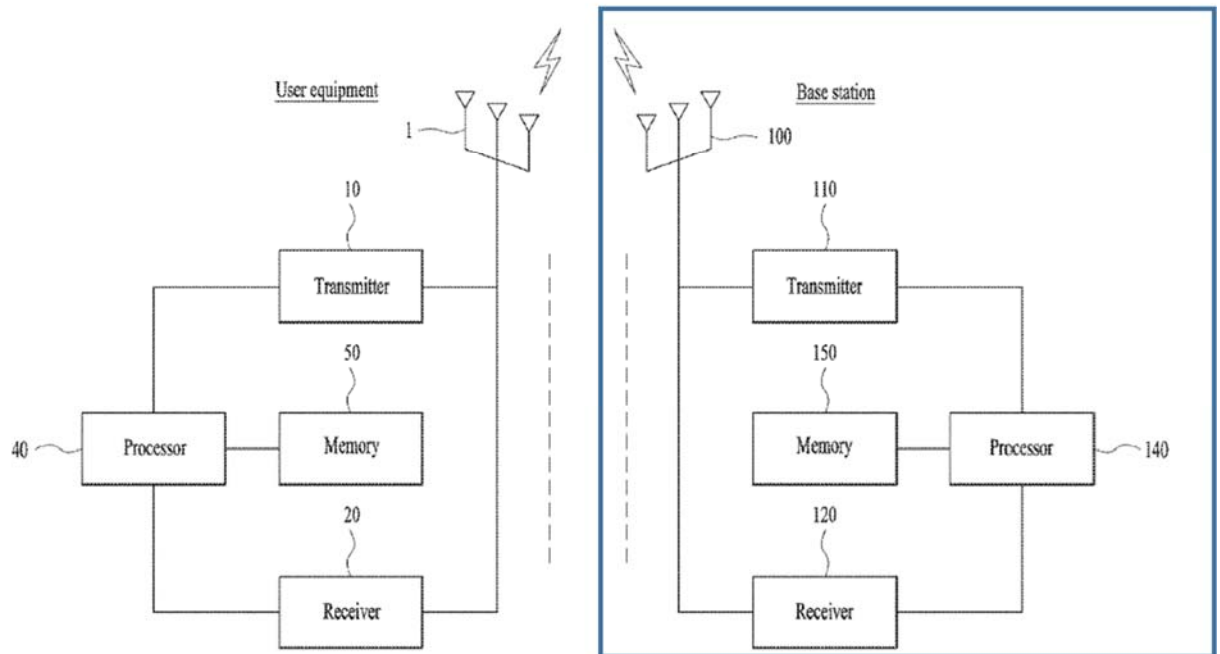
4. Detailed Application of Kim and Gao to the Challenged Claims

a. Claim 8

i. [8.0] A base station (gNB), comprising:

To the extent the preamble is limiting, Kim discloses this claim element. EX-1003 ¶¶ 96. As shown and described with reference to FIG. 18, Kim discloses a base station (*gNB 100*) (**blue**) including various components for performing the method of the invention. “The UE and the base station shown in FIG. 18 operate to implement the embodiments of the method for transmitting and receiving PUCCH between the UE and the base station. EX-1004 ¶305; EX-1003 ¶¶ 96.

FIG. 18



EX-1004, FIG. 18⁴; EX-1003 ¶¶ 96.

Kim states that the term base station is exemplary and further states, “[t]he term ‘BS’ may be replaced with a fixed station, a Node B, an evolved Node B (eNode B or eNB), an Advanced Base Station (ABS), an access point, etc.” EX-1004 ¶48; EX-1003 ¶97.

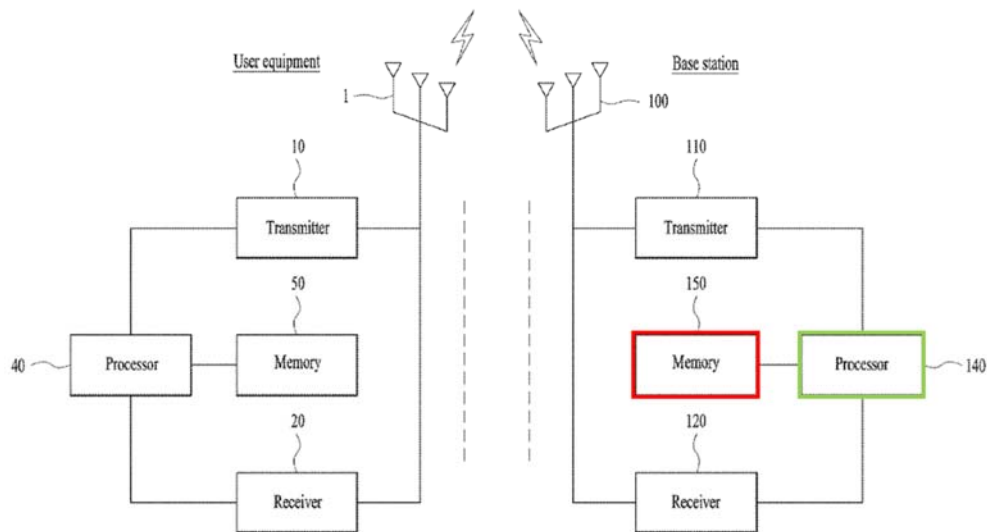
Kim discloses this claim element. EX-1003 ¶98.

⁴ All annotations added unless otherwise stated.

- ii. *[8.1] a processor; and memory in electronic communication with the processor, wherein instructions stored in the memory are executable to:*

Kim discloses this claim element. As shown in annotated FIG. 18 below, Kim discloses the processor 40, 140 (*processor*) (**green**) and memory 50, 150 (*memory*) (**red**). Kim further discloses software code may be stored in the memory 50, 150 (*instructions stored in the memory*) and executed by the processor 40, 140 (*instructions ... are executable*). EX-1004 ¶¶316, 317; EX-1003 ¶99.

FIG. 18



EX-1004 FIG. 18; EX-1003 ¶99.

Accordingly, Kim discloses this claim element. EX-1003 ¶100.

- iii. ***[8.2] transmit, to a user equipment (UE), a signaling, an uplink control channel (PUCCH) spans over multiple slots being determined based on the signaling; and***

Kim discloses this claim element. EX-1003 ¶101. Kim discloses a base station that is configured to transmit downlink control information (DCI/L1 signaling) (*signaling*) to the UE for configuring the PUCCH. EX-1004 ¶¶59, 62, 85; EX-1003 ¶101. Kim states, “***[t]he region in which the long PUCCH is transmitted can be configured via DCI*** (e.g., DL assignment or higher layer signaling).” EX-1004 ¶228. The number of symbols per slot of the long PUCCH can be determined based on the signaling (e.g., DL assignment or higher layer signaling):

The number of slots where a long PUCCH (PUSCH or PDSCH) is transmitted and indices thereof can be determined by RRC signaling, first layer (e.g., PHY, L1) signaling, or a combination thereof.

EX-1004 ¶¶242, 244, 245; EX-1003 ¶101.

Accordingly, Kim discloses this claim element. EX-1003 ¶102.

- iv. ***[8.3] receive uplink control information (UCI) with the frequency hopping for the configured multiple slots PUCCH,***

Kim discloses this claim element. EX-1003 ¶103. Kim discloses the base station receives uplink control information (UCI) from a UE in a PUCCH:

Referring to FIG. 4, a UL subframe may be divided into a control region and a data region in the frequency domain. *A PUCCH carrying UCI* is allocated to the control region and a PUSCH carrying user data is allocated to the data region.

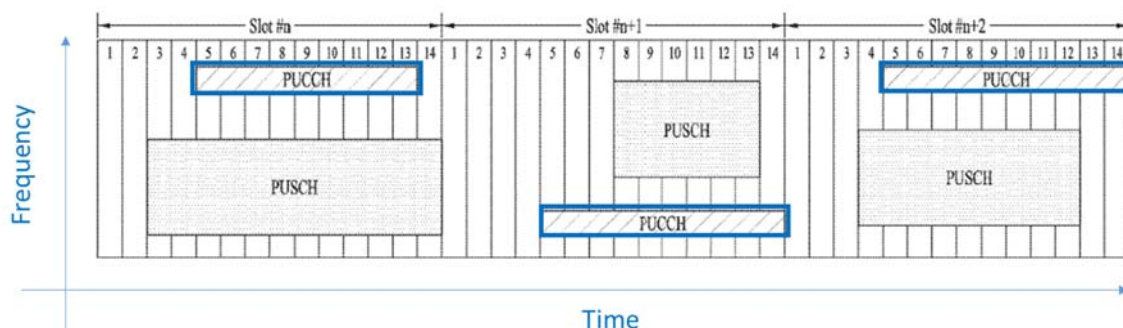
EX-1004 ¶82; *see also* EX-1004 ¶68; EX-1003 ¶103.

Kim discloses that frequency hopping may be applied to the PUCCH based on the DCI (e.g., Layer 1) or higher layer signaling from the base station:

Additionally, *information about a time when frequency hopping is applied to such a long PUCCH and/or information about a frequency hopping interval may be configured/indicated via DCI or higher layer signaling*. In this case, the frequency hopping may be hopping in a single TTI (or slot), inter-TTI (or inter-slot) hopping as shown in FIG. 14, or hopping every several slots (for example, hopping may be performed every two slots).

EX-1004 ¶235; EX-1003 ¶104.

FIG. 14



EX-1004 FIG. 14; EX-1003 ¶104.

Kim further provides, “[i]n addition, *time/frequency resource candidate*

where UCI will be actually transmitted may be defined per format by higher layer signaling, and the locations of the resources that will be actually used among the UCI resources may be dynamically indicated by the DCI that schedule multiple TTIs.” EX-1004 ¶287; EX-1003 ¶105.

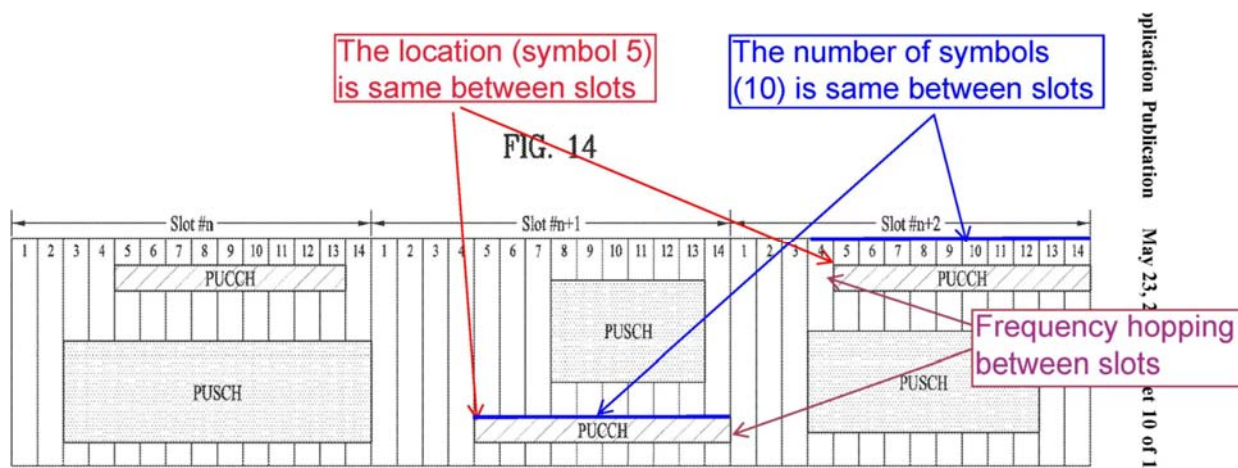
Accordingly, a POSITA would have understood that the base station receives UCI with the frequency hopping for the configured multiple slot PUCCH. EX-1003 ¶106. Thus, Kim discloses this claim element. EX-1003 ¶106.

- v. *[8.4] wherein the number of symbols of the PUCCH is the same in each slot of the multiple slots, and the location of the symbols for the PUCCH is the same in the each slot of the multiple slots.*

Kim discloses this claim element, either alone or in combination with Gao. EX-1003 ¶107. Kim discloses “one TTI is illustrated as one slot.” EX-1004 ¶227. Kim discloses that the PUCCH includes a plurality of symbols and that “[t]he *number of symbols allocated for the PUCCH transmission within one TTI may be constant for all TTIs*” EX-1004 ¶233. Although in the foregoing description Kim describes the number of symbols within a TTI, Kim further describes “the methods for transmitting and receiving UL/DL signals across a plurality of TTIs” can also be applied to *slots* and subframes. EX-1004 ¶¶222-223. Accordingly, based on the foregoing disclosures, a POSITA would have understood Kim as disclosing, or at least rendering obvious, that the number of

symbols allocated for the PUCCH is the same in each slot. EX-1003 ¶107.

Kim also states that the “PUCCH transmission *symbol allocation in one TTI can be equally applied to a plurality of TTIs used/allocated for transmitting one long PUCCH.*” EX-1004 ¶233; EX-1003 ¶108. As discussed above, Kim provides “methods of transmitting and receiving UL/DL signals across a plurality of TTIs (slots or subframes) will be described” and that “one TTI is illustrated as one slot.” EX-1004 ¶¶222-223, 227. A POSITA would have understood that *equally applying PUCCH transmission symbol allocations* to each slot discloses the claim element of “the location of the symbols for the PUCCH is the same in each slot of the multiple slots.” EX-1004 ¶233; EX-1003 ¶108. This is particularly true because Fig. 14 shows both the number and location of the PUCCH as being the same between slots $n+1$ and $n+2$ as shown below.



EX-1004, Fig. 14. Kim shows a “long PUCCH transmission is configured over a total of two TTIs or slots, i.e., slot # $n+1$ and slot # $n+2$ as shown in FIG. 14.”

EX-1004, ¶234. The **“location” (red)** is the same as both slot#n+1 and slot#n+2 start at symbol 5. The **number (blue)** of symbols is the same (10 symbols) going from symbols 5-14.⁵

To the extent Kim does not expressly show *the location of the symbols for the PUCCH is the same in each slot of the multiple slots*, Gao discloses this limitation. Gao also discloses a method for transmitting and receiving a physical uplink control channel (PUCCH). EX-1005 (“Gao”) 1:21-26; EX-1006 (“Gao Prov.”) 1:6-8; EX-1003 ¶110. Gao further discloses the plurality of slots (e.g., slot i, slot i+1) are the same and have the same transmission structure, i.e., the location of the symbols in each slot is the same. EX-1005 (Gao) 15:13-20, 31:53-63, FIG. 7; EX-1006 (Gao Prov.) 18:15-19, 37:26-33, FIG. 7; EX-1003 ¶110. Gao states:

The ***uplink regions*** in a plurality of target slots ***are the same***, as shown in FIG. 7, both structures of slots i and i+1 include a downlink region of 2 symbols, a guard period (GP) of 1 symbol, and ***an uplink region***

⁵ While Fig. 14 shows a different number of symbols used in the leftmost slot #n (from symbols 5-13), Kim’s description clarifies that the configuration for the slots #n+1 and #n+2 is an alternative configuration. EX-1004 ¶0234 (“For example, if long PUCCH transmission is configured over a total of two TTIs or slots, i.e., slot #n+1 and slot #n+2 as shown in FIG. 14, the first four symbols in each slot may be reserved for DL control (and/or a guard period).”).

of 4 symbols.

UE determines, according to a feedback period of periodic UCI, that CSI/SR feedback is to be conducted in slot i and determines that *a transmission duration of the PUCCH is 4 symbols* by a predetermined duration or a duration configured by means of a higher layer signaling in advance or a size of an uplink region (or a region for a PUCCH transmission in the uplink region) in at least one of two slots.

EX-1005 (Gao) 31:53-63, FIG. 7; EX-1006 (Gao Prov.) 37:26-33; EX-1003 ¶110.

FIG. 7 of Gao further illustrates the symbols used for the PUCCH (PUCCH1 and PUCCH2) are in the same location in slot i and slot $i+1$. EX-1005 (Gao) 31:53-56, FIG. 7, EX-1006 (Gao Prov.) 37:26-28, FIG. 7; EX-1003 ¶111.

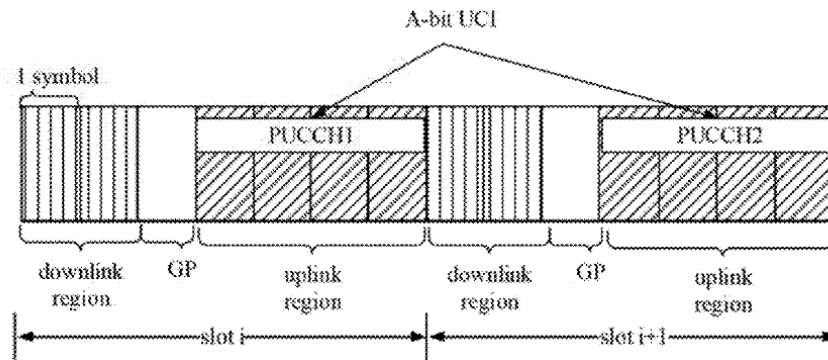


Fig. 7

EX-1005 (Gao) FIG. 7; EX-1006 (Gao Prov.) FIG. 7; EX-1003 ¶111.

Accordingly, Kim, alone or in combination with Gao disclose this limitation.

EX-1003 ¶112. As such, Kim, alone or in combination with Gao, render obvious claim 8. EX-1003 ¶112.

b. **Claim 9**

- i. ***[9.0] The gNB of claim 8, wherein the number of symbols of the PUCCH in each slot of the multiple slots PUCCH is greater than or equal to 4, and a reference symbol (RS) pattern in each slot is determined on a per slots basis by a long PUCCH format of a given the number of PUCCH symbols in the slot.***

Kim, alone or in combination with Gao, renders obvious claim 9. EX-1003

¶113. First, Kim discloses the specific number of symbols (4 or more) recited in claim 9 (*wherein the number of symbols of the PUCCH in each slot of the multiple slots PUCCH is greater than or equal to 4*). For example, as shown in Figure 14 (above for claim 8), Kim teaches using 10 symbols in slots #n+1 and #n+2.

Moreover, Kim expressly recites the specific number of symbols recited in the claim:

Hereinafter, *if the number of symbols within one TTI used for transmitting a UL control channel is equal to or more than a predetermined value (e.g., 4)*, the UL control channel is defined as a long PUCCH. In addition, to support wider coverage, the long PUCCH may be transmitted over a plurality of TTIs.

EX-1004 ¶226; EX-1003 ¶114.

Thus, a POSITA would have understood that Kim discloses the number of symbols within one TTI being greater than or equal to 4 also applies to each slot.

EX-1003 ¶115.

Kim discusses the transmission of reference symbols, but does not expressly disclose that a reference symbol (RS) pattern in each slot is determined on a per slots basis by a long PUCCH format of a given number of PUCCH symbols in the slot. EX-1004 ¶155, FIG. 9; EX-1003 ¶116. However, Gao discloses a method for transmitting the UCI in the PUCCH in each of the plurality of target slots. EX-1005 (Gao) 3:15-26; EX-1006 (Gao Prov.) 37:12-14; EX-1003 ¶116. Gao further discloses the method determines a transmission structure of the UCI and a reference signal (RS) (*reference symbol pattern*) in the PUCCH in each of the plurality of target slots in accordance with the determined transmission duration or format of the PUCCH (*PUCCH format of a given [the] number of PUCCH symbols in the slot*) carrying the to-be-fed-back UCI in each of the plurality of target slots. EX-1005 (Gao) 14:42-25:5; EX-1006 (Gao Prov.) 17:29-18:9; EX-1003 ¶116. Additionally, Gao states:

One transmission duration or format corresponds to one transmission structure of UCI and RS, that is, *a structure of mapping the UCI and RS for PUCCH may be determined by the transmission duration or format*, namely, which symbols among multiple symbols occupied by the PUCCH are used to transmit the UCI, and which symbols are used to transmit the RS.

EX-1005 (Gao) 14:53-60; EX-1006 (Gao Prov.) 17:37-18:1, 28:34-38; EX-1003 ¶116.

Indeed, Gao discloses determining a transmission structure (i.e., the placement of an RS) for “each” target slot (*per slot basis*). EX-1005 (Gao) 14:42-52; EX-1006 (Gao Prov.) 17:29-36; EX-1003 ¶117. Gao further discloses “the slot structure... may apply to the case that *each slot* includes 14 symbols” and states, “[t]he PUCCH of a transmission duration of 4 symbols (or a format corresponding to the transmission duration of 4 symbols) is for exemplification only, the PUCCH may be transmitted by using a duration of another *quantity of symbols*/another format, e.g., a duration of any integer quantity of symbols ranging from 4 to 14.” EX-1005 (Gao) 34:6-15; EX-1006 (Gao Prov.) 39:38-40:8; EX-1003 ¶117. Gao discloses the same long PUCCH as described by the ’566 Patent, which provides the long PUCCH in a slot may have durations from 4 to 14 symbols.” EX-1001 9:66-10:15; EX-1005 (Gao) 2:3-7, 11:30-31; EX-1006 (Gao Prov.) 1:34-37; EX-1003 ¶117.

Accordingly, a POSITA would have understood that configuring the RS pattern based on a per slot basis provides for efficient utilization of the PUCCH when slots of various sizes are transmitted, as opposed to using a fixed/static RS pattern for all slots regardless of its size. EX-1003 ¶118. Also, a POSITA would have been motivated to combine the teachings of Kim and Gao to provide a method in which the RS pattern is determined on a per slot basis to allow for the dynamic configuration of the PUCCH of the wireless access network as needed.

EX-1003 ¶118.

c. Claim 10

- i. [10.0] The gNB of claim 8, wherein the same PUCCH symbol location may be allocated in each slot.*

Kim, alone or in combination with Gao, renders obvious claim 10. EX-1003 ¶119. As discussed above, Kim discloses “methods of transmitting and receiving UL/DL signals across a plurality of TTIs (*slots* or subframes)” and that “one TTI is illustrated as *one slot*.” EX-1004 ¶¶222, 223, 227. Therefore, Kim’s discussion of TTIs is applicable to slots. EX-1004 ¶227. Kim discloses that if a TTI (slot) has more than a predetermined number of symbols (e.g., 4) used for transmitting the UL control channel, the UL control channel is defined as a long PUCCH. EX-1004 ¶¶225, 226; EX-1003 ¶119.

Kim further states, “PUCCH transmission *symbol allocation* in one TTI can be *equally applied to a plurality of TTIs* used/allocated for transmitting one long PUCCH,” and “[t]he number of symbols allocated for the PUCCH transmission within one TTI may be *constant for all TTIs* or vary per TTI.” EX-1004 ¶233; EX-1003 ¶120. Kim, in describing that one TTI represents one slot, discloses the PUCCH transmission allocation for one slot being equally applied to the plurality slots discloses this claim limitation because the symbol allocation defines the symbol location. EX-1004 ¶¶223, 227; EX-1003 ¶120.

A POSITA would have understood that *equally applying PUCCH transmission allocation* and having a *constant symbol allocation for all TTIs* (slots) to mean that the same PUCCH symbol location may be allocated in each slot. EX-1003 ¶121. Therefore, Kim discloses the claim element. EX-1003 ¶121. Moreover, as shown in Kim’s Figure 14 (detailed for claim 8), slots #n+1 and #n+2 have the same symbol locations for PUCCH.

To the extent Kim does not expressly disclose the “same PUCCH symbol location” may be allocated in each slot, Gao discloses this limitation at least for the reasons set forth in claim element [8.4] above and discussed below. *See*

VII.A.4.a.v; EX-1003 ¶122. For example, Gao states

The uplink regions in a plurality of target slots *are the same*, as shown in FIG. 7, both structures of slots i and i+1 include a downlink region of 2 symbols, a guard period (GP) of 1 symbol, and *an uplink region of 4 symbols*.

EX-1005 (Gao) 15:12-25, 31:53-56, FIG. 7; EX-1006 (Gao Prov.) 18:15-22, 37:26-28, 29-33; EX-1003 ¶123.

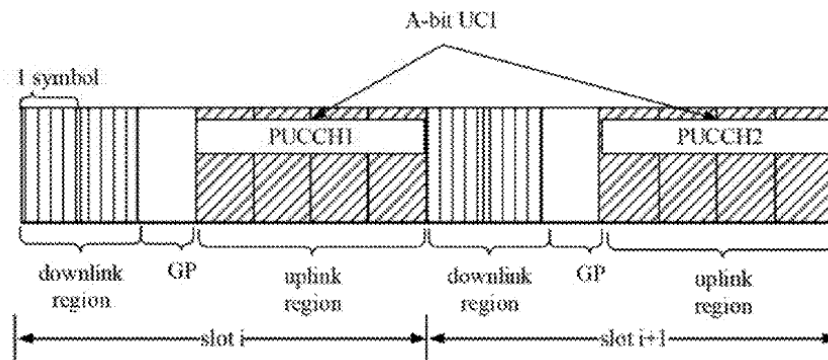


Fig. 7

EX-1005 (Gao) FIG. 7; EX-1006 (Gao Prov.) FIG. 7; EX-1003 ¶123.

As shown in FIG. 7 above, the PUCCH 1 and PUCCH 2, are provided in the same location in each “slot i” and “slot i+1,” respectively. EX-1003 ¶124. The location describes the position of the symbol in the slot and the uplink region of the slot, and Gao provides “the positions of PUCCH in the plurality of target slots may be the same,” i.e., the location of the symbols in each slot is the same. EX-1005 (Gao) 15:13-20, 31:53-63, FIG. 7; EX-1006 (Gao Prov.) 18:15-19, 37:26-33, FIG. 7; EX-1003 ¶124.

A POSITA would have been motivated to combine Gao’s express teachings of allocating the PUCCH symbols in the *same location* in each slot with Kim’s teachings for allocating symbols in the PUCCH in order to reduce the overhead signaling in the network by avoiding the need to re-configure (configure) the PUCCH for different symbol allocations using the DCI or other higher layer signaling. EX-1004 ¶235. A POSITA would have understood the modification

Kim’s teaching of the PUCCH with Gao’s teachings of the PUCCH symbol placement to involve nothing more than routine skill of a POSITA and matter of design choice, given that Kim already disclosed the “PUCCH transmission *symbol allocation* in one TTI can be *equally applied to a plurality of TTIs* used/allocated for transmitting one long PUCCH,” where the TTI represents a single slot. EX-1004 ¶233; EX-1003 ¶125. A POSITA would also have a reasonable expectation of success for the combined teachings of Kim and Gao because disclose symbol allocation of the PUCCH. EX-1003 ¶125. Accordingly, Kim, alone or in combination with Gao, discloses the limitations of claim 10. EX-1003 ¶125. Claim 10 therefore is obvious from the combination of Kim and Gao. EX-1003 ¶125.

d. **Claim 11**

- i. *[11.1] The gNB of claim 8, wherein UCI encoded bits are rate matched and loaded to all to PUCCH UCI carrying symbols of each slot of the long PUCCH separately,*

Kim, alone or in combination with Gao, renders obvious claim 11. EX-1003 ¶126. Gao discloses this claim limitation in claim 11. EX-1003 ¶126. Gao discloses “the PUCCH is transmitted by a UCI+RS structure with a duration of 4 symbols in both uplink regions of slots i and i+1, as shown by PUCCH1 and PUCCH2 in FIG. 7.” EX-1005 (Gao) 32:6-8; EX-1006 (Gao Prov.) 37:38-39; EX-1003 ¶126.

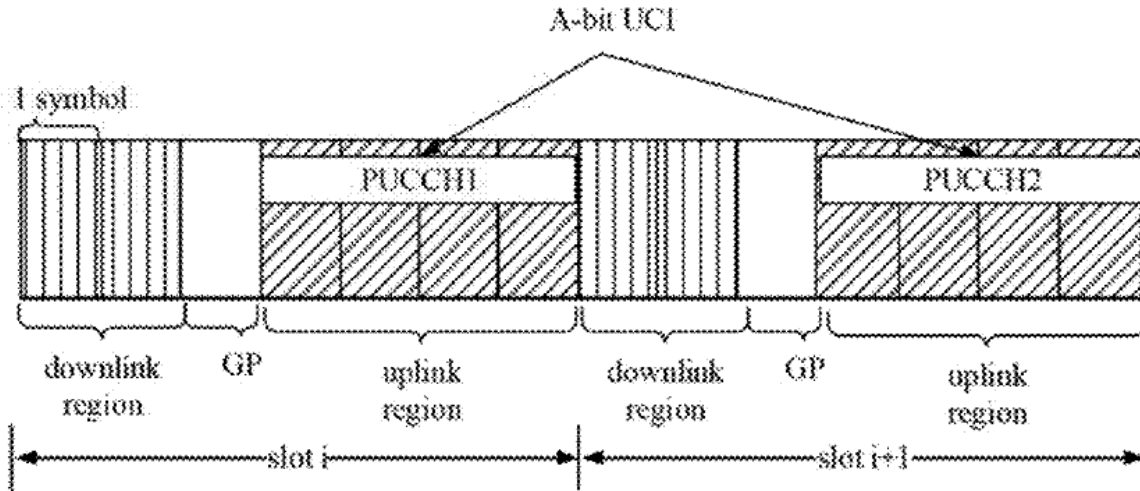


Fig. 7

EX-1005 (Gao) FIG. 7; EX-1006 (Gao Prov.) FIG. 7; EX-1003 ¶126.

Gao states, “[t]he UCI may be transmitted repeatedly in every slot, that is, UE performs *channel coding and rate matching based on a quantity of transmission symbols of UCI* in the UCI+RS structure determined by the transmission duration” (*UCI encoded bits are rate matched*). EX-1005 (Gao) 32:27-33; EX-1006 (Gao Prov.) 38:7-22; EX-1003 ¶127. Gao further states the UE “*then transmits the same coded sequence in two slots repeatedly*” (*loaded to all to PUCCH UCI carrying symbols of each slot of the long PUCCH separately*). EX-1005 (Gao) 32:27-33; EX-1006 (Gao Prov.) 38:7-22; EX-1003 ¶127.

A POSITA would have understood that transmitting the “same coded sequence” in “two slots” discloses *UCI encoded bits... loaded to all [the] PUCCH UCI carrying symbols of each slot of the long PUCCH separately*. EX-1005 (Gao)

32:19-32:44; EX-1006 (Gao Prov.) 38:7-22; EX-1003 ¶128.

A POSITA would have been motivated to combine the teachings of Kim and Gao because the POSITA would have understood rate matching to improve the utilization of the channel by having the total bit rate of the TTI (slot) equal to the channel rate and also to improve the alignment of transmitted resources in the network. EX-1014 (“R1-00426”), 2; EX-1012 (“Nazar”) 31:17-35; EX-1013 (“Ahn”) 14:19-32; EX-1003 EX-1003 ¶129. Both Kim and Gao disclosed the use of rate-matching, and modifying the teachings of Kim with the teachings of Gao would require nothing more than routine skill of a POSITA, where the combination would yield a predictable result (e.g, improved channel utilization). EX-1004 10, 14, 32:27-33; EX-1006 (Gao Prov.) 38:7-22. EX-1003 ¶129. Accordingly, a POSITA would have understood Gao as disclosing the limitation of wherein UCI encoded bits are rate matched and loaded to all to PUCCH UCI carrying symbols of each slot of the long PUCCH separately. EX-1003 ¶129.

ii. [11.2] if the number of symbols of the PUCCH in each slot is the same, the PUCCH format and encoded UCI in each slot is repeated in the multiple slots.

Gao discloses this claim limitation. EX-1003 ¶130. As described and shown in FIG. 7 of Gao below, the number of symbols in each slot is the same and the encoded UCI bits are repeated in multiple slots (i.e., slot i, slot i+1) as required

by the claim limitation. EX-1003 ¶130.

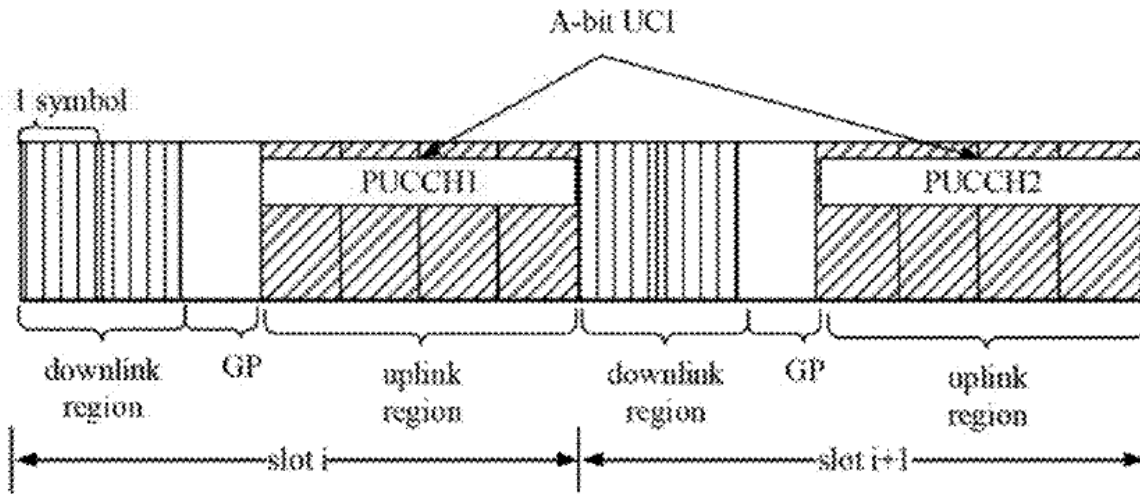


Fig. 7

EX-1005 (Gao) FIG. 7; EX-1006 (Gao Prov.) FIG. 7; EX-1003 ¶130.

As shown in FIG. 7 above, “slots i” and “slots i+1” are the same as required by claim 11. EX-1003 ¶131. Gao states, “both structures of slots i and i+1 include a downlink region of 2 symbols, a guard period (GP) of 1 symbol, and an uplink region of 4 symbols.” EX-1005 (Gao) 31:53-54; EX-1006 (Gao Prov.) 37:26-28; EX-1003 ¶131. Gao further discloses that the transmission duration can be determined by, for example, higher layer signaling or a size of an uplink region (or a region for a PUCCH transmission in the uplink regions). EX-1005 (Gao) 32:6-10; EX-1006 (Gao Prov.) 37:38-38:4 (“The PUCCH is transmitted by a UCI+RS structure with a duration of 4 symbols in both uplink regions of slots i and i+1, as shown by PUCCH1 and PUCCH2 in FIG. 7.”) EX-1003 ¶131.

Gao further describes the UCI is transmitted in every slot (*repeated in every slot*) by a determined UCI+RS structure (*the PUCCH format and encoded UCI in each slot*) corresponding to a same transmission duration (*number of symbols of the PUCCH in each slot is the same*). EX-1005 (Gao) 32:19-33; EX-1006 (Gao Prov.) 38:7-14; EX-1003 ¶132.

A POSITA would have been motivated to combine the teachings of Kim with Gao's teachings of repeating the PUCCH format and encoded UCI in slot in order to reduce the signaling overhead (e.g., DCI or other higher layer signaling) in the network used to re-configure/configure the PUCCH for each slot. EX-1003 ¶133. Provided that both Kim and Gao disclosed techniques for configuring the PUCCH, it would have required nothing more than routine skill of a POSITA to modify the teachings of Kim with Gao. EX-1004 ¶233; EX-1005 (Gao) 15:13-20, 31:53-63, FIG. 7; EX-1006 (Gao Prov.) 18:15-19, 37:26-33, FIG. 7; EX-1003 ¶133. Accordingly, a POSITA would have understood Gao disclosed if the number of symbols of the PUCCH in each slot is the same, the PUCCH format and encoded UCI in each slot is repeated in the multiple slots. EX-1003 ¶133. Claim 11 is invalid over Gao. EX-1003 ¶133.

e. **Claim 13**

- i. ***[13.0] The gNB of claim 8, wherein the frequency hopping is applied within each slot in the multiple slots PUCCH.***

Kim, alone or in combination with Gao, renders obvious claim 13. EX-1003 ¶134. As discussed above, Kim discloses “methods of transmitting and receiving UL/DL signals across a plurality of TTIs (***slots*** or subframes)” and that “one TTI is illustrated as ***one slot***.” EX-1004 ¶¶222, 223, 227; EX-1003 ¶134. Therefore, Kim’s discussion of TTIs is applicable to slots. EX-1004 ¶227; EX-1003 ¶134.

Kim further discloses that if a TTI (slot) has more than a predetermined number of symbols (e.g., 4) for transmitting the UL control channel, the UL control channel is defined as a long PUCCH. EX-1004 ¶¶225, 226; EX-1003 ¶135. As previously discussed above for claim element [8.3], Kim further discloses applying frequency hopping to the long PUCCH and states, “the frequency hopping may be ***hopping in a single TTI (or slot)***.” EX-1004 ¶235; VII.A.4.a.iv; EX-1003 ¶135.

Kim further discloses that the frequency hopping can be applied to multiple slots by describing the PUCCH transmission symbol allocation in one TTI can be ***equally applied to a plurality of TTIs used/allocated for transmitting one long PUCCH***. EX-1004 ¶233; EX-1003 ¶136. Kim discloses that frequency hopping that occurs ***in a single slot*** and ***equally applying the symbol allocation to a***

plurality of TTIs for the long PUCCH discloses the limitation. EX-1004 ¶¶225, 226, 233; EX-1003 ¶136. Therefore, Kim discloses the elements of claim 13. EX-1003 ¶136.

f. Claim 14

- i. [14.0] The gNB of claim 8, wherein whether the frequency hopping is inter-slot or intra-slot can be configured by higher layer signaling for the multiple slots PUCCH.*

Kim, alone or in combination with Gao, renders obvious claim 14. EX-1003 ¶137. Kim discloses the PUCCH that spans over multiple slots. EX-1004 ¶¶225, 226; EX-1003 ¶137. As discussed above, Kim discloses “methods of transmitting and receiving UL/DL signals across a plurality of TTIs (*slots* or subframes)” and that “one TTI is illustrated as *one slot*.” EX-1004 ¶¶222, 223, 227. Therefore, Kim’s discussion of TTIs is also applicable to slots. EX-1004 ¶227; EX-1003 ¶137.

Kim further provides that if a TTI (slot) has more than a predetermined number of symbols (e.g., 4) for transmitting the UL control channel, the UL control channel is defined as a long PUCCH. EX-1004 ¶¶225, 226. As discussed with reference to claim element [8.3] above, Kim further discloses the frequency hopping is configured by *higher layer signaling* for the multiple slots PUCCH. EX-1004 ¶235; VII.A.4.a.iv; EX-1003 ¶138.

Kim states, “[i]nformation about a time when frequency hopping is applied

to such a long PUCCH and/or information about a frequency hopping interval may be configured/indicated via DCI or *higher layer signaling*. In this case, the *frequency hopping may be hopping in a single TTI (or slot), inter-TTI (or inter-slot) hopping....*” EX-1004 ¶235; EX-1003 ¶139. Kim further discloses other types of signaling can be used for configuring the PUCCH, for example, a *high-layer signaling* (e.g., via RRC or a like), lower-layer signaling (e.g., via a physical control channel or a broadcast channel), or a combination thereof, EX-1004 ¶56; EX-1003 ¶139.

Kim discloses this limitation of claim 14. EX-1003 ¶140.

g. Claim 16

i. [16.0] A method by a base station (gNB), comprising:

To the extent the preamble is limiting, Kim discloses a method performed by a base station. EX-1003 ¶141. Kim further discloses the base station as set forth above in element [8.1], Section VII.A.4.a.i.

ii. [16.1] transmit, to a user equipment (UE), a signaling, an uplink control channel (PUCCH) spans over multiple slots being determined based on the signaling;

Kim discloses this claim element for the same reasons set forth above in element [8.3], Section VII.A.4.a.iii. EX-1003 ¶142.

iii. [16.2] receiving uplink control information (UCI) with the frequency hopping for the configured multiple slots PUCCH, and

Kim discloses this claim element for the same reasons set forth above in element [8.4], Section VII.A.4.a.iv. EX-1003 ¶143.

iv. [16.3] wherein the number of symbols of the PUCCH is the same in each slot of the multiple slots, and the location of the symbols for the PUCCH is the same in the each slot of the multiple slots.

Kim discloses this claim element for the same reasons set forth above in element [8.5], Section VII.A.4.a.v. EX-1003 ¶144.

B. Ground 2: Claim 12 is unpatentable over Kim, alone or in view of Gao and in further view of R1-1710555

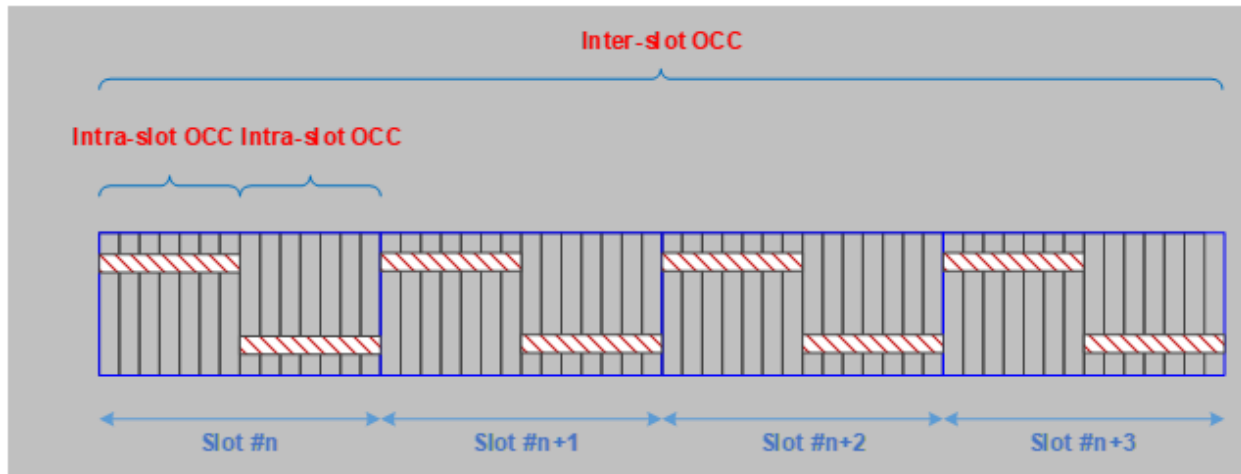
Ground 2 is that Kim, alone, or in view of Gao and R1-1710555, renders the Challenged Claim obvious.

1. Overview of 3GPP (“R1-1710555”)

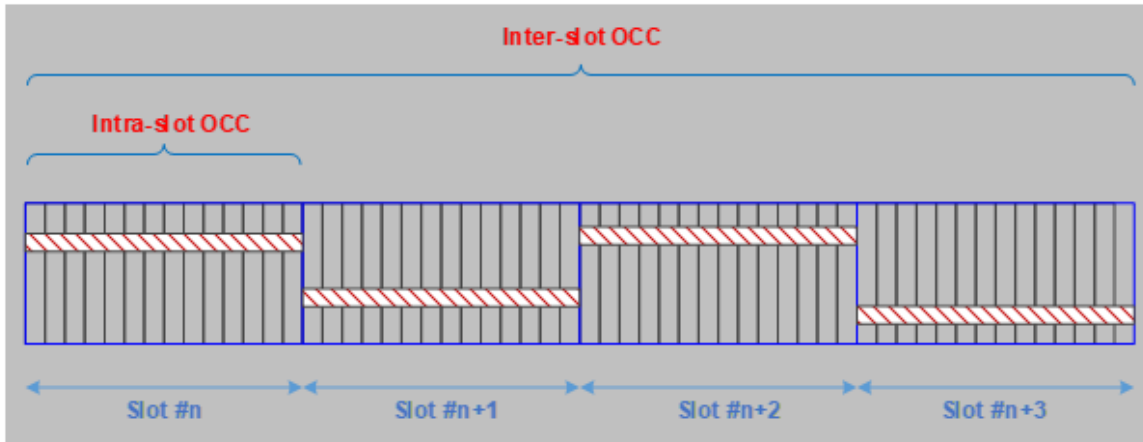
The 3GPP submission, “Long PUCCH Over Multiple Slots” (“R1-1710555”), discloses resource allocation and frequency hopping for long PUCCH with multiple slot durations. EX-1011 (R1-1710555); EX-1003 ¶145.

Specifically, R1-1710555 discloses that inter-slot frequency hopping and intra-slot frequency hopping have been in use to improve frequency diversity in wireless transmission. EX-1011 (R1-1710555) 1-2; EX-1003 ¶145. For example, R1-1710555 discloses that “inter-slot frequency hopping may be employed to further

improve the link budget for long PUCCH.” EX-1011 (R1-1710555) 3; EX-1003 ¶145. FIG. 2(a) below depicts a frequency hopping pattern that performs switching at the slot boundaries and FIG. 2(b) depicts an inter-slot frequency hopping pattern that performs switching within the slot. EX-1003 ¶145. The x-axis of the illustration of FIGS. 2(a), 2(b) represents time (duration of the slot) and the y-axis represents the frequency of the PUCCH. EX-1011 (R1-1710555) 1-3; EX-1003 ¶145.



(b) Inter-slot hopping with intra-slot hopping.



(a) Inter-slot hopping without intra-slot hopping.

Figure 2. Intra-slot and inter-slot frequency hopping of long PUCCH with OCC.

EX-1011 (R1-1710555) FIG. 2(a), 2(b).

As shown above in FIG. 2(b), intra-slot hopping occurs within the slot boundaries. EX-1003 ¶146. FIG. 2(a) shows inter-slot frequency hopping occurs at the slot boundary (no frequency hopping within the single slot). EX-1011 (R1-1710555) FIG. 2(a), 2(b); EX-1003 ¶146.

2. Reasons to combine Kim and Gao with R1-1710555

A POSITA would be motivated to combine Kim's techniques for configuring and receiving long PUCCH in a wireless access network, as modified with Gao's teachings of providing symbols for the PUCCH is the same location in each slot of the multiple slots, with R1-1710555's teachings of performing interslot frequency hopping at slot boundaries, which had the benefit of increasing the frequency diversity of a transmission. EX-1003 ¶161.

Kim and Gao involve the configuration of PUCCH for communication over the wireless network and allowing PUCCH transmission in multiple slots. EX-1004 ¶¶1, 2, 6; EX-1005 (Gao) 1:21-26; EX-1006 (Gao Prov.) 1:6-8; EX-1003 ¶162.

R1-1710555 discloses various frequency hopping schemes. EX-1011 (R1-1710555) FIG. 2(a), 2(b); EX-1003 ¶163. A POSITA would have understood that the frequency hopping schemes disclosed by R1-1710555 could be applied to Kim to provide benefits including increasing the frequency diversity of the transmission. EX-1003 ¶163. Frequency diversity was known to improve the reliability of the transmission from interference of other signals. EX-1003 ¶163. R1-1710555 discloses an additional benefit of frequency hopping and states “inter-slot frequency hopping may be employed to further improve the link budget for long PUCCH.” EX-1011 (R1-1710555) 3; EX-1003 ¶163.

Further, a POSITA would have had a reasonable expectation of success because a POSITA would have recognized that the frequency hopping techniques of R1-1710555 were compatible with the teachings of Kim’s interslot and intraslot frequency hopping techniques. EX-1004 ¶235; EX-1003 ¶164.

Additionally, incorporating the frequency hopping techniques disclosed in R1-1710555 into Kim’s frequency hopping configuration of the PUCCH as modified by Gao would thus involve nothing more than routine skill of a POSITA

as Kim already discloses interslot and intraslot frequency hopping. EX-1003 ¶165.

A POSITA would thus have been motivated to combine the teachings of Kim and Gao with R1-1710555. EX-1003 ¶166.

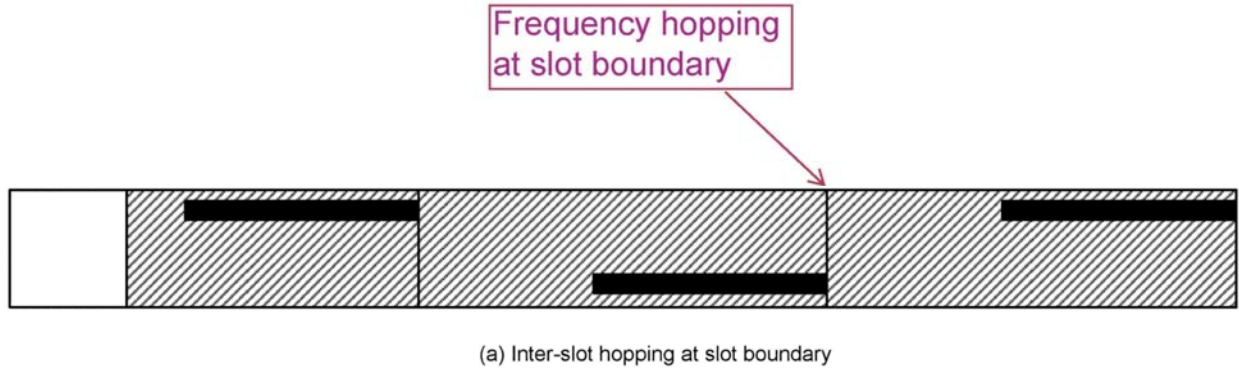
3. Detailed Application of Kim and Gao and further combination with R1-1710555 to the Challenged Claims

a. Claim 12

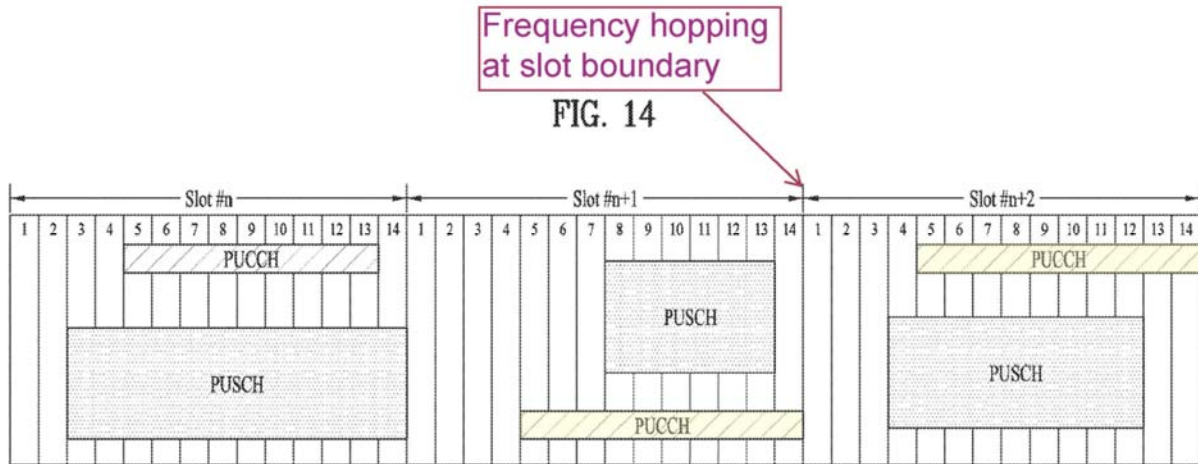
i. [12.0] The gNB of claim 8, wherein the frequency hopping is applied at slot boundaries in the multiple slots PUCCH.

Kim, alone or in combination with Gao and R1-1710555, renders obvious claim 12. EX-1003 ¶167. Kim and R1-171055 each disclose this limitation. EX-1003 ¶167. The '566 Patent equates frequency hopping at slot boundaries with “inter-slot hopping.” “In one approach, frequency hopping may be applied at slot boundaries in a multi-slot PUCCH (*i.e., inter-slot hopping*).” EX-1001 40:13-15. *See also* EX-1001 41:63-65.

A comparison of Fig. 38 from the '566 Patent and Fig. 14 from Kim shows that Kim discloses the same frequency hopping at the slot boundary as is disclosed in the '566 Patent. FIG. 38(a) of the '566 Patent illustrates “inter-slot hopping at slot boundary.”



EX-1001 FIG. 38 (annotation added), 43:32-49. Kim’s Fig. 14 shows exactly the same sort of frequency hopping occurring at the slot boundary.



EX-1004 Fig. 14 (annotation added). Moreover Kim, just like the ’566 Patent description of this claim element, uses the same language of “inter-slot” hopping, ¶¶ 235-236 (“the frequency hopping may be hopping in a single TTI (or slot), inter-TTI (or *inter-slot*) hopping as shown in FIG. 14... Alternatively,... *inter-slot hopping can be applied to the long PUCCH transmission resources....*”).

To the extent Kim does not expressly disclose the claim limitation *wherein the frequency hopping is applied at slot boundaries in the multiple slots PUCCH*,

R1-1710555 discloses this limitation. EX-1003 ¶171. As shown in FIG. 2(a), the frequency hopping of the PUCCH occurs at the slot boundary of each slot (e.g., the slot boundary between slot #n and slot #n+1), and not within the slot boundary of each slot.

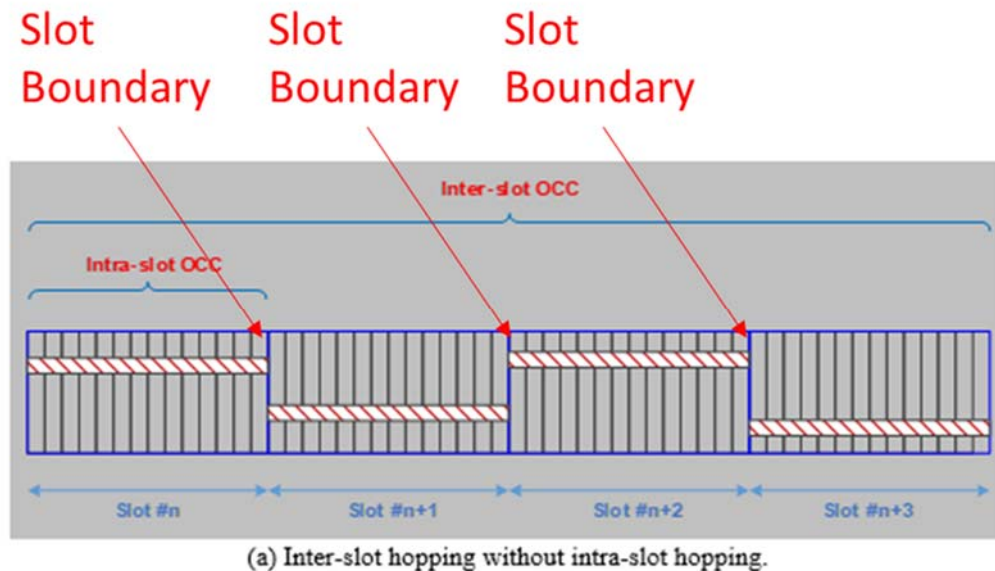


Figure 2. Intra-slot and inter-slot frequency hopping of long PUCCH with OCC.

EX-1011 (“R1-1710555”) FIG. 2(a) (annotations added); EX-1003 ¶171.

A POSITA would have understood that inter-slot frequency hopping occurring at the slot boundaries was well-known and providing a variety of frequency hopping patterns increase frequency diversity which improves the reliability in the transmission. EX-1008 FIG. 2(a); EX-1003 ¶173. Accordingly, to the extent Kim does not disclose the limitation, R1-1710555 discloses this limitation. EX-1003 ¶173. Thus, claim 12 is obvious from Kim in view of Gao and R1-1710555.

C. Ground 3: Claim 12 is unpatentable over Kim, alone or in view of Gao and in further view of Huang

Ground 3 is that Kim, alone, or in view of Gao and in further view of Huang, renders the Challenged Claim obvious.

1. Overview of U.S. Patent No. 10,873,435 (“Huang”)

Huang is an AIA reference and meets the ministerial requirements of 35 U.S.C. §§ 119 and 120. On its face, Huang (EX-1016) was filed on May 3, 2018 claiming priority to U.S. Provisional Patent Application No. 62/501,681, which was filed on May 4, 2017 (EX-1017). Accordingly, Huang was co-pending with the Huang provisional application. Huang identifies Yi Huang, Renqui Wang, Hao Xu, and Seyong Park as inventors (EX-1016 Huang Reference (72)), which are all listed as inventors in the Huang provisional application. (EX-1017 Huang Prov., 1). Accordingly, Huang is entitled to the priority date afforded to it by the Huang provisional application. *Penumbra*, IPR2021-01466, Paper 34. Petitioners cite to the both the Huang and the Huang provisional applications demonstrating that the subject matter upon which Petitioners rely is prior art to the ’566 Patent.

Huang relates generally to communication systems and more specifically to uplink control channels in a communication system. EX-1016 (Huang) 1:18-20; EX-1017 (Huang Prov.) ¶1; EX-1003 ¶175. Huang discloses various frequency hopping methods including intra-slot hopping and inter-slot hopping. EX-1003

¶175. Huang states, “Intra-slot hopping may include individual PUCCHs hopping between frequencies within a set of frequencies used for the PUCCHs. Inter-slot hopping may include changing sets of frequencies used for PUCCHs hopping, e.g., changing from one set of frequencies to another set of frequencies.” EX-1016 (Huang) 15:55-59; EX-1017 (Huang Prov.) ¶60; EX-1003 ¶175. Huang illustrates the inter-slot frequency hopping in FIG. 4 below.

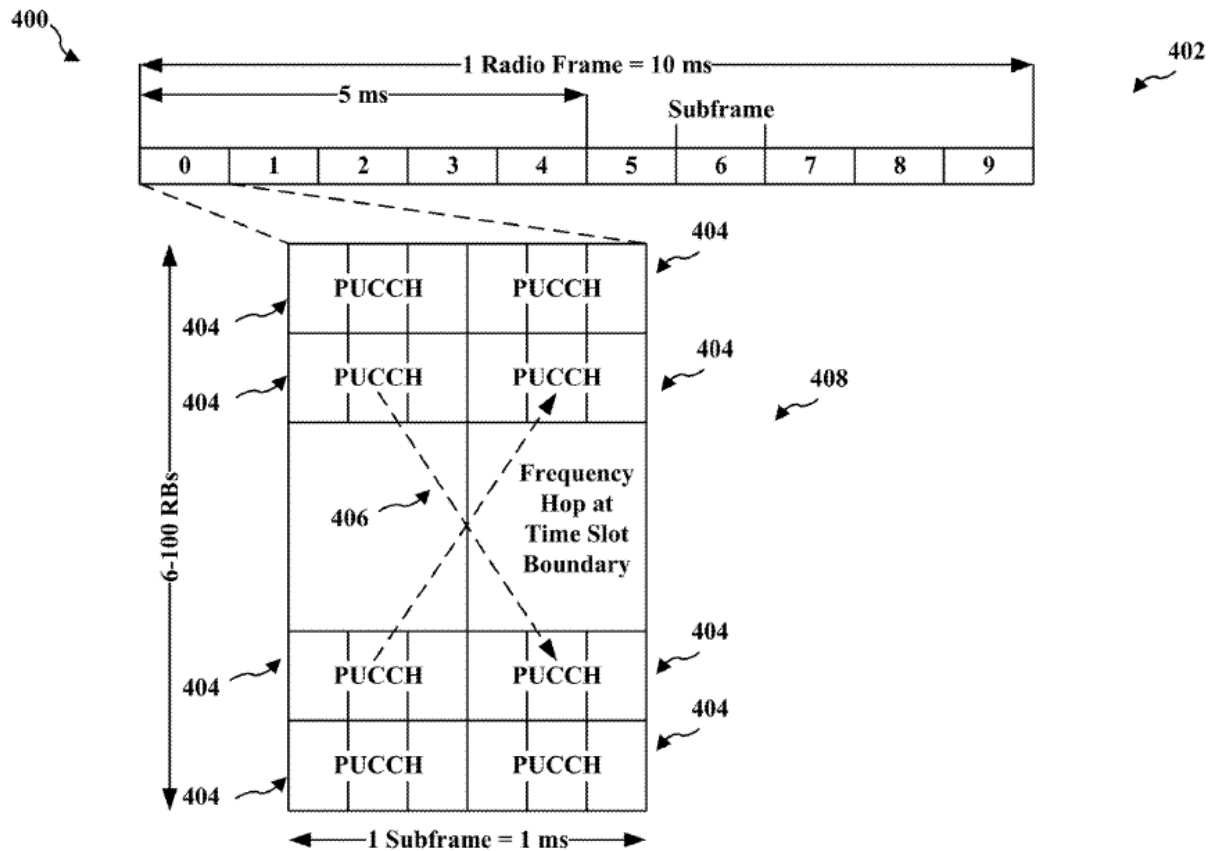


FIG. 4

EX-1016 (Huang) FIG. 4; EX-1017 (Huang Prov.) FIG. 4.

Similarly, FIG. 6 of Huang illustrates another example of inter-slot

frequency hopping at the slot boundary is shown below.

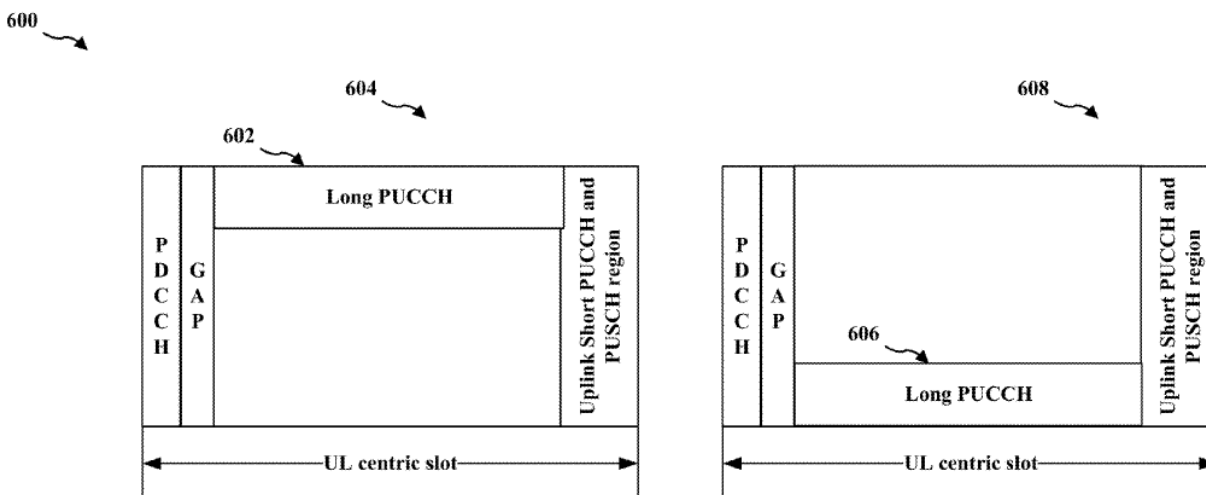


FIG. 6

EX-1016 (Huang) FIG. 6; EX-1017 (Huang Prov.) FIG. 6.

2. Reasons to combine Kim and Gao with Huang

A POSITA would be motivated to combine Kim's techniques for configuring a long PUCCH in a wireless access network, as modified with Gao's teachings of configuring symbol location in a slot of the PUCCH, with Huang's teachings of performing inter-slot frequency hopping at slot boundaries, which had the benefit of achieving frequency diversity. EX-1016 (Huang) 16:35-36; EX-1017 (Huang Prov.) ¶61; EX-1003 ¶177.

Further, a POSITA would have had a reasonable expectation of success because a POSITA would have recognized that the frequency hopping techniques of Huang disclose the same interslot and intraslot frequency hopping techniques of

Kim. EX-1004 ¶235; EX-1016 (Huang) 15:55-59; EX-1017 (Huang Prov.) ¶60; EX-1003 ¶178. Similarly, Huang is compatible with Gao as they both address the configuration of variable length PUCCH for the 5G NR systems. EX-1005 (Gao) 2:1-10; EX-1006 (Gao Prov.) 1:33-2:1; EX-1016 (Huang) 2:8-11; EX-1017 (Huang Prov.) ¶6; EX-1003 ¶178.

Additionally, incorporating the frequency hopping techniques disclosed in Huang into Kim' frequency hopping configuration of the PUCCH as modified by Gao would thus involve nothing more than routine skill of a POSITA as Kim already discloses interslot and intraslot frequency hopping. EX-1003 ¶179.

A POSITA would thus have been motivated to combine the teachings of Kim and Gao with Huang. EX-1003 ¶180.

3. Detailed Application of Kim and Gao further combination with Huang to the Challenged Claims

a. Claim 12

i. [12.0] The gNB of claim 8, wherein the frequency hopping is applied at slot boundaries in the multiple slots PUCCH.

Kim, alone or in combination with Gao and Huang, renders obvious claim 12. EX-1003 ¶181.

To the extent that the combination of Kim and Gao does not disclose this limitation (e.g., “*wherein the frequency hopping is applied at slot boundaries in the multiple slots PUCCH*”), Kim and Gao in view of Huang does. EX-1003 ¶182.

Huang states, “With inter-slot hopping, a frequency of a PUCCH may be changed within a subframe across a time slot boundary. For example, referring back to FIG. 4, for inter-slot hopping, the time/frequency blocks 408 may be moved from subframe 0 and split between two subframes, e.g., the latter half of subframe 4 and the first half of subframe 5, such that a frequency of a PUCCH may be changed within a subframe across a time slot boundary, e.g., between the first and second time slots at the border of subframe 4 and subframe 5.” EX-1016 (Huang) 16:4-13; EX-1017 (Huang Prov.) ¶¶60-62; EX-1003 ¶183.

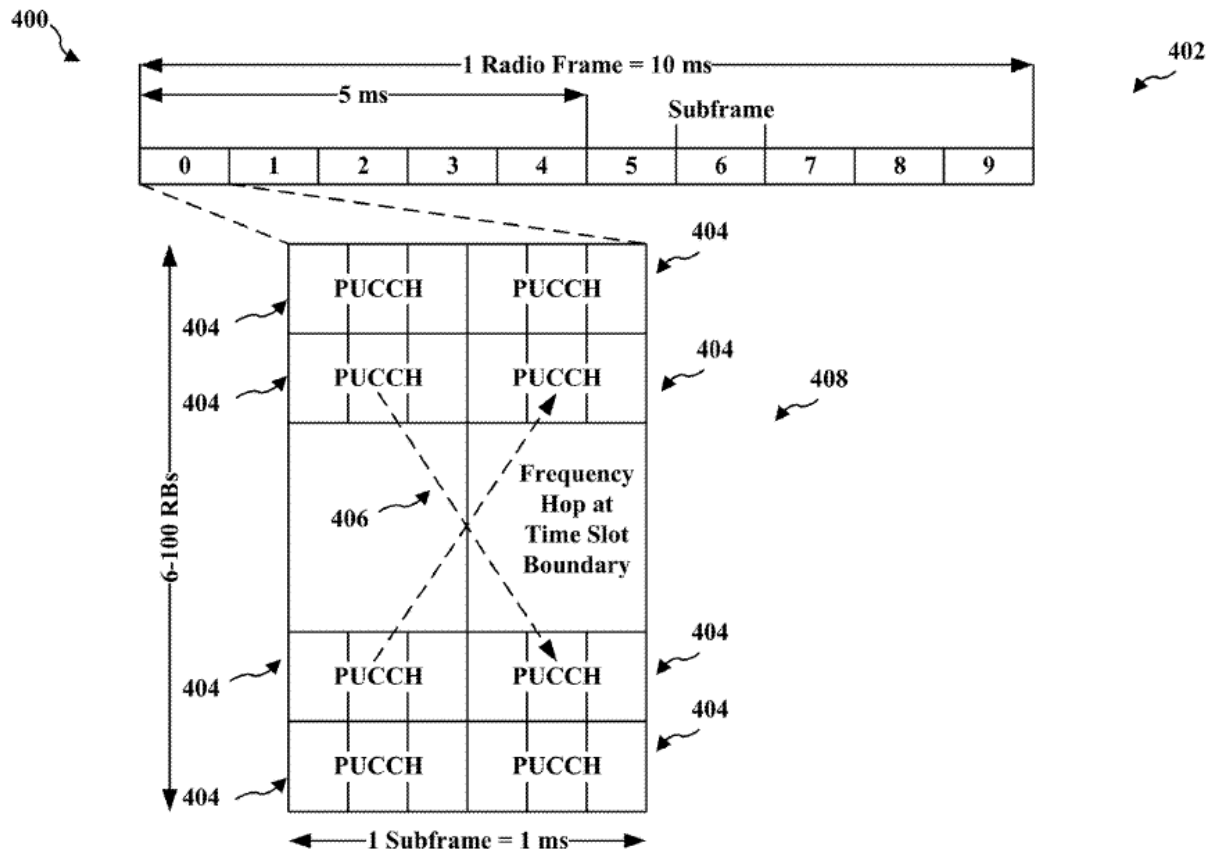


FIG. 4

EX-1016 (Huang) FIG. 4; EX-1017 (Huang Prov.) FIG. 4; EX-1003 ¶183.

Huang discloses inter-slot frequency hopping at the time slot boundary as shown in FIG. 4 and states:

The frequency used to transmit the longer PUCCH may vary. For example, the x-axis in FIG. 6 may be time and the y-axis in FIG. 6 may be frequency. Frequency may increase along the y-axis. For example, the long PUCCH 602 may be at a higher frequency as compared to the long PUCCH 606. For intra-slot hopping, different PUCCHs may change frequency within each long PUCCH 602 and/or a long PUCCH 606. For inter-slot hopping, a set of PUCCH may change frequency. For example, for inter-slot hopping, the long PUCCH may change frequency from the frequencies for the long PUCCH 602 to the frequencies for the long PUCCH 606.

EX-1016 (Huang) 16:38-49; EX-1017 (Huang Prov.) ¶60; EX-1003 ¶184.

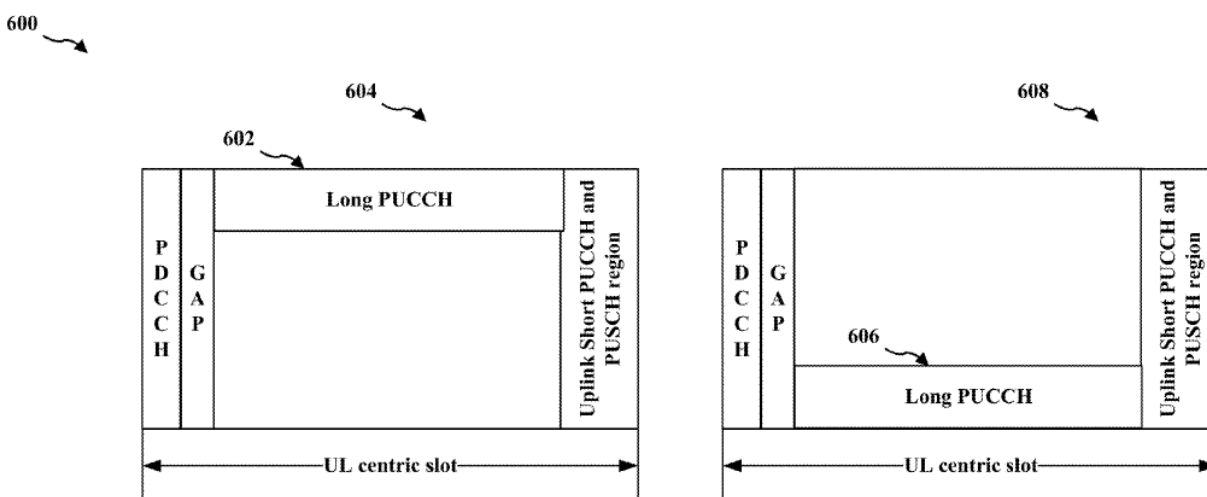


FIG. 6

EX-1016 (Huang) FIG. 6; EX-1017 (Huang Prov.) FIG. 6; EX-1003 ¶184.

A POSITA would have understood that inter-slot frequency hopping could occur at the slot boundaries. “Factors such as number of symbols available for each PUCCH, channel conditions, a need for efficiency in the use of symbols, a lack of a need for efficiency in the use of symbols, or other factors may be used to determined when hopping should be used or not used.” EX-1016 (Huang) 12:17-28; EX-1017 (Huang Prov.) ¶52; EX-1003 ¶185. “Inter-slot hopping may be turned on (or off) to achieve frequency diversity” based on the factors listed above. EX-1016 (Huang) 16:35-36; EX-1017 (Huang Prov.) ¶¶52, 61.

Accordingly, Kim, alone or in combination with Gao and Huang, renders obvious claim 12. EX-1003 ¶186.

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

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

The ’566 Patent has not been previously challenged in an IPR. There are three grounds presented in this Petition—one ground based on Kim, alone or in combination with Gao, another based on Kim, alone or in combination with Gao in further view of R1-1710555, and the last ground based on Kim, alone or in combination with Gao in further view of Huang.

Kim, Gao, and Huang were not cited during prosecution of the ’566 Patent, which weighs against discretionary denial under § 325(d). The grounds based on

R1-1710555 also weighs against discretionary denial for the reasons discussed below.

R1-1710555 was submitted to the Patent Office by Applicant in an IDS on August 9, 2018 but was not relied upon to reject any claims during prosecution. EX-1002 ('566 Patent File History), 129. The *Advanced Bionics* framework disfavors discretionary denial in this IPR for grounds based on R1-1710555 because the “Office erred in a manner material” to patentability by overlooking the relevance of R1-1710555 to the '566 Patent claims. *Advanced Bionics, LLC v. MED-EL Elektromedizinische Gerate GmbH*, IPR2019-01469, Paper 6, 8-9 (Feb. 13, 2020). Analysis of this issue is guided by factors (c), (e), and (f) as enumerated in *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 (Dec. 15, 2017); (precedential as to § III.C.5, first para.) (“*Becton*”). *Advanced Bionics* at 9-10.

Regarding *Becton* factor (c) (the extent to which the asserted art was evaluated during examination), R1-1710555 was not the basis of any rejection for the '566 Patent, which weighs against exercising discretion. *See Celco Partnership v. Huawei Device Co.*, IPR2020-01117, Paper 10, 13 (Feb. 3, 2021).

Regarding *Becton* factors (e) (Petitioners’ identification of examiner error) and (f) (other facts and evidence presented in the petition), this petition specifically points out and explains how R1-1710555 alone discloses or renders obvious the

limitations of claim 12. For example, this analysis shows how R1-1710555 discloses the feature “... *wherein the frequency hopping is applied at slot boundaries in the multiple slots PUCCH.*” Thus, Petitioners has shown how the prior art differs from the evaluation during the prosecution. *See Celco Partnership*, IPR2020-01117, Paper 10 at 13-14.

The Examiner erred in a material way by allowing the claims instead of rejecting them based on R1-1710555. Thus, under the second prong of *Advanced Bionics*, discretionary denial under § 325(d) is not appropriate on the basis of the R1-1710555 grounds.

Further, because Kim, Gao, and Huang were also not considered during prosecution of the '566 Patent, and because the Examiner erred in a material way by allowing the claims instead of rejecting them based on R1-1710555, discretionary denial under § 325(d) is disfavored.

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

Related to the Director’s June 2022 interim guidance regarding application of the *Fintiv* factors⁶, (1) the Petition is particularly strong in the underlying merits,

⁶ Interim Procedure For Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director’s Memorandum (June 21, 2022).

and (2) Petitioners will not pursue in the Related Litigation any ground raised in this IPR. Thus, under the Interim Guidance, the Board should not deny institution.

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

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

Under factor 2, the earliest scheduled trial date is March 3, 2025. A Final Written Decision is expected in the present matter in July of 2025. Considering the inherent uncertainties of litigation scheduling, this factor is neutral. Because much can change in four months, the current trial date does not support denial. See *Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).

Factor 3 favors institution. The *Markman* hearing is scheduled for September 11, 2024, which is around the time of the projected institution date. Fact discovery closes on October 4, 2024, and expert discovery closes on November 18, 2024, which is after the projected institution date. Thus, the Related Litigation is in its early stages, and the investment in it has been minimal at this time. The district court will not invest significant resources or issue substantive orders related to the challenged patent prior to the issuance of an institution

decision. Moreover, Petitioners diligently prepared this Petition and filed well in advance of the statutory deadline, which weighs further against denying institution.

Under factor 4, there will not be complete overlap in the issues raised in the IPR and the Related Litigation and this favors institution. PO has asserted 88 claims from five patents in the Related Litigation – an amount that far exceeds the number of claims that the district court will allow to be presented at trial. See <https://txed.uscourts.gov/?q=model-order-focusing-patent-claims-and-prior-art-reduce-costs>. (Model Order limiting patentees to a “Final Election of Asserted Claims, which shall identify no more than five asserted claims per patent from among the ten previously identified claims and no more than a total of 16 claims”). Given that the patentee will likely be limited to only five claims from the ’566 Patent (at most), it is highly unlikely the district court will be addressing the validity of all of the eight (8) claims challenged by this Petition. Petitioners stipulate that they will not pursue invalidity against the asserted claims in the district court using the specific combination of prior art references set forth in the grounds presented in this Petition for purposes of establishing obviousness. See *Sand Revolution II LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 11-12 (PTAB June 16, 2020) (holding a similar stipulation weighs against discretionary denial).

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

Under factor 6, other circumstances weigh in favor of institution. Here, the merits of the Petition are particularly strong. For example, Kim is directed at the same problem and proposes the same solution as the ’566 Patent, and discloses identical communications and the identical concepts disclosed in the ’566 Patent, demonstrating that the Petition is particularly strong in the underlying merits.

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

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

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

The real party-in-interest in this Petition is Ericsson Inc., and corporate parent Telefonaktiebolaget LM Ericsson, and Nokia of America Corporation. No other parties have directed, funded, or controlled the filing of this IPR, and this IPR

was not filed at the behest of any other party.

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

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

1. Judicial Matters

As of the filing date of this Petition and to the best knowledge of Petitioners, the '566 Patent is involved in the following litigations:

- *Active Wireless Technologies LLC v. Verizon Communications, Inc. et al.*, U.S.D.C. EDTX Case No. 2:23-cv-00620-JRG-RSP;
- *Active Wireless Technologies LLC v. T-Mobile USA, Inc. et al.*, U.S.D.C. EDTX Case No. 2:23-cv-00261-JRG-RSP.

These are referenced collectively herein as the "Related Litigation(s)."

2. Administrative Matters:

As of the filing date of this Petition and to the best knowledge of Petitioners, the '566 Patent was not subject to any administrative matters.

C. Related Patents

Petitioners are unaware of any related patents.

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

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

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

X. CONCLUSION

Petitioners requests the Board institute *inter partes* review and cancel all Challenged Claims.

Respectfully submitted,

DUANE MORRIS LLP

BY: /Jarrad M. Gunther/

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Duane Morris LLP

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Dated: June 4, 2024

CERTIFICATION OF SERVICE ON PATENT OWNER

Pursuant to 37 C.F.R. §§ 42.6(e), 42.8(b)(4) and 42.105, the undersigned certifies that on the 4th of June, 2024, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 10,601,566 and all supporting exhibits were served via email and/or electronic download by agreement of Patent Owner, to the following address:

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24 *et seq.*, the undersigned certifies that this document complies with the type-volume limitations. This document contains 12,052 words as calculated by the “Word Count” feature of Microsoft Word 2010, the word processing program used to create it.

Dated: June 4, 2024

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