

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
Petitioner,

v.

ASUS TECHNOLOGY LICENSING INC.,
Patent Owner.

Case IPR2024-01273
Patent No. 10,785,759

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT 10,785,759**

TABLE OF CONTENTS

I.	Introduction.....	1
II.	Mandatory Notices Under 37 C.F.R. §42.8.....	1
	A. Real Party-in-Interest Under 37 C.F.R. §42.8(b)(1)	1
	B. Related Matters.....	1
	C. Lead and Backup Counsel.....	2
III.	Grounds for Standing and Fees	3
IV.	U.S. Patent No. 10,785,759	3
	A. Overview	3
	B. Prosecution History	4
V.	Level of Ordinary Skill in the Art	4
VI.	Background.....	5
VII.	Ground 1: Claims 1-5 and 8-17 would have been obvious based on Noh in view of Tooher and the knowledge of a POSITA.	6
	A. Noh	6
	B. Tooher.....	8
	C. Scope, Content, and Rationale for Combining Prior Art	9
	D. Independent claim 1	11
	1. [1p]	11
	2. [1a]	14
	3. [1b]	23
	4. [1c]	26
	5. [1d]	28
	6. [1e]	29

E.	Claim 2	30
F.	Claim 3	32
	1. [3a]	32
	2. [3b]	37
	3. [3c]	38
	4. [3d]	39
G.	Claim 4	42
H.	Claim 5	44
	1. [5a]	44
	2. [5b]	45
I.	Claim 8	45
J.	Claim 9	46
K.	Claim 10	47
L.	Claim 11	47
M.	Claim 12	48
N.	Claim 13	48
	1. [13p]	48
	2. [13a]	48
	3. [13b]	49
	4. [13c]	50
	5. [13d]	50
	6. [13d-1]	51
	7. [13d-2]	51

8.	[13d-3].....	51
1.	[13d-4].....	51
1.	[13d-5].....	52
O.	Claim 14	52
P.	Claim 15	52
Q.	Claim 16	52
R.	Claim 17	53
VIII.	Ground 2: Claims 1-2, 4, 8-15, and 17 would have been obvious based on Islam in view of Jiang and the knowledge of a POSITA.....	53
A.	Islam	53
B.	Jiang.....	54
C.	Scope, Content, and Rationale for Combining Prior Art	55
D.	Independent claim 1	57
1.	[1p]	57
2.	[1a]	58
3.	[1b]	64
4.	[1c]	65
5.	[1d]	67
6.	[1e]	70
E.	Claim 2	71
F.	Claim 4	72
G.	Claim 8	73
H.	Claim 9	74

I.	Claim 10	74
J.	Claim 11	75
K.	Claim 12	75
L.	Claim 13	75
1.	[13p]	75
2.	[13a], [13b], [13c], 13[d]	76
3.	[13d-1]	76
4.	[13d-2]	77
5.	[13d-3]	77
6.	[13d-4]	77
7.	[13d-5]	77
M.	Claim 14	77
N.	Claim 15	77
O.	Claim 17	77
IX.	Ground 3: Claims 3, 5 and 16 would have been obvious based on Islam in view of Jiang, Miao, and the knowledge of a POSITA.....	77
A.	Miao.....	77
B.	Scope, Content, and Rationale for Combining Prior Art	78
C.	Claim 3	79
1.	[3a]	79
2.	[3b]	82
3.	[3c]	84
4.	[3d]	85

A. Claim 5 88

1. [5a] 88

2. [5b] 88

B. Claim 16 88

X. Non-Institution Under 35 U.S.C. §§ 314(a) or 325(d) Would Be
Improper.....89

WORD COUNT AND CERTIFICATION UNDER 37 C.F.R. § 42.24(d) 1

CERTIFICATE OF SERVICE 2

LIST OF EXHIBITS

Exhibit	Description
Ex. 1001	U.S. Patent No. 10,785,759 to Lin et al. (“the ’759 patent”)
Ex. 1002	Declaration of Harry V. Bims, Ph.D. (“Bims”)
Ex. 1003	U.S. Patent Publication No. 2019/0090218 (“Noh”)
Ex. 1004	U.S. Patent No. 11,140,640 (“Tooher”)
Ex. 1005	U.S. Patent App. No. 62/373,089 (“Tooher-Prov.”)
Ex. 1006	Prosecution History of the ’759 patent
Ex. 1007	CV of Harry V. Bims, Ph.D.
Ex. 1008	U.S. Patent Publication No. 2017/0215170 by Islam et al. (“Islam”)
Ex. 1009	U.S. Patent No. 10,756,838 by Jiang et al. (“Jiang”)
Ex. 1010	U.S. Patent No. 10,849,170 by Miao et al. (“Miao”)
Ex. 1011	WO2018/023364 by Jiang et al. (“Ex-1011-JiangPCT”)
Ex. 1012	WO2017/062061 to Miao et al. (“Ex-1012-MiaoPCT”)
Ex. 1013	Original and certified translation of KR 10-2016-0039964 (“Ex-1013-KRApp”)
Ex. 1014	Erik Dahlman et al. “4G, LTE-Advanced Pro and the Road to 5G,” Third Edition, published 2016 (“Ex-1014-Dahlman”)
Ex. 1015	“Part 16: Air Interface for Broadband Wireless Access Systems,” IEEE Standard for Local and metropolitan area networks, IEEE std. 802.16, May 29, 2009 (“Ex-1015-802.16”)
Ex. 1016	Samsung <i>Sotera</i> Stipulation letter re IPR grounds in District Court Litigation

CLAIM LISTING

Claim 1. [1p] A method for determining numerology bandwidth, the method comprising:

[1a] receiving, by a user equipment (UE), information for a first numerology associated with a first subcarrier spacing, wherein the information comprises a first frequency location and a first bandwidth for the first numerology for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH);

[1b] detecting a physical downlink control channel (PDCCH), wherein the PDCCH is associated with the PDSCH or the PUSCH;

[1c] deriving, by the UE, a first bandwidth portion based on the first frequency location and the first bandwidth for the first numerology; and

[1d] deriving, by the UE, a resource allocation scheduled by a network and carried by the PDCCH for the PDSCH or the PUSCH for the first numerology within the first bandwidth portion based on the PDCCH, the first frequency location and the first bandwidth;

[1e] wherein the resource allocation within the first bandwidth portion is done via a bit map indicating which resource unit within the first bandwidth portion is allocated for the UE.

Claim 2. The method of claim 1, further comprising: configuring, by the UE, a system bandwidth.

Claim 3. [3a] The method of claim 1, comprising: receiving, by the UE, second information for a second numerology associated with a second subcarrier spacing, wherein the second information comprises a second frequency location and a second bandwidth for the second numerology for a second PDSCH or a second PUSCH:

[3b] detecting a second PDCCH, wherein the second PDCCH is associated with the second PDSCH or the second PUSCH;

[3c] deriving, by the UE, a second bandwidth portion based on the second frequency location and the second bandwidth for the second numerology; and

[3d] deriving, by the UE, a second resource allocation scheduled by a second network and carried by the second PDCCH for the second PDSCH or the second PUSCH for the second numerology within the second bandwidth portion based on the second PDCCH, the second frequency location and the second bandwidth.

Claim 4. The method of claim 1, comprising: wherein the first frequency location is an index of a resource block.

Claim 5. [5a] The method of claim 1, comprising: receiving, by the UE, second information for a second numerology associated with a second subcarrier spacing,

wherein the second information comprises a second frequency location and a second bandwidth for the second numerology and;

[5b] deriving, by the UE, a second resource allocation for a second PDSCH or a second PUSCH for the second numerology within a second bandwidth portion based on the PDCCH, the second frequency location and the second bandwidth.

Claim 8. The method of claim 1, wherein the first bandwidth and the first frequency location is configured by UE-specific RRC message.

Claim 9. The method of claim 1, wherein the first bandwidth and the first frequency location is indicated by a physical control channel.

Claim 10. The method of claim 1, wherein the first numerology is indicated by a physical control channel.

Claim 11. The method of claim 1, wherein the first bandwidth is a maximum bandwidth for the first numerology.

Claim 12. The method of claim 1, wherein the first bandwidth is a maximum bandwidth that the UE is able to receive for the first numerology.

Claim 13. [13p] A User Equipment (UE) capable of determining numerology bandwidth, comprising:

[13a] a control circuit;

[13b] a processor installed in the control circuit; and

[13c] a memory installed in the control circuit and coupled to the processor;

[13d] wherein the processor is configured to execute a program code stored in the memory to;

[13d-1] receive information for a first numerology associated with a first subcarrier spacing, wherein the information comprises a first frequency location and a first bandwidth for the first numerology for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH);

[13d-2] detect a physical downlink control channel (PDCCH), wherein the PDCCH is associated with the PDSCH or the PUSCH;

[13d-3] derive a first bandwidth portion based on the first frequency location and the first bandwidth for the first numerology;

[13d-4] derive a resource allocation scheduled by a network and carried by the PDCCH for the PDSCH or the PUSCH for the first numerology within the first bandwidth portion based on the PDCCH, the first frequency location and the first bandwidth;

[13d-5] wherein the resource allocation within the first bandwidth portion is done via a bit map indicating which resource unit within the first bandwidth portion is allocated for the UE.

Claim 14. The UE of claim 13, wherein the UE configures a system bandwidth.

Claim 15. The UE of claim 14, wherein the system bandwidth is larger than the first bandwidth.

Claim 16. The UE of claim 13, wherein the processor is further configured to execute a second program code stored in the memory to: receive second information for a second numerology associated with a second subcarrier spacing, wherein the second information comprises a second frequency location and a second bandwidth for the second numerology and deriving, by the UE, a second resource allocation for a second PDSCH or a second PUSCH for the second numerology within a second bandwidth portion based on the PDCCH, the second frequency location and the second bandwidth.

Claim 17. The UE of claim 13, wherein the first bandwidth is a configured bandwidth for the first numerology.

I. Introduction

Samsung Electronics Co. Ltd. (“Petitioner”) requests *inter partes* review of claims 1-5 and 8-17 (“Challenged Claims”) of Asus’s U.S. Patent No. 10,785,759 (Ex-1001 (“the ’759 patent)). Petitioner requests review as follows:

Ground No.	Obviousness
1	Claims 1-5 and 8-17 would have been obvious based on Noh in view of Tooher and the knowledge of a person of ordinary skill in the art (“POSITA”).
2	Claims 1, 2, 4, 8-15, and 17 would have been obvious based on Islam in view of Jiang and the knowledge of a POSITA.
3	Claims 3, 5 and 16 would have would have been obvious based on Islam in view of Jiang, Miao and the knowledge of a POSITA.

II. Mandatory Notices Under 37 C.F.R. §42.8**A. Real Party-in-Interest Under 37 C.F.R. §42.8(b)(1)**

Petitioner certifies that Samsung Electronics Co. Ltd., Samsung Electronics America, Inc., and Samsung Research America are the real parties-in-interest.

B. Related Matters

Petitioner is aware of one case involving the ’759 patent: *Asus Technology Licensing Inc. et al. v. Samsung Elecs. Co. Ltd. et al.*, Case No. 2:23-cv-00409 (E.D.

Tex.) (the “Asus Litigation”).¹ Petitioner is not aware of any other matters involving the ’759 Patent.

C. Lead and Backup Counsel

Petitioner designates the following lead and backup counsel:

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¹ Asus filed an amended complaint on March 11, 2024, which was the first time that Asus asserted the ’759 patent in the Asus Litigation.

Service on Petitioner may be made by mail or hand delivery to: Greenberg Traurig, LLP, 1144 15th St. Suite 3300, Denver, CO 80202. Petitioner also consents to and prefers electronic service by emailing Samsung-ASUS-IPRs@gtlaw.com and counsel of record.

III. Grounds for Standing and Fees

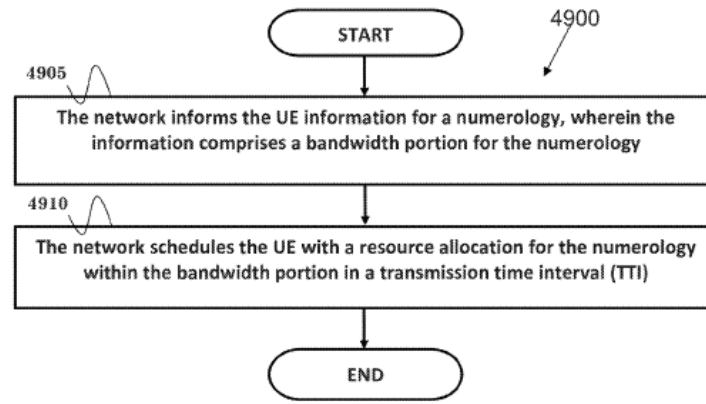
Pursuant to 37 C.F.R. § 42.104(a), Petitioner certifies that the '759 patent is available for IPR and that Petitioner is not barred or estopped from requesting cancellation of the Challenged Claims on Grounds 1, 2, and 3. The IPR Petition fee and any necessary additional fees may be charged to Deposit Account No. 50-2638.

IV. U.S. Patent No. 10,785,759

A. Overview

The '759 patent generally relates to user equipment receiving information for a numerology, wherein the information comprises a frequency location and a bandwidth. *Id.*, Abstract. The forty figures in the '759 patent labeled as “prior art” and their lengthy corresponding description in the specification qualify as Applicant-Admitted Prior Art (“AAPA”). *See Id.*, 6:45-40:30, Figs. 5-40. In fact, the majority of the specification is a copy and paste of various 3GPP standard documents. *Id.*, 7:48-50 (“As disclosed in 3GPP TR 36.211 V13.1.0, a brief description of LTE numerology is quoted as follows”).

The '759 patent describes determining the numerology in a wireless communication system, as illustrated in Fig. 49 below. *Id.*, 50:35-42, Fig. 49.



In “step 4905, the network informs the UE information for a numerology.” *Id.*, 50:36-39. Furthermore, “in step 4910, the network schedules the UE with a resource allocation for the numerology within the bandwidth portion in a transmission time interval (TTI).” *Id.*, 50:39-41.

B. Prosecution History

The claims of the '759 patent were subject to rejections in four Office Actions. Patent Owner ultimately overcame the rejection of claim 1 by amending to add the following limitation: “deriving, by the UE, a first bandwidth portion based on the first frequency location and the first bandwidth for the first numerology.” Ex-1006, 40.

V. Level of Ordinary Skill in the Art

A person of ordinary skill in the art (“POSITA”) as of the earliest claimed priority date for the '759 patent would have had at least a bachelor’s degree in

electrical engineering, familiarity with the relevant 3GPP standards as of this time, and two years of experience working in a field involving wireless communications. Ex-1002-Bims, ¶¶29-33.² Additional education, such as a master's degree of electrical engineering could substitute for professional experience and vice versa. *Id.*

VI. Background

Although the LTE standard allows for a 7.5 KHz subcarrier spacing, such a spacing is not practical at higher frequencies. Ex-1002-Bims, ¶¶42-57. Thus, in most deployments there is “only one downlink (DL) numerology defined for initial access, which is 15 KHz subcarrier spacing and the signal and channel to be acquired during initial access is based on 15 KHz numerology.” Ex-1001-'759 patent, 10:50-53. However, users' data requirements were rapidly changing with the rapid rise in demand for transmitting large amounts of data from mobile devices. Ex-1002-Bims, ¶49. In 2014 and 2015, contributors began working on a new radio technology to replace 4G. Ex-1002-Bims, ¶50. The new radio technology needed to be able to operate in a wide variety of user environments, all of which had varying needs. Ex-1002-Bims, ¶51. Developers also wanted to reduce latency to increase performance.

² Petitioner submits the declaration of Harry Bims (“Ex-1002-Bims”), who was a POSITA as of the earliest claimed priority date for the '759 patent. Ex-1002-Bims, ¶¶29-33.

Ex-1002-Bims, ¶52. It became obvious that one numerology would not be able to meet all these necessary requirements. Ex-1002-Bims, ¶53. Other standards, like IEEE 802.16, had used varying subcarrier spacing for years. Ex-1002-Bims, ¶¶55-57.

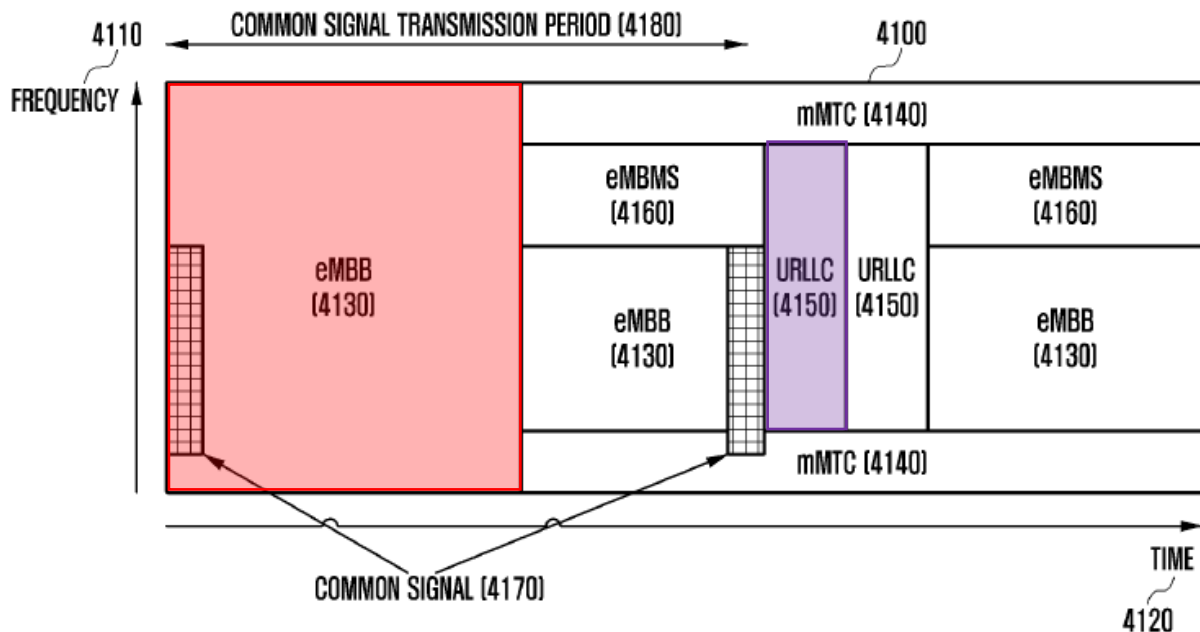
VII. Ground 1: Claims 1-5 and 8-17 would have been obvious based on Noh in view of Tooher and the knowledge of a POSITA.

A. Noh

Noh, U.S. Patent Publication No. 2019/0090218, is the national stage entry of PCT/KR2017/003654 (“Noh-PCT”), which was filed on April 3, 2017, and published on October 5, 2017, as WO 2017/171253. Noh has a §371(c) date of September 18, 2018, and was published on March 21, 2019. Noh claims priority to several foreign applications, including KR-10-2016-0039964 (“KRApp”), filed on April 1, 2016. Noh is prior art under at least AIA 35 U.S.C. §102(a)(2). *See also* 35 U.S.C. §102(d); *Penumbra, Inc. v. RapidPulse, Inc.*, IPR2021-01466, Paper 35 at 29-32 (March 10, 2023) (precedential). Noh is presumptively prior art as it is the national stage entry of a PCT document and claims priority to a foreign application that is prior art to the ’759 Patent. KR-App is in Korean, and Ex-1013 comprises KR-App and a certified translation of the same. Noh and the translated KR-App describe the same subject matter. This confirms that the subject matter upon which Petitioner relies was described in the priority document, KR-App, as required. Petitioner provides parallel citations to Noh and the translated KR-App herein.

Noh discloses “a procedure for a terminal to achieve synchronization and acquire system information in initial access a numerology and receive a service with another numerology in a 5G communication system.” Ex-1003-Noh, ¶378; Ex-1013-KRApp, ¶279. Figure 41 of Noh, reproduced below, “shows a situation where multiple services such as eMBB 4130, mMTC 4140, URLLC 4150, and eMBMS 4160 are multiplexed . . . in the 5G communication system.” Ex-1003-Noh, ¶376; Ex-1013-KRApp, ¶278.

FIG. 41



Ex-1003-Noh, Fig. 41; Ex-1013-KRApp, Fig. 4C.³

B. Tooher

Tooher, U.S. Patent No. 11,140,640, is the national stage entry of PCT/US2017/46105 (“Tooher-PCT”), published on February 15, 2018 as WO2018/031664. Tooher claims priority to multiple provisionals, including provisional application No. 62/373,089, filed on August 10, 2016 (“Tooher-Prov”). The reference is prior art under at least AIA 35 U.S.C. §102(a)(2). *See* 35 U.S.C. §102(d); *Penumbra*. Tooher is presumptively prior art as it is the national stage entry of a PCT document published in English and claims priority to a provisional that is prior art to the ’759 patent. 35 U.S.C. §§102(a)(1), (a)(2), (d), 122(b), 374; MPEP §901.03.⁴

Tooher discloses a 5G communication system that supports multiple services, including eMBB service. Ex-1004-Tooher, 16:23-32; Ex-1005-Tooher-Prov, ¶¶148-149. Specifically, Tooher discloses user equipment for a 5G communications system that supports “uses cases such as eMBB, URLLC, and mMTC” and “[e]ach use case

³ All color shown in the figures reproduced herein are annotations by Petitioner.

⁴ The disclosures in Tooher relied upon herein are fully supported by U.S. Provisional Application No. 62/373,089 and citations to the both the Tooher patent and the Tooher provisional application are provided below.

may have its own requirements that lead to the need for different transmission parameters, including signal structure, numerology.” Ex-1004-Tooher, 16:25-31; Ex-1005-Tooher-Prov-Prov, ¶¶148-149.

C. Scope, Content, and Rationale for Combining Prior Art

Both Noh and Tooher generally relate to cellular communications in a mobile communication system where multiple services are received with different numerologies at different frequency locations. Ex-1002-Bims, ¶¶95-98. A POSITA would have been motivated to combine Tooher’s teachings with Noh because both references are directed to provisioning multiple numerologies for multiple services. *Id.* Noh discloses that its terminal (“UE”) can “ascertain the start and end frequency of the system bandwidth” for “initial access” and “receive service with another numerology in a 5G communication system.” Ex-1003-Noh, ¶¶378, 392; Ex-1013-KRApp, ¶¶279, 287. Therefore, it would have been obvious for a POSITA to implement Noh’s 5G communication system such that Noh’s terminal could ascertain the “*first frequency location and a first bandwidth for the first numerology*,” such as the first frequency location and first bandwidth for the eMBB service. Ex-1002-Bims, ¶¶95-96.

A POSITA would have been motivated to implement Tooher’s teachings regarding providing the “numerology block boundaries” for eMBB service in Noh’s 5G communication system for including eMBB service to a terminal, because it

would have enabled efficient and reliable provisioning of the eMBB service in Noh's 5G communication system. Ex-1002-Bims, ¶¶97.

Noh discloses that its terminal (“UE”) receives a first frequency location and a first bandwidth for “initial access” and “ascertain the start and end frequency of the system bandwidth” for “initial access,” but does not provide express disclosure of how the UE “receive[s] service with another numerology in a 5G communication system.” Ex-1003-Noh, ¶¶378, 392; Ex-1013-KRApp, ¶¶279, 287. “[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious.” *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 417 (2007). In other words, this combination would have involved “the mere application of a known technique”—Tooher’s teachings regarding a terminal receiving the numerology block boundaries—“to a piece of prior art”—Noh’s 5G communication system for providing eMBB service—that is “ready for the improvement.” *Id.*; Ex-1002-Bims, ¶¶97. Tooher’s system is highly similar to Noh’s system, as both references disclose terminals operating in a 5G communication system and being configured with multiple numerologies to provide eMBB, mMTC, URLLC services. Ex-1003-Noh, ¶376; Ex-1013-KRApp, ¶278; Ex-1004-Tooher, 16:23-32; Ex-1005-Tooher-Prov, ¶¶148-149.

A POSITA would have had a reasonable expectation of success in applying Tooher's teachings regarding determining numerology boundaries to Noh because both references teach provisioning a terminal in a 5G communication system for multiple numerologies for multiple services, including eMBB. *See* Ex-1003-Noh, ¶392; Ex-1013-KRApp, ¶287; Ex-1004-Tooher, 16:23-32; Ex-1005-Tooher-Prov, ¶¶148-149. Therefore, a POSITA would have had reasonable expectation of success in combining Tooher's teachings into Noh's 5G communication system. Ex-1002-Bims, ¶98.

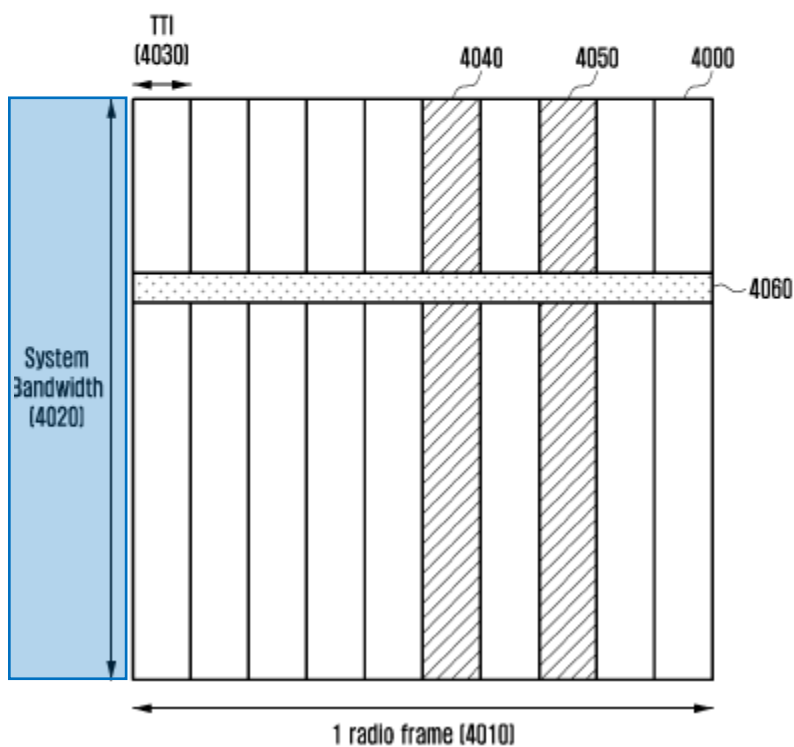
D. Independent claim 1

1. [1p]

[1p] A method for determining numerology bandwidth, the method comprising:

Noh discloses a 5G communication system where "individual services may be provided with different numerologies." Ex-1003-Noh, ¶359; Ex-1013-KRApp, ¶263. Noh further discloses that the "term 'numerology' is intended to include cyclic prefix (CP) length, subcarrier spacing, OFDM symbol length, and TTI in the OFDM-based or OFMDA-based communication systems." Ex-1003-Noh, ¶359; Ex-1013-KRApp, ¶263. Figure 40 of Noh, reproduced below, provides a "diagram for explaining **resource allocation** in a time-frequency resources grid ... in a 5G communication system." Ex-1003-Noh, ¶363; Ex-1013-KRApp, ¶266, Fig. 4B.

FIG. 40

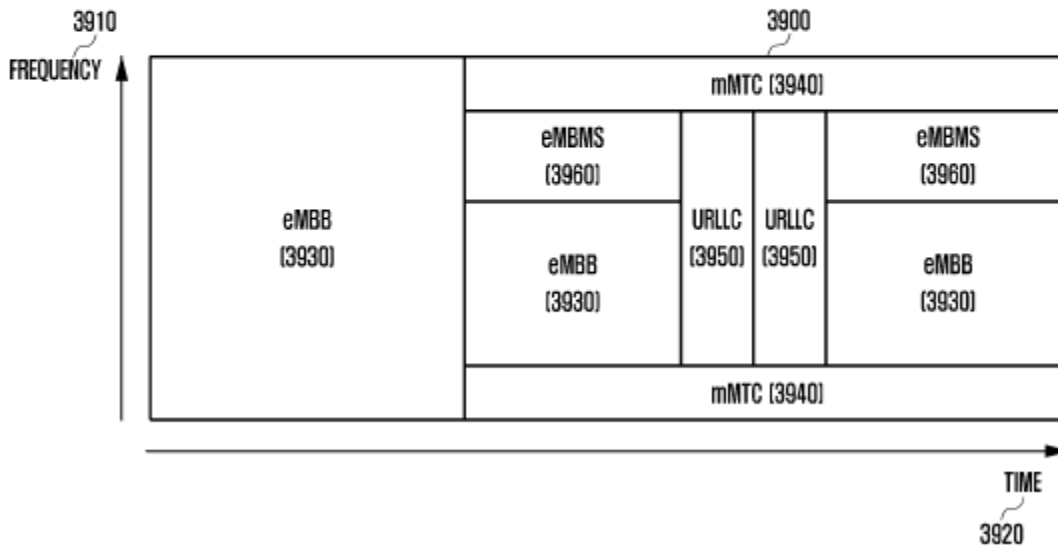


As shown above in Figure 40, “the time-frequency resources 4000 for use in the 5G communication system are defined by a radio frame 4010 and a system bandwidth 4020.”⁵ Ex-1003-Noh, ¶364; Ex-1013-KRApp, ¶267. Additionally, related Figure 39 of Noh, provides “a diagram for explaining resource allocation for supporting

⁵ All color emphases on text herein are annotations by Petitioner.

multiple services,” including “**eMBB 3930.**” Ex-1003-Noh, ¶378, Fig. 39; Ex-1013-KRApp, ¶279, Fig. 4A.

FIG. 39



Noh discloses that “FIG. 39 depicts that eMBB 3930, mMTC 3940, and URLLC 3950 are administrated by way of example on one frame in the 5G communication system.” Ex-1003-Noh, ¶354; Ex-1013-KRApp, ¶260. Noh discloses procedures “for a terminal to achieve synchronization and acquire system information in initial access [with] a numerology and receive a service with another numerology in a 5G communication system.” Ex-1003-Noh, ¶378; Ex-1013-KRApp, ¶279. Accordingly, by teaching the provisioning of multiple services like eMBB and URLLC, in a 5G

communication system, Noh teaches the claimed “*method for determining numerology bandwidth.*”⁶ Ex-1002-Bims, ¶¶99-101.

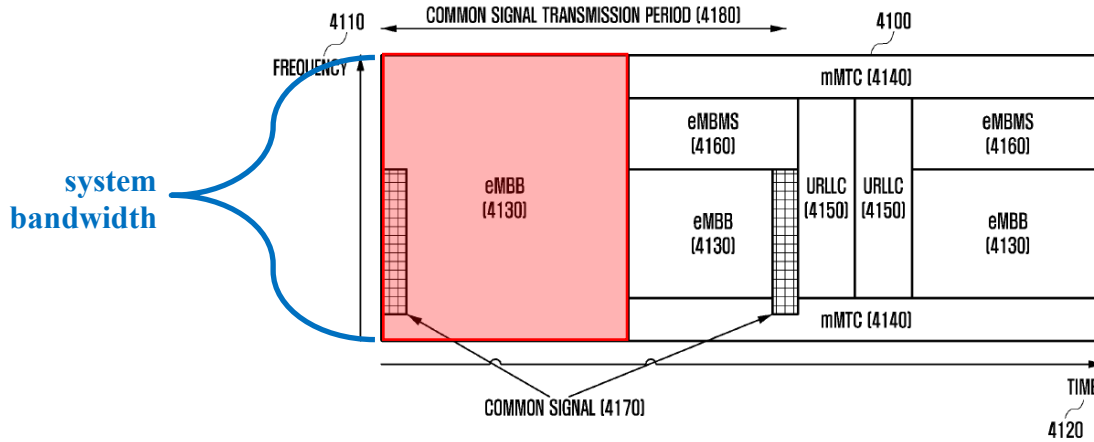
2. [1a]

[1a] receiving, by a **user equipment (UE)**, information for a **first numerology** associated with a **first subcarrier spacing**, wherein the information comprises a **first frequency location** and a **first bandwidth for the first numerology** for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH);

Figure 41 of Noh, “shows a situation where multiple services such as **eMBB 4130**, ... are multiplexed [and] provided in a multiplexed manner in the 5G communication system as in FIG. 39.” Ex-1003-Noh, ¶376, Fig. 41; Ex-1013-KRApp, ¶278; Fig. 4C.

⁶ Italicized text appearing in quotes herein provides quotations from the Challenged Claims.

FIG. 41



Noh discloses that in one embodiment, “**the system bandwidth information**” may be “transmitted in the MIB [“Master Information Block”] of the 5G communication system.” Ex-1003-Noh, ¶387; Ex-1013-KRApp, ¶284. With respect to multiple services handled by the UE, Noh discloses that “[t]he 5G synchronization signal may be [a] service-specific synchronization signal for **eMBB**, mMTC, and URLLC services being transmitted with **service-specific numerologies**,” and that “services may be provided with different transmission/reception schemes and transmission reception parameters to meet the service specific requirements.” Ex-1003-Noh, ¶¶358, 485; Ex-1013-KRApp, ¶¶263, 362. For example, Noh discloses that the “**eMBB** aims to provide exceptionally high data rate” and “increase the peak data rate.” Ex-1003-Noh, ¶348; Ex-1013-KRApp, ¶255. Specifically, Noh discloses that: “**For the eMBB 3930, it is preferred to occupy the frequency bandwidth as**

broad as possible ... to secure increased data rate as described above. That is, it is preferred for the terminal to be allocated RBs as many as possible for data transmission.” Ex-1003-Noh, ¶355; Ex-1013-KRApp, ¶260.

In view of these disclosures in Noh of providing “transmission reception parameters to meet the service specific requirements,” a POSITA would have understood that Noh’s disclosure of a “**service-specific numerolog[y]**” for **eMBB**, teaches a “**first numerology**.” Ex-1003-Noh, ¶355; Ex-1013-KRApp, ¶260. Additionally, Noh discloses that the “Physical Downlink Shared Channel (PDSCH 1220)” is “a downlink channel for use in transmitting traffic (or data) from an eNB to a **UE**.” Ex-1003-Noh, ¶171; *see also* ¶418 (“Downlink data may be transmitted over a Physical Downlink Shared Channel (PDSCH) that is a physical channel for downlink data transmission.”); Ex-1013-KRApp, ¶97; *see also* ¶312. Dr. Bims testifies that a POSITA would have been familiar with the 3GPP standards and it was well known to a POSITA that a **UE** operating in accordance with the standard receives data via a physical channel, such as Physical Downlink Shared Channel (PDSCH). Ex-1002-Bims, ¶¶102-105. In fact, the ’759 patent quotes 3GPP TR 36.211 V13.1.0 (AAPA) for following: “[a] downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers” and “[t]he following downlink physical channels are defined: Physical Downlink Shared Channel PDSCH . . . Physical Downlink Control Channel PDCCH.” Ex-

1001, 8:9:18. Accordingly, a POSITA would have understood that Noh's disclosure of a "**service-specific numerolog[y]**" for **eMBB** (claimed "***first numerology***") would have been associated with a PDSCH on which downlink data for the **eMBB** service is received by the **UE**. Ex-1002-Bims, ¶105.

As to receiving frequency locations and bandwidths for numerologies, Noh discloses "the present invention proposes a method for locating the common signal at an arbitrary location in the system bandwidth to achieve more robust forward compatibility and higher degree of freedom in the 5G communication system. Ex-1003-Noh, ¶383; Ex-1013-KRApp, ¶283. For example, Noh discloses that: "[i]n order to make it possible to locate the common signal at an arbitrary location in the system bandwidth, there is a need of a set of candidate frequency locations for transmitting the common signal in order for the terminal to select an arbitrary frequency location from the set to transmit the common signal." Ex-1003-Noh, ¶384; Ex-1013-KRApp, ¶285. Noh discloses that one "method for transmitting the common signal transmission location information is to transmit the corresponding information in an SIB ... Here, the common signal transmission **frequency location may be notified to the terminal in the form of an offset** or a center frequency of the bandwidth in which the common signal is transmitted." Ex-1003-Noh, ¶389; Ex-1013-KRApp, ¶285. "If the field for indicating the common signal transmission frequency location is included in the SIB as described in the second method of

embodiment 4-2, **the terminal may ascertain the start and end frequency of the system bandwidth based on the system bandwidth information obtained at step 4340 and the common signal transmission frequency location information ascertained from the SIB at step 4350.**” Ex-1003-Noh, ¶392; Ex-1013-KRApp, ¶287. In other embodiments, Noh discloses “the common signal is generated with a numerology configured for the common signal.” Ex-1003-Noh, ¶395; Ex-1013-KRApp, ¶289. Further, after the common signal transmission is acquired in initial access with one numerology, Noh describes a service being received with a different numerology. “FIG. 42 is a flowchart illustrating a procedure for a terminal to achieve synchronization and acquire system information in initial access a numerology and receive a service with another numerology.” Ex-1003-Noh, ¶378; Ex-1013-KRApp, ¶279.

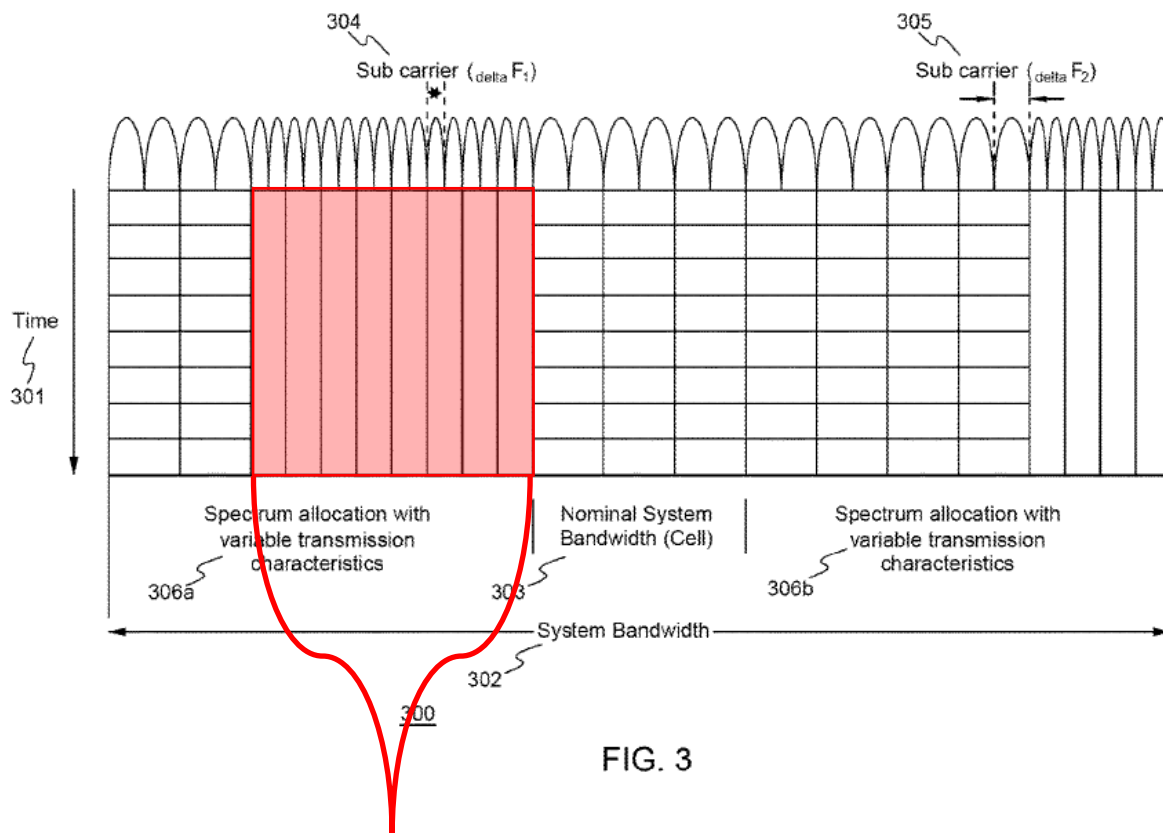
As described in §VII(C), although Noh expressly discloses receiving a frequency location for the common signal, the system bandwidth information, and resource allocation and provisioning for multiple services, such as **eMBB**, Noh does not expressly disclose receiving “*a first frequency location and a first bandwidth for the first numerology.*” However, Tooher expressly discloses a terminal receiving “*first frequency location*” and “*a first bandwidth*” for the “*first numerology*” and it would have been obvious to combine the teachings in Tooher

with the 5G communication system disclosed in Noh when implementing a **UE**. Ex-1002-Bims, ¶¶106-107.

Similar to Noh, Tooher discloses a 5G communication system that supports multiple services, including “uses cases such as **eMBB**, URLLC, and mMTC” and “[e]ach use case may have its own requirements that lead to the need for different transmission parameters, including signal structure, **numerology**.” Ex-1004-Tooher, 16:23-32; Ex-1005-Tooher-Prov, ¶¶148-149. Furthermore, Tooher discloses that a “carrier may be configured to support different transmission types, each associated with a different numerology,” and “**a carrier’s bandwidth may be segmented into numerology blocks**.” Ex-1004-Tooher, 16:50-54; Ex-1005-Tooher-Prov, ¶151. Additionally, Tooher discloses that a “block or region or portion of a carrier may be defined by . . . **a frequency range, for example a contiguous frequency range**.” Ex-1004-Tooher, 17:1-3; Ex-1005-Tooher-Prov, ¶152.

Tooher refers to **UEs** as “**Wireless Transmit/Receive Units (WTRUs)**” and Tooher discloses that “**a WTRU needs to know the boundaries of at least one numerology block along with the parameters associated with transmissions on at least one numerology block**.” Ex-1004-Tooher, 1:33, 19:19-25; Ex-1005-Tooher-Prov, ¶167. A POSITA would have understood that “**to know the boundaries**,” as disclosed in Tooher, the terminal would need to know where the boundary starts and where it ends. Ex-1002-Bims, ¶¶108-109. Tooher further

discloses that “one or more numerology block boundaries or sets of parameters may be indicated dynamically.” Ex-1004-Tooher, 19:52-53; Ex-1005-Tooher-Prov, ¶170. “For example, **downlink control information (DCI) may indicate the boundary and set of parameters of at least one numerology block.**” Ex-1004-Tooher, 19:54-56; Ex-1005-Tooher-Prov, ¶170. As shown below, Tooher’s Figure 3 shows an example of “spectrum allocation” where “different subcarriers [are] assigned to different modes of operation.” Ex-1004-Tooher, 15:16-19; Ex-1005-Tooher-Prov, ¶145.



**first numerology
block boundaries
(defining first bandwidth)**

As illustrated in Figure 3 above, Tooher discloses “spectrum allocation with variable transmission characteristics,” such as “**Sub-carrier (delta F₁)**” for a first numerology block, such as **eMBB** service. Ex-1004-Tooher, Fig. 3; Ex-1005-Tooher-Prov, Fig. 3.

A POSITA would have understood that Tooher’s “numerology block boundaries” for a continuous frequency range would have included a starting frequency and an ending frequency for the “numerology block.” Ex-1004-Tooher, 19:52-53; Ex-1005-Tooher-Prov, ¶170; Ex-1002-Bims, ¶¶110-111. In *KSR*, the Supreme Court held the obviousness analysis should consider the “background knowledge possessed by a person having ordinary skill in the art.” 550 U.S. at 398.⁷ Furthermore, a POSITA would have understood that Tooher’s “boundary” starting frequency teaches the claimed “**first frequency location.**” Ex-1002-Bims, ¶111. Additionally, a POSITA would have understood that the starting frequency and the ending frequency defined by Tooher’s “boundary” teaches the claimed “**a first bandwidth**” for the “**first numerology.**” Ex-1002-Bims, ¶111. Furthermore, a

⁷ In *Koninklijke Philips N.V. v. Google LLC*, the Federal Circuit determined that “the obviousness inquiry turns not only on the prior art, but whether the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious . . . to a person having ordinary skill in the art.” 948 F.3d 1330, 1337 (Fed. Cir. 2020).

POSITA would have understood Tooher's "**Sub-carrier (delta F₁)**" teaches the claimed "**first subcarrier spacing**" for the "**first numerology**." Ex-1004-Tooher, Fig. 3; Ex-1005-Tooher-Prov, Fig. 3. Accordingly, it would have been obvious to a POSITA to incorporate Tooher's teachings regarding providing the "numerology block boundaries" with "sets of parameters" for **eMBB** service into Noh's 5G communication system for providing **eMBB** service to a terminal. Ex-1004-Tooher, 19:26-27; Ex-1005-Tooher-Prov, ¶170; Ex-1002-Bims, ¶111.

As to the claimed "*the **first numerology** for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH)*," Noh discloses that "[d]ownlink data may be transmitted over a Physical Downlink Shared Channel (PDSCH) that is a physical channel for downlink data transmission." Ex-1003-Noh, ¶418 *see also* ¶171 ("Physical Downlink Shared Channel (PDSCH 1220): This is a downlink channel for use in transmitting traffic (or data) from an eNB [evolved Node B] to a UE."). Accordingly, a POSITA would have understood that the downlink data for the **eMBB** service would have been received at the **UE** via a PDSCH. Ex-1002-Bims, ¶112.

3. [1b]

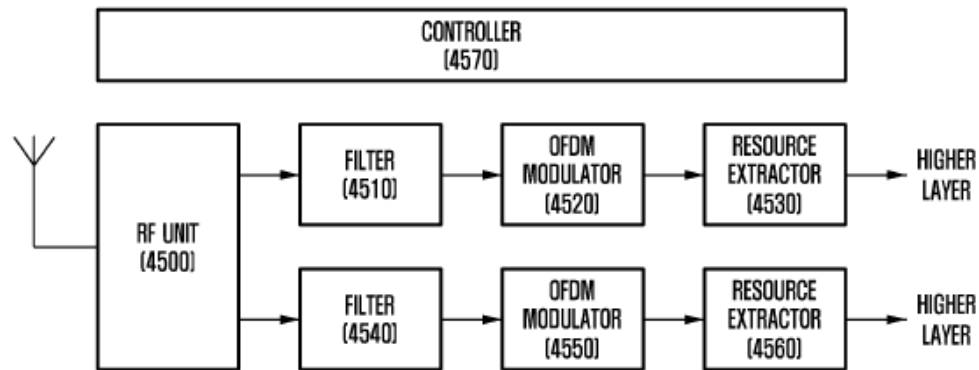
[1b] detecting a physical downlink control channel (PDCCH), wherein the PDCCH is associated with the PDSCH or the PUSCH;

Regarding the claimed “*PDCCH*,” Noh discloses that “in the 5G communication system, a physical channel being transmitted across the system bandwidth ... exists” and “[e]xamples of the signal being transmitted across the system bandwidth” include “**a physical downlink control signal.**” Ex-1003-Noh, ¶368; Ex-1013-KRApp, ¶269. Furthermore, Noh discloses that “DCI [Downlink Control Information] may be transmitted over a **Physical Downlink Control Channel (PDCCH).**” Ex-1003-Noh, ¶416; Ex-1013-KRApp, ¶310. Additionally, Noh discloses that “[d]ownlink data may be transmitted over a Physical Downlink Shared Channel (PDSCH) that is a physical channel for downlink data transmission,” and a “PDSCH may be transmitted after the control channel transmission period, and the scheduling information such as the detailed mapping location in the frequency domain and the modulation scheme may be indicated by the DCI that is transmitted over the PDCCH.” Ex-1003-Noh, ¶418; *see also* ¶171 (“Physical Downlink Shared Channel (PDSCH 1220): This is a downlink channel for use in transmitting traffic (or data) from an eNB [evolved Node B] to a UE.”); Ex-1013-KRApp, ¶312; *see also* ¶97. Noh also discloses that “Physical Downlink Control Channel (PDCCH)” may “provide a **UE** with control information for use in

receiving data on PDSCH.” Ex-1003-Noh, ¶173; Ex-1013-KRApp, ¶99. Thus, a POSITA would have understood that Noh teaches the PDCCH transmits the control information, referred to as Downlink Control Information (DCI), and a POSITA would have understood that Noh teaches that DCI transmitted over the PDCCH provides the “detailed mapping location in the frequency domain and modulation scheme” for the PDSCH that is transmitted after the information in the DCI. Ex-1003-Noh, ¶418; Ex-1013-KRApp, ¶312; Ex-1002-Bims, ¶113. Therefore, Noh teaches that the “*PDCCH is associated with the PDSCH or the PUSCH.*” Ex-1002-Bims, ¶113. Moreover, a POSITA familiar with 3GPP standards such as LTE and 5G would also have understood that a PDCCH is associated with the PDSCH or the PUSCH. Ex-1002-Bims, ¶113.

Noh discloses that “[a] **physical channel** and signal carrying a service may be generated via the resource mapper, OFDM modulator, and filter specific to the corresponding service.” Ex-1003-Noh, ¶395; Ex-1013-KRApp, ¶289. For example, Noh discloses that “**a physical channel and signal carrying an eMBB service may be generated** by the resource mapper, OFDM modulator, and filter assigned for the **eMBB** service.” Ex-1003-Noh, ¶395; Ex-1013-KRApp, ¶289. Figure 45, reproduced below, of Noh illustrates the “receiver of a **terminal**.” Ex-1003-Noh, ¶396; Ex-1013-KRApp, ¶290.

FIG. 45



Ex-1003-Noh, Fig. 45; Ex-1013, KRApp, Fig. 4G. Noh discloses that the receiver of the **terminal** includes “an RF unit 4500,” “OFDM demodulators,” “resource extractors 4530 and 4560,” and a “controller 4570” configured to “support services being provided with two or more different numerologies.” Ex-1003-Noh, ¶396; Ex-1013-KRApp, ¶290. Noh discloses that “the receiver of the **terminal** should operate as disclosed in the description of the initial access method and apparatus in the 5G communication system according to embodiments 4-1 and 4-2.” Ex-1003-Noh, ¶393; Ex-1013-KRApp, ¶288. Accordingly, a POSITA would have understood that Noh teaches a **terminal** (claimed “**UE**”) equipped to detect downlink channels, including a PDCCH. Ex-1002-Bims, ¶114-116.

4. [1c]

[1c] deriving, by the **UE**, a first bandwidth portion based on **the first frequency location and the first bandwidth for the first numerology**; and

Although Noh teaches that the **terminal** (“**UE**”) receives a “**the first numerology**,” it does not expressly disclose “*deriving, by the **UE**, a first bandwidth portion.*” Ex-1002-Bims, ¶117. However, Tooher discloses “*deriving, by the **UE**, a first bandwidth portion based on a **first frequency location** and the **first bandwidth for the first numerology**,*” and, as described in §VII(C) above, it would have been obvious to combine the teachings in Tooher regarding the **UE** deriving a first bandwidth portion with the 5G communication system disclosed in Noh when implementing a **UE** and Noh. Ex-1002-Bims, ¶117.

As described above, Tooher discloses that its “**WTRU** needs to know the boundaries of at least one numerology block along with the parameters associated with transmissions on at least one numerology block.” Ex-1004-Tooher, 19:19-25; Ex-1005-Tooher-Prov, ¶167. Tooher also discloses that “in a DCI scheduling transmission (for either DL or UL) the appropriate numerology (or numerologies) may be indicated to the **WTRU** to be used in the resources on which the **WTRU** is scheduled to transmit or receive data.” Ex-1004-Tooher, 19:66-20:3; Ex-1005-Tooher-Prov, ¶171. Tooher also discloses that the **WTRU** is responsible for “**decoding the boundaries**” received by the **WTRU**. Ex-1004-Tooher, 20:66-67;

Ex-1005-Tooher-Prov, ¶176. Therefore, Tooher teaches that the **WTRU** must derive the starting frequency and ending frequency for the numerology boundaries. Ex-1004-Tooher, 20:66-67; Ex-1005-Tooher-Prov, ¶176. More particularly, a POSITA would have understood Tooher's teaching regarding the **WTRU** "**decoding the boundaries**" teaches the claimed "*deriving, by the **UE**, a first bandwidth portion*" because Tooher teaches that the **WTRU** must derive these boundaries based upon the information received at the **WTRU**. Ex-1004-Tooher, 20:66-67; Ex-1005-Tooher-Prov, ¶176; Ex-1002-Bims, ¶118. For example, Tooher teaches that "one or more numerology block boundaries or sets of parameters may be indicated dynamically," such that the **WTRU** must repeatedly and continually derive the "numerology block boundaries." Ex-1004-Tooher, 19:52-54; Ex-1005-Tooher-Prov, ¶170.

It would have been obvious to a POSITA to combine Tooher's teaching regarding "**decoding the boundaries**" for an **eMBB service** with Noh's disclosure of provisioning the **eMBB service** on the **terminal** for **eMBB service**. Ex-1002-Bims, ¶119.

5. [1d]

[1d] deriving, by the UE, a **resource allocation** scheduled by a network and carried by the PDCCH for the PDSCH or the PUSCH for the first numerology within the first bandwidth portion based on the PDCCH, the first frequency location and the first bandwidth;

Noh discloses “**resource allocation** for supporting multiple services.” Ex-1003-Noh, ¶¶352, 363; Ex-1013-KRApp, ¶¶259, 266. Noh discloses that “DCI may be transmitted over a Physical Downlink Control Channel (PDCCH).” Ex-1003-Noh, ¶416; Ex-1013-KRApp, ¶310. Furthermore, Noh discloses that the DCI can be transmitted over the PDCCH and provide the “scheduling information,” including the “detailed mapping location in the frequency domain and the modulation scheme.” Ex-1003-Noh, ¶418; Ex-1013-KRApp, ¶312. Thus, Noh teaches that this information transmitted over PDCCH can provide the “**resource allocation**” for the downlink data to be transmitted over the PDSCH. Ex-1003-Noh, ¶418; Ex-1013-KRApp, ¶312; Ex-1002-Bims, ¶¶120-121. Noh also discloses the following:

Resource allocation type 0/1 flag: **Resource allocation** type 0/1 flag indicates whether the **resource allocation** scheme is Type 0 or Type 1. A Type-0 is to allocate resources in units of Resource Block Group (RBG) by applying a bitmap scheme ... A Type-I is to allocate a particular RB in an RBG.

Resource block assignment: Resource block assignment indicates an RB allocated for data transmission. The resources may be determined depending on the system bandwidth and the **resource allocation** scheme.

Ex-1003-Noh, ¶¶409, 410; Ex-1013-KRApp, ¶¶303, 304. Thus, Noh teaches **resource allocation** scheduled by a network. Ex-1003-Noh, ¶¶409, 410; Ex-1013-KRApp, ¶¶303, 304.

Although, the disclosure above relates to “Embodiment 5” in Noh, Noh expressly discloses that the “the embodiments may be combined in whole or in part.” Ex-1003-Noh, ¶398; Ex-1013-KRApp, ¶291. “For example, embodiments 1 and 2 of the present invention and part of embodiment 5 may be combined to form an embodiment for the operations of a base station and a terminal.” Ex-1003-Noh, ¶398; Ex-1013-KRApp, ¶291. Accordingly, a POSITA would have found it obvious to combine the teachings from “Embodiment 5” with “Embodiment 4-1” referenced above. Ex-1002-Bims, ¶¶122-123.

6. [1e]

[1e] wherein the resource allocation within the first bandwidth portion is done via a bit map indicating which resource unit within the first bandwidth portion is allocated for the UE.

The use of a bit map scheme for resource allocation was well known in the art. Ex-1002-Bims, ¶124. As noted above, Noh discloses that “resource allocation” is done via a bit map. Specifically, Noh discloses to “**allocate resources** in units of

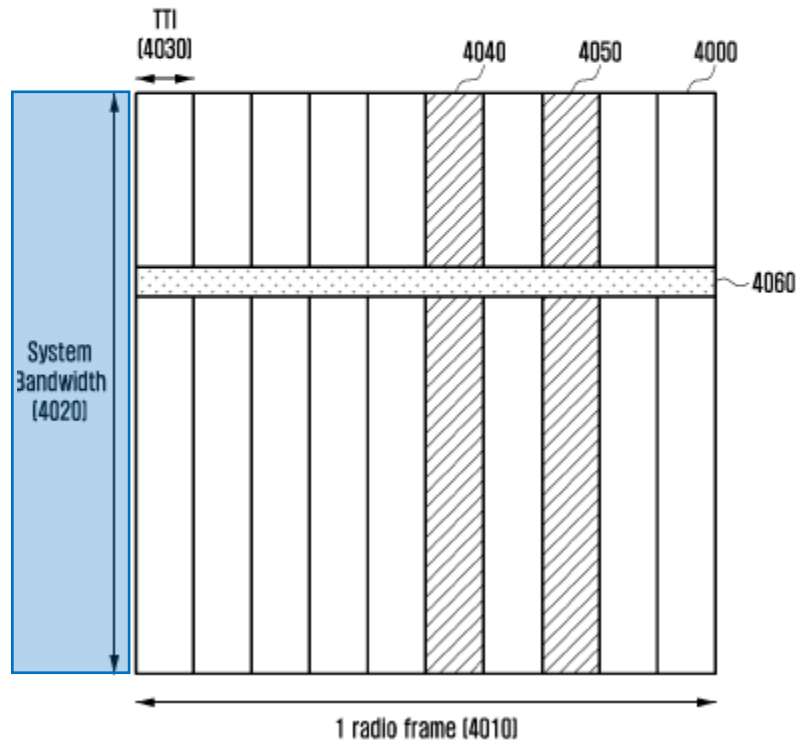
Resource Block Group (RBG) by applying a **bitmap scheme**.” Ex-1003-Noh, ¶409; Ex-1013-KRApp, ¶303. As an additional example, Tooher teaches providing a **“bitmap of allocated resource blocks.”** Ex-1004-Tooher, 31:65-67; Ex-1005-Tooher-Prov, ¶224. Thus, using a bit map for resource allocation was well known. Ex-1002-Bims, ¶124.

E. Claim 2

**[2] The method of claim 1, further comprising:
configuring, by the UE, a system bandwidth.**

Figure 40 of Noh, shows “the time-frequency resources 4000 for use in the 5G communication system are defined by a radio frame 4010 and **a system bandwidth 4020**.” Ex-1003-Noh, ¶364, Fig. 40; Ex-1013-KRApp, ¶267, Fig. 4B.

FIG. 40



Noh discloses that in one embodiment, “**the system bandwidth information**” may be “transmitted in the MIB [“Master Information Block”] of the 5G communication system.” Ex-1003-Noh, ¶387; Ex-1013-KRApp, ¶284. Furthermore, Noh discloses that the “**terminal** ascertain the **system bandwidth information** from the MIB.” Ex-1003-Noh, ¶389; Ex-1013-KRApp, ¶285; Ex-1002-Bims, ¶¶125-126.

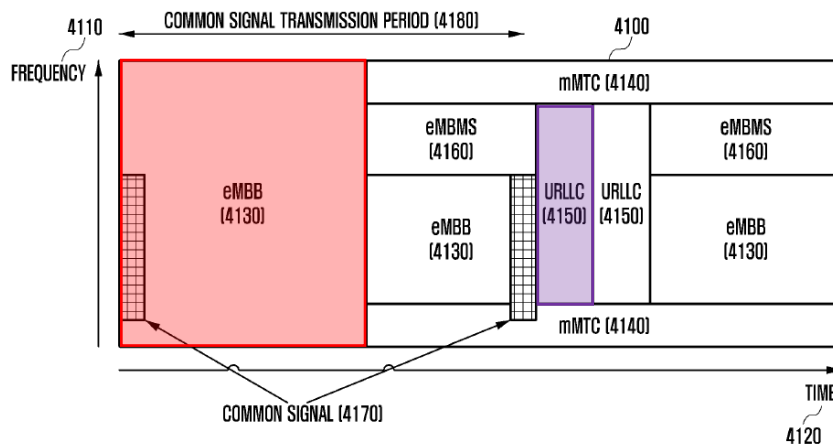
F. Claim 3

1. [3a]

[3a] The method of claim 1, comprising: receiving, by the UE, second information for a **second numerology** associated with a **second subcarrier spacing**, wherein the **second information** comprises a **second frequency location** and a **second bandwidth** for the **second numerology** for a second PDSCH or a second PUSCH;

Figure 41 of Noh, reproduced below, “shows a situation where multiple services such as **eMBB 4130**, mMTC 4140, **URLLC 4150**, and eMBMS 4160 are multiplexed.”

FIG. 41



Ex-1003-Noh, ¶376, Fig. 41; Ex-1013-KRApp, ¶278; Fig. 4C.

Noh discloses that “[t]he 5G synchronization signal may be [a] service-specific synchronization signal for **eMBB**, mMTC, and **URLLC** services being transmitted with service-specific numerologies.” Ex-1003-Noh, ¶358, 485; Ex-

1013-KRApp, ¶¶263, 329, 362. Additionally, Noh discloses that after synchronization, “the terminal acquires the transmission parameters and configuration information necessary for use of a target service,” such as the **URLLC** service. Ex-1003-Noh, ¶380; Ex-1013-KRApp, ¶¶280, 290. For example, Noh discloses that “**URLLC 3950** may be provided with a TTI shorter than those for other services, which requires a very short OFDM symbol length and a **broad subcarrier spacing**.” Ex-1003-Noh, ¶360; Ex-1013-KRApp, ¶330. In view of these disclosures in Noh of providing “transmission reception parameters to meet the service specific requirements,” a POSITA would have understood that Noh’s disclosure of a “**service-specific numerolog[y]**” for **URLLC** teaches a “*second numerology*.” Ex-1003-Noh, ¶¶360; Ex-1013-KRApp, ¶330. Additionally, Noh discloses that the “PDSCH 1220” is “a downlink channel for use in transmitting traffic (or data) from an eNB to a **UE**.” Ex-1003-Noh, ¶171; *see also* ¶418; Ex-1013-KRApp, ¶¶97, 312. Accordingly, a POSITA would have understood that Noh’s disclosure of a **URLLC** (claimed “*second numerology*”) would have been associated with a PDSCH on which downlink data for the **URLLC** is received by the **UE**. Ex-1002-Bims, ¶¶127-129.

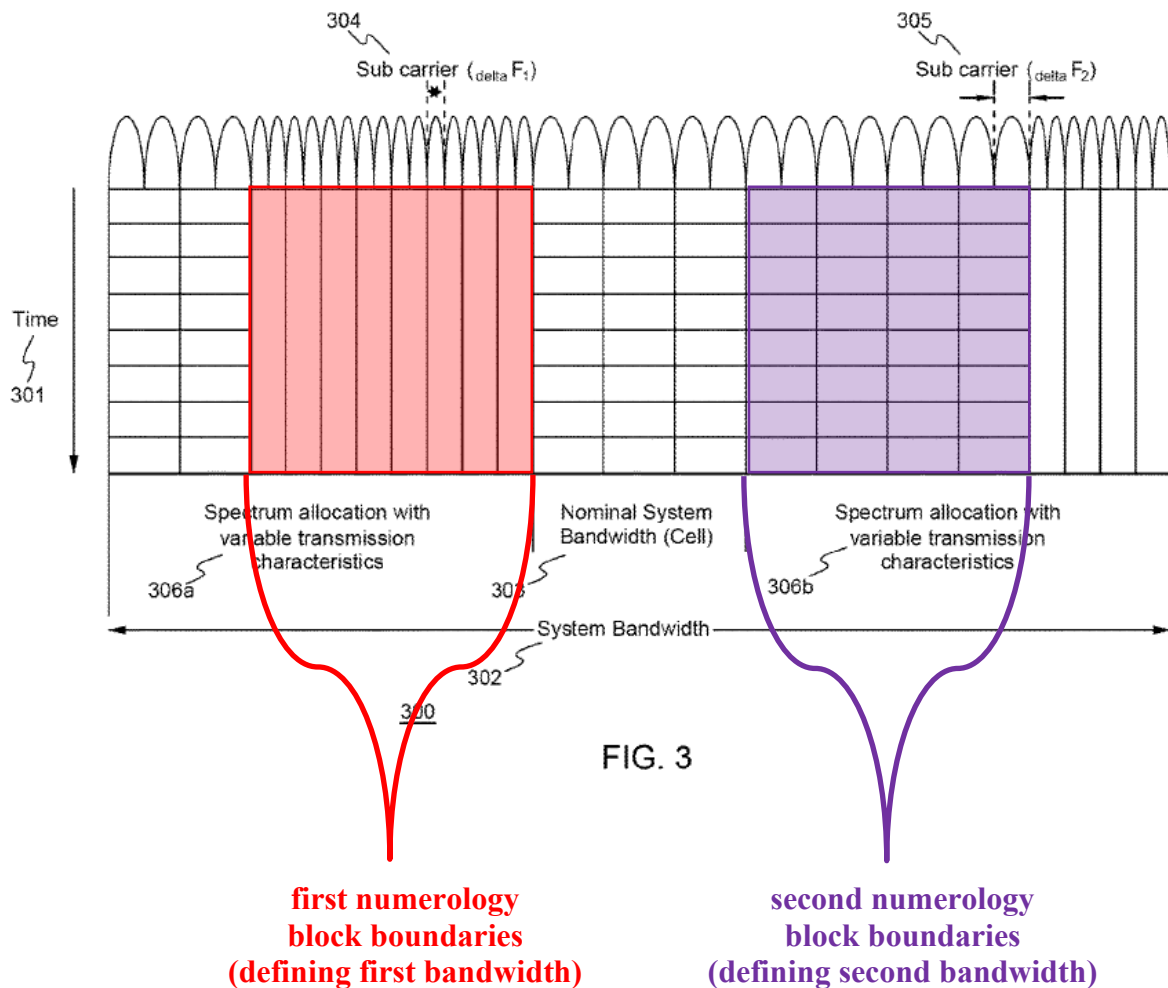
Although Noh discloses resource allocation and provisioning for multiple services, like **URLLC**, Noh does not expressly disclose receiving “*a second frequency location and a second bandwidth for the second numerology*.”

However, Tooher expressly discloses these limitations and, as described in §VII(C), it would have been obvious to combine the teachings in Tooher with Noh. Ex-1002-Bims, ¶129.

Similar to Noh, Tooher discloses a 5G communication system that supports multiple services, including “uses cases such as **eMBB**, **URLLC**, and mMTC” and “[e]ach use case may have its own ... **numerology**.” Ex-1004-Tooher, 16:23-32; Ex-1005-Tooher-Prov, ¶¶148-149. Significantly, Tooher discloses “**a system has a carrier support a first service (e.g. **eMBB**) with a first numerology block and a second service (e.g. **URLLC**) with a **second numerology** having different numerology parameters.**” Ex-1004-Tooher, 30:14-18; Ex-1005-Tooher-Prov, ¶215.

Tooher discloses that “**a WTRU [UE] needs to know the boundaries of at least one numerology block along with the parameters associated with transmissions on at least one numerology block.**” Ex-1004-Tooher, 19:19-25; Ex-1005-Tooher-Prov, ¶167. A POSITA would have understood that “to know the boundaries,” the terminal would need to know where the boundary starts and where it ends. Ex-1002-Bims, ¶¶131-132. Tooher further discloses that “one or more numerology block boundaries or sets of parameters may be indicated dynamically.” Ex-1004-Tooher, 19:52-54; Ex-1005-Tooher-Prov, ¶170. “For example, **downlink control information (DCI) may indicate the boundary and set of parameters of**

at least one numerology block.” Ex-1004-Tooher, 19:54-56; Ex-1005-Tooher-Prov, ¶170. As shown below, Tooher’s Figure 3 shows an example of “spectrum allocation” where “different subcarriers [are] assigned to different modes of operation.” Ex-1004-Tooher, 15:16-19; Ex-1005-Tooher-Prov, ¶145.



As illustrated in Figure 3 above, Tooher discloses “spectrum allocation with variable transmission characteristics,” such as “**Sub-carrier (ΔF_2)**” for a second numerology block, such as **URLLC** service. Ex-1004-Tooher, Fig. 3; Ex-1005-Tooher-Prov, Fig. 3.

A POSITA would have understood that Tooher’s “numerology block boundaries” for a continuous frequency range would have included a starting frequency and an ending frequency for the “numerology block.” Ex-1004-Tooher, 19:52-53; Ex-1005-Tooher-Prov, ¶170; Ex-1002-Bims, ¶¶133-134. Furthermore, a POSITA would have understood that the “boundary” starting frequency for the **second numerology** for **URLLC** teaches the claimed “*second frequency location*.” Ex-1002-Bims, ¶134. Additionally, a POSITA would have understood that the starting frequency and the ending frequency for Tooher’s “boundary” for the “*second numerology*” teaches the claimed “*second bandwidth*.” Ex-1002-Bims, ¶134. Furthermore, a POSITA would have understood Tooher’s “**Sub-carrier (ΔF_2)**” teaches the claimed “*second subcarrier spacing*” for the “*second numerology*.” Ex-1004-Tooher, Fig. 3; Ex-1005-Tooher-Prov, Fig. 3. It would have been obvious to a POSITA to incorporate Tooher’s teachings regarding providing the “numerology block boundaries” for **URLLC** service into Noh’s 5G communication system for providing **URLLC** service to a terminal. Ex-1004-Tooher, 19:52-53; Ex-1005-Tooher-Prov, ¶170; Ex-1002-Bims, ¶134.

2. [3b]

[3b] detecting a second PDCCH, wherein the second PDCCH is associated with the second PDSCH or the second PUSCH;

Regarding the claimed “*second PDCCH*,” Noh discloses that “a physical channel being transmitted across the system bandwidth” exists and includes “**a physical downlink control signal.**” Ex-1003-Noh, ¶368; Ex-1013-KRApp, ¶269. Furthermore, Noh discloses that “DCI may be transmitted over a [] **PDCCH.**” Ex-1003-Noh, ¶416; Ex-1013-KRApp, ¶310. Additionally, Noh discloses that “[d]ownlink data may be transmitted over a [] PDSCH [] that is a physical channel for downlink data transmission,” and a “PDSCH may be transmitted after the control channel transmission period, and the scheduling information such as the detailed mapping location in the frequency domain and the modulation scheme may be indicated by the DCI that is transmitted over the PDCCH.” Ex-1003-Noh, ¶418; Ex-1013-KRApp, ¶312. Noh also discloses that PDCCH may “provide a **UE** with control information for use in receiving data on PDSCH.” Ex-1003-Noh, ¶173; Ex-1013-KRApp, ¶99. Thus, a POSITA would have understood that the PDCCH transmitted the control information, referred to as DCI, and a POSITA would have understood that Noh teaches that DCI transmitted over the PDCCH provides the “detailed mapping location in the frequency domain and modulation scheme” for the PDSCH that is transmitted after the information in the DCI. Ex-1003-Noh, ¶418;

Ex-1013-KRApp, ¶312; Ex-1002-Bims, ¶¶135-136. In view of Noh's teachings regarding “**service-specific numerolog[y]**” for **URLLC**, a POSITA would have considered it obvious that the **terminal** would have detected a “*second PDCCH*,” associated with a “*second PDSCH*” for the **URLLC** service in a service-specific numerology that is distinct from another PDCCH associated with another PDSCH in another service-specific numerology detected by the UE. Ex-1002-Bims, ¶¶135-136.

As described for claim [1b] above, Noh discloses that “the receiver of the terminal should operate as disclosed in the description of the initial access method and apparatus in the 5G communication system according to embodiments 4-1 and 4-2.” Ex-1003-Noh, ¶393; Ex-1013-KRApp, ¶288. Accordingly, it would have been obvious to a POSITA to implement a **terminal** (claimed “**UE**”) equipped to detect downlink channels, including a “*second PDCCH*” associated with a “*second PDSCH*,” based on the disclosure in Noh. Ex-1002-Bims, ¶¶136-138.

3. [3c]

[3c] deriving, by the UE, a second bandwidth portion based on the **second frequency location and the **second bandwidth** for the **second numerology**; and**

Although Noh teaches that the **terminal** (“**UE**”) receives “*the **second numerology***,” it does not expressly disclose “*deriving, by the **UE**, a second bandwidth portion.*” However, Tooher discloses “*deriving, by the **UE**, a second*

*bandwidth portion based on a **second frequency location** and the **second bandwidth** for the **second numerology**,*” and it would have been obvious to combine the teachings in Tooher with Noh. Ex-1002-Bims, ¶139.

As described above for claim [1c], Tooher discloses that the **WTRU** (claimed “**UE**”) is responsible for “**decoding the boundaries**” received by the **WTRU**. Ex-1004-Tooher, 20:66-67; Ex-1005-Tooher-Prov, ¶176. A POSITA would have understood Tooher’s teaching regarding the **WTRU** “**decoding the boundaries**” teaches the claimed “*deriving, by the **UE**, a second bandwidth portion*” because Tooher teaches that the WTRU must derive these boundaries based upon the information received at the WTRU. Ex-1004-Tooher, 20:66-67; Ex-1005-Tooher-Prov, ¶176; Ex-1002-Bims, ¶140. It would have been obvious to POSITA to combine Tooher’s teaching regarding “**decoding the boundaries**” for a **URLLC** service with Noh’s disclosure of provisioning the **terminal** for **URLLC** service. Ex-1002-Bims, ¶141.

4. [3d]

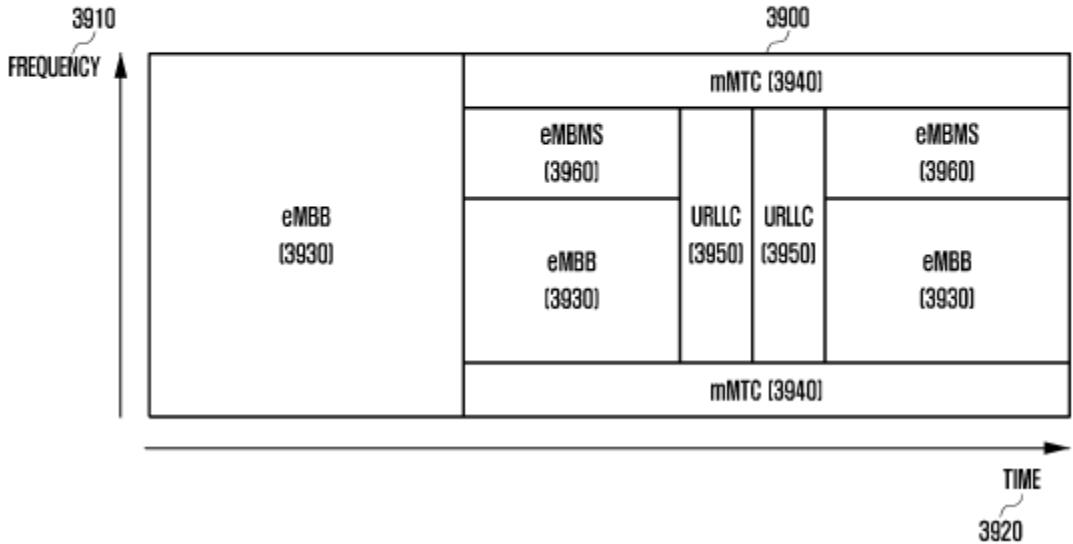
[3d] deriving, by the UE, a **second resource allocation** scheduled by a second network and carried by the second PDCCH for the second PDSCH or the second PUSCH for the second numerology within the second bandwidth portion based on the second PDCCH, the second frequency location and the second bandwidth.

Noh discloses “**resource allocation** for supporting multiple services in a 5G Communication system.” Ex-1003-Noh, ¶352, 363 (“Fig. 40 is a diagram for

explaining resource allocation in a time-frequency resources grid”); Ex-1013-KRApp, ¶¶ 259, 266. As described above for claim [1d], Noh discloses that “DCI may be transmitted over a Physical Downlink Control Channel (PDCCH).” Ex-1003-Noh, ¶416; Ex-1013-KRApp, ¶310. Accordingly, Noh discloses that the DCI can be transmitted over the PDCCH and provide the “scheduling information,” including the “detailed mapping location in the frequency domain and the modulation scheme.” Ex-1003-Noh, ¶418; Ex-1013-KRApp, ¶312. Accordingly, Noh teaches that this information transmitted over PDCCH can provide the “*resource allocation*” for the downlink data PDSCH. Ex-1003-Noh, ¶418; Ex-1013-KRApp, ¶312; Ex-1002-Bims, ¶¶142-143. Noh also teaches the claimed “*resource allocation*,” such as “**Resource allocation** type 0/1 flag: **Resource allocation** type 0/1 flag indicates whether the **resource allocation** scheme is Type 0 or Type 1 ... Resource block assignment: Resource block assignment indicates an RB allocated for data transmission.” Ex-1003-Noh, ¶¶409, 410; Ex-1013-KRApp, ¶¶303, 304.

Noh also discloses, as shown in Figure 39, “**resource allocation** for supporting multiple services:

FIG. 39



Ex-1003-Noh, Fig. 39; Ex-1013-KRApp, Fig. 4A. Furthermore, Noh discloses multiple embodiments of procedures “for a terminal to achieve synchronization and acquire system information in initial access a numerology and receive a service with another numerology in a 5G communication system.” Ex-1003-Noh, ¶378; Ex-1013-KRApp, ¶279. A POSITA would have understood Noh’s **resource allocation** disclosures highlighted above to teach a **terminal** configured to derive appropriate **resource allocation** for each service, such that the **terminal** would derive a **second resource allocation** for the second service configured. Ex-1002-Bims, ¶¶144-145. For example, Noh’s **terminal** would derive a **second resource allocation** for **URLLC** service, the second service configured. Ex-1002-Bims, ¶145.

G. Claim 4

[4] The method of claim 1, comprising: wherein the first frequency location is an index of a resource block.

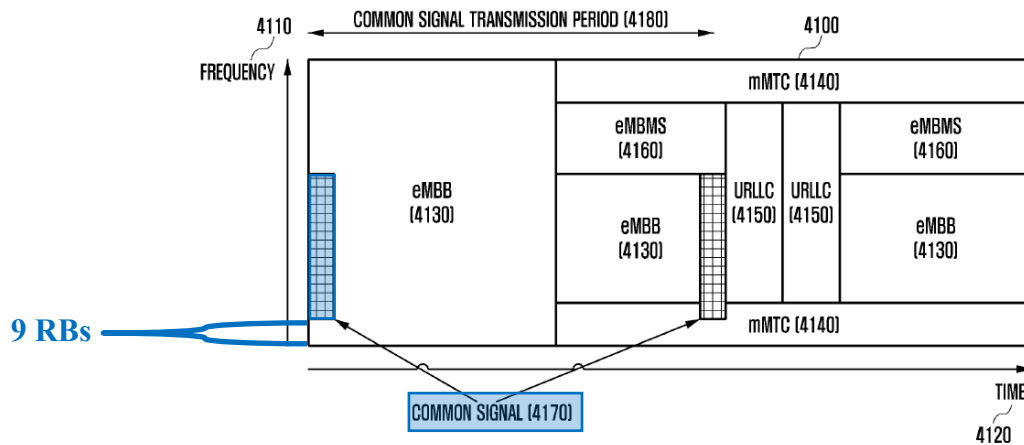
As to “a resource block,” Noh discloses that “[a] **Resource Block (RB)** (or Physical Resource Block (PRB) 4660 is defined by N_{symb} consecutive OFDM symbols 4640 in the time domain and N_{RB} consecutive subcarriers 4630 in the frequency domain.” Ex-1003-Noh, ¶405; Ex-1013-KRApp, ¶299. Additionally, Noh discloses the following:

The candidate frequency location set may be determined in unit of one or multiple RBs [Resource Blocks]. Here, one RB is the smallest unit of scheduling in the frequency domain and it may be composed of a plurality of subcarriers as in LTE. For example, if 6 RBs are required for transmitting the common signal as in the legacy LTE and if the base station configure the 10th RB as the starting RB for transmitting the common signal in the system bandwidth, the **common signal may be transmitted in the bandwidth starting from the 10th RB to the 15th RB.**

Ex-1003-Noh, ¶384; Ex-1013-KRApp, ¶285. As provided in the example in Noh, a POSITA would have understood that the “common signal may be transmitted in the bandwidth starting from the 10th RB” (*id.*) or, in other words, the common signal (“*frequency location*”) is at the 10th RB (“*index of a resource block*”). This is

illustrated in Figure 41 of Noh reproduced below, in which “common signal 4170” is transmitted starting at 10th RB. Ex-1003-Noh, ¶376-377, Fig. 41; Ex-1013-KRApp, ¶278, Fig. 4C.

FIG. 41



Although Noh discloses providing a frequency location for the common signal as an index of a resource block, it does not expressly disclose the claimed “*wherein the first frequency location is an index of a resource block,*” such as the first frequency location associated with the **eMBB service**. However, Tooher discloses that the “**WTRU** may receive a set of indices, each corresponding to one of the segments or numerology blocks that may be utilized as the configured WTRU-specific bandwidth for a given time.” Ex-1004-Tooher, 31:37-41; Ex-1005-Tooher-Prov, ¶222. Furthermore, Tooher discloses that the “**WTRU** may apply scaling on the following quantities within the DCI: resource block index (e.g.

starting index for a resource allocation).” Ex-1004-Tooher, 31:63-65; Ex-1005-Tooher-Prov, ¶224.

Tooher also discloses that different services have different numerology blocks. Ex-1004-Tooher, 30:14-18; Ex-1005-Tooher-Prov, ¶215. For example, Tooher discloses “**a system has a carrier support a first service (e.g. eMBB) with a first numerology block.**” Ex-1004-Tooher, 30:14-18; Ex-1005-Tooher-Prov, ¶215. It would have been obvious to a POSITA to implement Tooher’s teachings for provisioning the **eMBB** service in Noh’s 5G communication system, such that “*an index of a resource block*” was provided as the “*first frequency location*” for the **eMBB** service. Ex-1002-Bims, ¶¶146-149.

H. Claim 5

1. [5a]

[5a] The method of claim 1, comprising: receiving, by the UE, second information for a **second numerology** associated with a **second subcarrier spacing**, wherein the second information comprises a **second frequency location** and a **second bandwidth** for the **second numerology** and;

See Claim [3a].

2. [5b]

[5b] deriving, by the UE, a **second resource allocation for a second PDSCH or a second PUSCH for the second numerology within a second bandwidth portion based on the PDCCH, the second frequency location and the second bandwidth.**

As explained above in [3d], Noh discloses deriving a second resource allocation of a second PDSCH or a second PUSCH for the second numerology (i.e., the URLLC service)) based on the second frequency location and the second bandwidth of the URLLC.

Toohar further discloses that “downlink control information (DCI) may indicate the boundary and ... of at least one numerology block.” Ex-1004-Toohar, 19:49-63; Ex-1005-Toohar-Prov, ¶170. A POSITA would have understood that Toohar teaches that the DCI carried in the PDCCH of the first numerology indicates the boundary of the second numerology, i.e., the second frequency location and the second bandwidth. 1002-Bims, ¶¶151-152.

I. Claim 8

[8] The method of claim 1, wherein the **first bandwidth and the **first frequency location** is configured by UE-specific RRC message.**

Toohar discloses that “the at least one boundary or sets of parameters for at least one numerology block may be indicated semi-statically by higher layer signaling (e.g. **RRC signaling**).” Ex-1004-Toohar, 19:43-46; Ex-1005-Toohar-Prov, ¶169. It would have been obvious to a POSITA to implement Toohar’s

teachings for provisioning with RRC signaling in Noh's 5G communication system such that "*the **first bandwidth** and the **first frequency location** is configured by UE-specific RRC message.*" Ex-1002-Bims, ¶153.

J. Claim 9

[9] The method of claim 1, wherein the **first bandwidth and the **first frequency location** is indicated by a physical control channel.**

Tooher discloses the following:

In a method and system for flexible resource usage a carrier's bandwidth may be segmented into numerology blocks, wherein the numerology block may be configured for dynamic indication. Further, one or more numerology block boundaries or sets of parameters may be indicated dynamically. **For example, downlink control information (DCI) may indicate the boundary and set of parameters of at least one numerology block.** The DCI transmission may use common control signaling (e.g., including a group RNTI identifier or the like); this may enable a group of WTRU s to be updated with new boundaries for at least one numerology block and/or new sets or sets of parameters for at least one numerology block. The DCI transmission may occur periodically, for instance according to a configuration provided by higher layers.

Ex-1004-Tooher, 19:49-63; Ex-1005-Tooher-Prov, ¶170. Furthermore, Noh discloses that "DCI [Downlink Control Information] may be transmitted over a

Physical Downlink Control Channel (PDCCH).” Ex-1003-Noh, ¶416; Ex-1013-KRApp, ¶310. It would have been obvious to a POSITA to implement Tooher’s teachings for providing boundary and parameter information (claimed “*the first bandwidth and the first frequency location*”) in the DCI with Noh’s teachings that the DCI be transmitted over the PDCCH (claimed “physical control channel”). Ex-1002-Bims, ¶¶154-155.

K. Claim 10

[10] The method of claim 1, wherein the first numerology is indicated by a physical control channel.

See claim 9.

L. Claim 11

[11] The method of claim 1, wherein the **first bandwidth** is a maximum bandwidth for the first numerology.

Noh discloses that: “[f]or the **eMBB 3930**, it is preferred to occupy the frequency bandwidth as broad as possible during an arbitrary time period to secure increased data rate as described above. That is, **it is preferred for the terminal to be allocated RBs as many as possible for data transmission**. The **eMBB service 3930** is preferred to be TDMed with other services in the system frequency-time resources 3900.” Ex-1003-Noh, ¶355; Ex-1013-KRApp, ¶260. In view of these disclosures in Noh, a POSITA would have understood that Noh’s disclosure that “[f]or the **eMBB 3930**, it is preferred to occupy the frequency

bandwidth as broad as possible,” teaches that the “*first bandwidth*” for the “*first numerology*” corresponding to “**eMBB service**” would have been the entire **system bandwidth**, such that the “**terminal**” (claimed “*user equipment*”) is “allocated RBs as many as possible for data transmission” associated with the “**eMBB service**.” Ex-1003-Noh, ¶355; Ex-1013-KRApp, ¶260. Thus, Noh in view of Tooher and the knowledge of a POSITA teaches that “*the first bandwidth is a maximum bandwidth for the first numerology.*” Ex-1002-Bims, ¶157.

M. Claim 12

[12] The method of claim 1, wherein the first bandwidth is a maximum bandwidth that the UE is able to receive for the first numerology.

See claim 11.

N. Claim 13

1. [13p]

[13p] A User Equipment (UE) capable of determining numerology bandwidth, comprising:

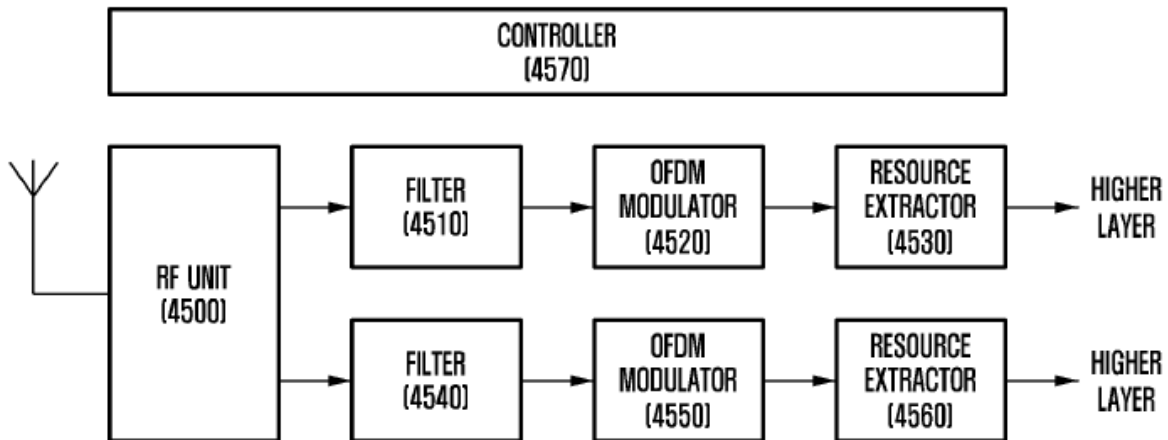
See Claim [1p].

2. [13a]

[13a] a control circuit;

Noh discloses that “**controller 4570** may control the overall operations of the terminal according to an embodiment of the present invention,” as shown in Figure 45 reproduced below. Ex-1003-Noh, ¶397; Ex-1013-KRApp, ¶290.

FIG. 45



Ex-1003-Noh, Fig. 45; Ex-1013-KRApp, Fig. 4G. Noh also discloses that “**Application Specific Integrated Circuit (ASIC)**, which performs certain tasks.” Ex-1003-Noh, ¶84; Ex-1013-Noh, ¶22. Accordingly, Noh teaches a “*control circuit*.” Ex-1002-Bims, ¶¶159-161.

3. [13b]

[13b] a processor installed in the control circuit; and

Regarding Noh’s 5G communication system, Noh discloses that “each block of the flowcharts and/or block diagrams, and combinations of blocks in the flowcharts and/or block diagrams, can be implemented by computer program instructions. **These computer program instructions may be provided to a**

processor of a general-purpose computer, special purpose computer, or other programmable data processing apparatus, **such that the instructions that are executed via the processor of the computer.**” Ex-1003-Noh, ¶82; Ex-1013-KRApp, ¶20. Accordingly, Noh teaches “*a processor installed in the control circuit.*” Ex-1002-Bims, ¶162.

4. [13c]

[13c] a memory installed in the control circuit and coupled to the processor;

Noh discloses that “[t]hese computer program instructions **may also be stored in a non-transitory computer-readable memory** that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the non-transitory computer-readable memory produce articles of manufacture embedding instruction means that implement the function/act specified in the flowcharts and/or block diagrams.” Ex-1003-Noh, ¶82; Ex-1013-KRApp, ¶20. Accordingly, Noh teaches a “*a memory installed in the control circuit and coupled to the processor.*” Ex-1002-Bims, ¶163.

5. [13d]

[13d] wherein the processor is configured to execute a program code stored in the memory to;

Noh discloses that “[t]hese computer program instructions may be provided to a processor of a general-purpose computer, special purpose computer, or other programmable data processing apparatus, **such that the instructions that are**

executed via the processor of the computer.” Ex-1003-Noh, ¶82; Ex-1013-KRApp, ¶20. Accordingly, Noh teaches “*the processor is configured to execute a program code stored in the memory to.*” Ex-1002-Bims, ¶164.

6. [13d-1]

[13d-1] receive information for a first numerology associated with a first subcarrier spacing, wherein the information comprises a first frequency location and a first bandwidth for the first numerology for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH);

See Claim [1a].

7. [13d-2]

[13d-2] detect a physical downlink control channel (PDCCH), wherein the PDCCH is associated with the PDSCH or the PUSCH;

See Claim [1b].

8. [13d-3]

[13d-3] derive a first bandwidth portion based on the first frequency location and the first bandwidth for the first numerology;

See Claim [1c].

9. [13d-4]

[13d-4] derive a resource allocation scheduled by a network and carried by the PDCCH for the PDSCH or the PUSCH for the first numerology within the first bandwidth portion based on the PDCCH, the first frequency location and the first bandwidth;

See Claim [1d].

10. [13d-5]

[13d-5] wherein the resource allocation within the first bandwidth portion is done via a bit map indicating which resource unit within the first bandwidth portion is allocated for the UE;

See Claim [1e].

O. Claim 14

[14] The UE of claim 13, wherein the UE configures a system bandwidth.

See claim [2a].

P. Claim 15

[15] The UE of claim 14, wherein the system bandwidth is larger than the first bandwidth.

See claim [13d-1].

Q. Claim 16

[16] The UE of claim 13, wherein the processor is further configured to execute a second program code stored in the memory to: receive second information for a second numerology associated with a second subcarrier spacing, wherein the second information comprises a second frequency location and a second bandwidth for the second numerology and deriving, by the UE, a second resource allocation for a second PDSCH or a second PUSCH for the second numerology within a second bandwidth portion based on the PDCCH, the second frequency location and the second bandwidth.

See claim [5a] and [5b].

R. Claim 17

[17] The UE of claim 13, wherein the first bandwidth is a configured bandwidth for the first numerology.

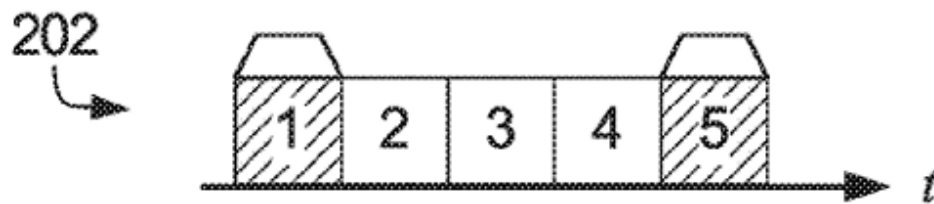
See claim [1a].

VIII. Ground 2: Claims 1-2, 4, 8-15, and 17 would have been obvious based on Islam in view of Jiang and the knowledge of a POSITA.

A. Islam

Islam, U.S. Patent Publication No. 2017/0215170, was filed on January 26, 2016, and published on July 27, 2017. Islam is prior art under at least AIA §§102(a)(1) and/or (a)(2).

Islam discloses that “[a] system bandwidth is divided into bandwidth portions, and the bandwidth portions are used as the unit of assignment for assigning sub-bands to numerologies.” Ex-1008-Islam, at Abstract. “An example of this approach is depicted in FIG. 3 generally indicated at 202, where a bandwidth of 100 MHz is divided into $L=5$ bandwidth portions of 20 MHz each, and bandwidth portions 1 and 5 are allocated to a particular numerology.”:

**FIG. 3**

Id.

B. Jiang

Jiang, U.S. Patent No. 10,756,838, is the national stage entry of PCT/CN2016/092809, which was filed on August 2, 2016, and published on February 8, 2018, as WO2018/023364 (“JiangPCT”). Jiang is prior art under at least AIA 35 U.S.C. §102(a)(2). *See also* 35 U.S.C. §102(d); *Penumbra*. Jiang is presumptively prior art as it is the national stage entry of a PCT document that is prior art to the ’759 Patent. Both Jiang and JiangPCT describe the same subject matter. To facilitate efficient review, Petitioner provides parallel citations to Jiang and JiangPCT herein. Both are prior art to the ’759 patent and are cited for that purpose. 35 U.S.C. §§102(a)(1), (a)(2), (d), 122(b), 374; MPEP §901.03.

Jiang discloses “methods and apparatuses of numerology multiplexing at a serving node and a terminal device in a wireless communication system.” Ex-1009-Jiang, Abstract; Ex-1011-JiangPCT, [0001]. Jiang’s Fig. 2 “illustrates a diagram of

different numerology multiplexing patterns ... the numerologies can be multiplexed with one of frequency spacings for the numerologies on the center frequency f_c of the system bandwidth.”

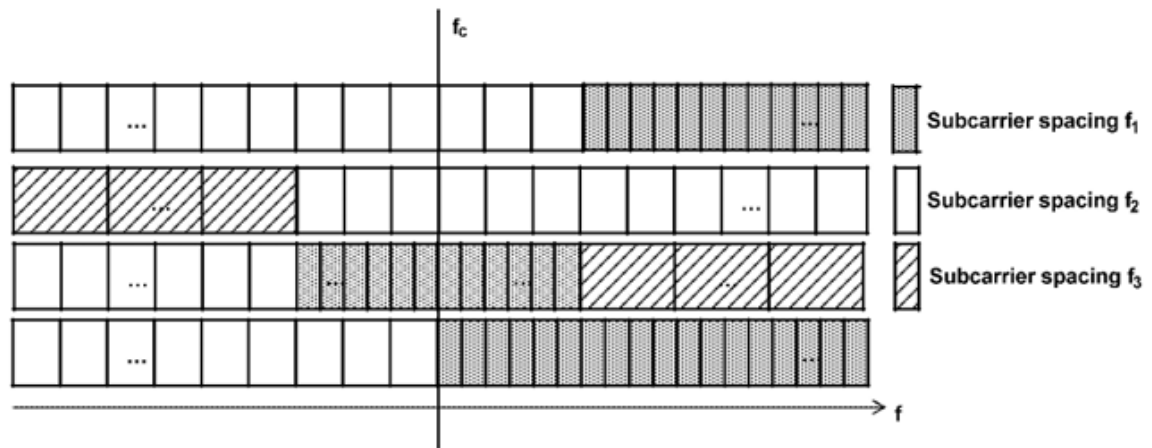


Fig. 2

Ex-1009-Jiang, Fig. 2; 5:32-66; Ex-1011-JiangPCT, Fig. 2; [0033].

C. Scope, Content, and Rationale for Combining Prior Art

A POSITA would have been motivated to combine Islam’s teachings regarding a wireless communication system and using signal bits to assign sub-bands to a numerology with Jiang’s teachings regarding setting the start and end positions of a sub-band at the physical resource block level and Jiang’s detailed teachings regarding numerology and an improved signaling method because, as described below, it would have helped balance flexibility and overhead, benefitting support of services that may have very different requirements. Ex-1008-Islam, Abstract; Ex-

1009-Jiang, Abstract; Ex-1011-JiangPCT, Abstract; Ex-1009-Jiang, 8:42-44; Ex-1011-JiangPCT, [0046]. Islam teaches, “[i]n some embodiments, by defining a set of L bandwidth portions, a fully flexible assignment of the bandwidth portions to a given numerology is supported, meaning that an arbitrary combination of one or more bandwidth portions can be assigned to a given numerology.” Ex-1008-Islam, [0040]. Islam also discloses, “[t]he choice of L is a trade-off between flexibility and overhead. A larger value of L gives more flexibility at the cost of increased overhead.” Ex-1008-Islam, [0044]. However, Jiang teaches an improved signaling method to help balance flexibility and overhead. Ex-1009-Jiang, 8:42-44; Ex-1011-JiangPCT, [0046]. Specifically, Jiang teaches that it is “easy to indicate the start position and end position [of the sub-band] with the PRB number,” Ex-1009-Jiang, 8:42-44; Ex-1011-JiangPCT, [0046], and that reducing the number of potential positions for a sub-band “may reduce the complexity and required resource for indicating the sub-band bandwidth information.” Ex-1009-Jiang, 8:55-58; Ex-1011-JiangPCT, [0046]. A POSITA would have been motivated to improve Islam’s system with the teachings of Jiang to set the bandwidth portions at the PRB level because it is “easy” to indicate the start and end position and can help reduce signaling complexity, thus balancing flexibility and overhead. *Id.*; Ex-1002-Bims, ¶¶172-179. “[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the

same way, using the technique is obvious.” *KSR*, 550 U.S. at 417. In other words, this combination would have involved “the mere application of a known technique”—Jiang’s teachings regarding setting start and end positions of a sub-band at PRB level —“to a piece of prior art”—Islam’s 5G communication system—that is “ready for the improvement.” *Id.*; Ex-1002-Bims, ¶179.

A POSITA would have had a reasonable expectation of success in applying Jiang’s teachings regarding numerology to Islam because both references teach wireless communication systems in which sub-bands are assigned to numerologies, because both systems are directed to flexible, rather than fixed numerology, and because a POSITA would understand that one numerology would not be able to meet all system requirements. Ex-1008-Islam, Abstract; Ex-1009-Jiang, Abstract; Ex-1011-JiangPCT, Abstract; Ex-1002-Bims, ¶180. Therefore, a POSITA would have had a reasonable expectation of success in combining Jiang’s teachings into Islam’s wireless communication system. Ex-1002-Bims, ¶180.

D. Independent claim 1

1. [1p]

Islam discloses “systems and apparatus for assigning sub-bands to numerologies” in which “[a] system bandwidth is divided into bandwidth portions, and the **bandwidth portions are used as the unit of assignment for assigning sub-bands to numerologies.**” Ex-1008-Islam, Abstract. Islam discloses “there is

provided a method comprising: **transmitting a bandwidth portion assignment to indicate at least one bandwidth portion of a plurality of bandwidth portions that is assigned to a given numerology**, the given numerology having an associated OFDM subcarrier spacing and symbol duration.” Ex-1008-Islam, [0004]; Ex-1002-Bims, ¶181.

2. [1a]

Islam teaches “*receiving, by a **user equipment**, information for a **first numerology** associated with a **first subcarrier spacing**.*” For example, Islam discloses “a sub-band is a contiguous range of bandwidth assigned to a numerology. ... A system bandwidth can be divided into bandwidth portions A contiguous set of one or more bandwidth portions can be used to define a sub-band. Similarly, a sub-band can be divided into one or more sub-band portions. The sub-band portions ... function as building blocks for an allocation of spectrum within a sub-band for RB allocation.” Ex-1008-Islam, [0033]. Islam discloses: “[A] **UE** supports multiple numerologies, and the network (typically a base station) signals to the **UE** which numerology to use. An embodiment of the invention provides a mechanism of flexibly assigning portions of an available system bandwidth, referred to above as sub-bands, to a numerology, **and conveying this assignment to a UE**.” Ex-1008-Islam, [0036]-[0037]. Islam discloses that signaling to the **UE** can be for “both of the numerology assignment and sub-band bandwidth assignment for an assigned

numerology.” Ex-1008-Islam, [0038]. Islam further teaches that “**a numerology is defined in terms of subcarrier spacing,**” *i.e.*, “**a first numerology associated with a first subcarrier spacing.**” Ex-1008-Islam, [0025].

Islam also teaches that this numerology can be for a physical downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH). Islam discloses for particular sub-bands, “RB allocation ... can for example be sent using a Physical Downlink/Uplink Control channel (PDCCH or PUCCH)” Ex-1008-Islam, [0104]. It was well-known to a POSITA that the UE receives data via a physical channel, such as Physical Downlink Shared Channel (PDSCH). In fact, the ’759 patent quotes 3GPP TR 36.211 V13.1.0 (AAPA) for the following: “[a] downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers” and “[t]he following downlink physical channels are defined: Physical Downlink Shared Channel PDSCH ... Physical Downlink Control Channel PDCCH.” Ex-1001, 8:9:18. The ’759 patent also quotes 3GPP TS 36.213 V13.1.1 (AAPA) for the following: “7.1 UE Procedure for Receiving the Physical Downlink Shared Channel ... [A] **UE** shall upon detection of a PDCCH of the serving cell ... decode the corresponding PDSCH in the same subframe” Ex-1001, 23:1-15. A POSITA would have understood Islam’s disclosure of assigning a numerology to a sub-band teaches the claimed “*the first numerology for a physical*

downlink shared channel (PDSCH) or a physical uplink shared channel (PUSCH)."

Ex-1002-Bims, ¶182-183.

Islam's Fig. 1 discloses "[i]n sub-band 100, a numerology with a 7.5 kHz subcarrier spacing is used.":

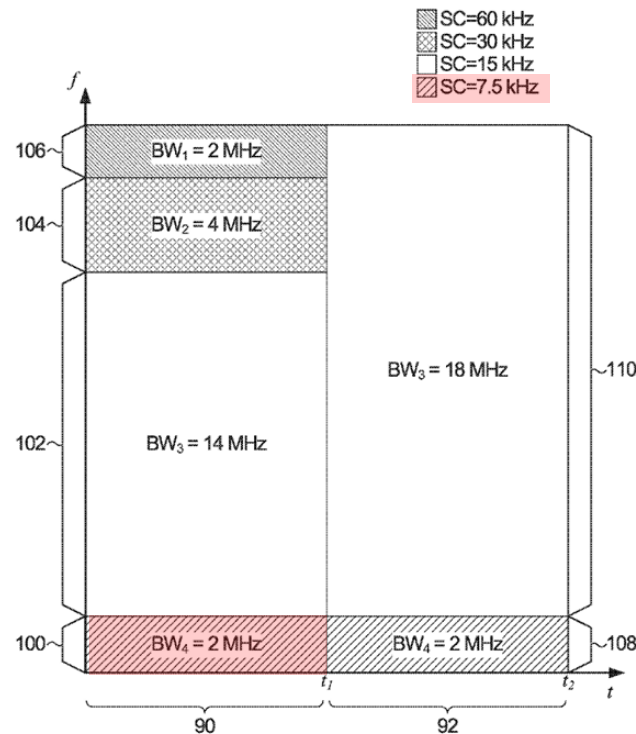
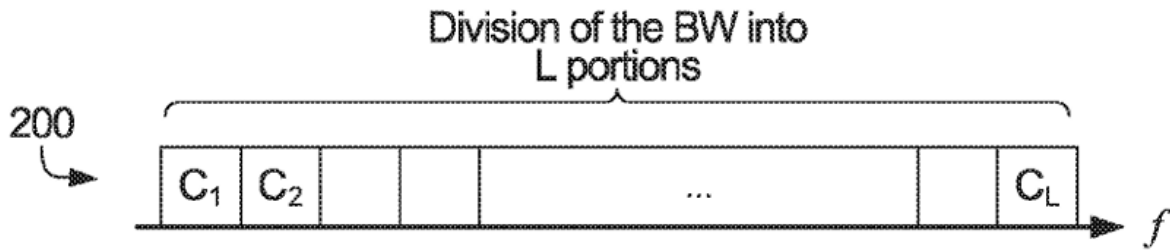


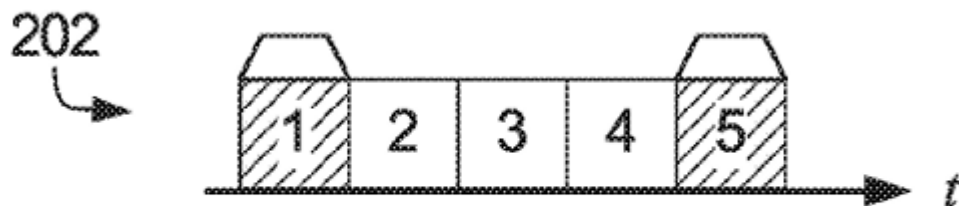
FIG. 1

Ex-1008-Islam, Fig. 1, [0035].

Islam also discloses that "a system bandwidth is decomposed into a set of fixed equal size bandwidth portions. An example is depicted in FIG. 2 generally indicated at 200, where an available bandwidth is shown divided into L equal sized bandwidth portions":

**FIG. 2**

Ex-1008-Islam, [0039], Fig. 2. Islam also discloses that “L bits of signaling can be used to convey the assignment of any combination of bandwidth portions to a numerology.” Ex-1008-Islam, [0040]. Islam discloses, “[i]n some embodiments, contiguous assignment of bandwidth portions to a given numerology is supported. In this case, the available bandwidth is divided into L bandwidth portions, and a set of one or more contiguous bandwidth portions are assigned to a **first numerology**.”

**FIG. 3**

Ex-1008-Islam, [0041], Fig. 3.

Islam does not explicitly disclose that the information received by the **UE** comprises the claimed “**first frequency location** and a **first bandwidth** for the **first**

numerology.” However, Jiang discloses this limitation. Jiang, like Islam, relates to methods and apparatuses for transmitting information about numerology in wireless communication systems. Ex-1009-Jiang, Abstract; Ex-1011-JiangPCT, Abstract. Jiang discloses that this apparatus “**could be implemented at a terminal device, for example UE or other like terminal devices**” and that “[t]he apparatus comprises an information receiving module and a numerology multiplexing module. The information receiving module is configured to receive information about at least two numerologies in common downlink transmission resource.” Ex-1009-Jiang, 2:19-30; Ex-1011-JiangPCT, [0004]. Jiang discloses that the “information about at least two numerologies can include the information for different numerologies” including “**sub-band bandwidth information for at least one of the numerologies.**” Ex-1009-Jiang, 5:12-21; Ex-1011-JiangPCT, [0031]. Jiang’s Fig. 2 illustrates “**two numerologies with the subcarrier spacing f_1 and subcarriers spacing f_2 are multiplexed on the same band.**”

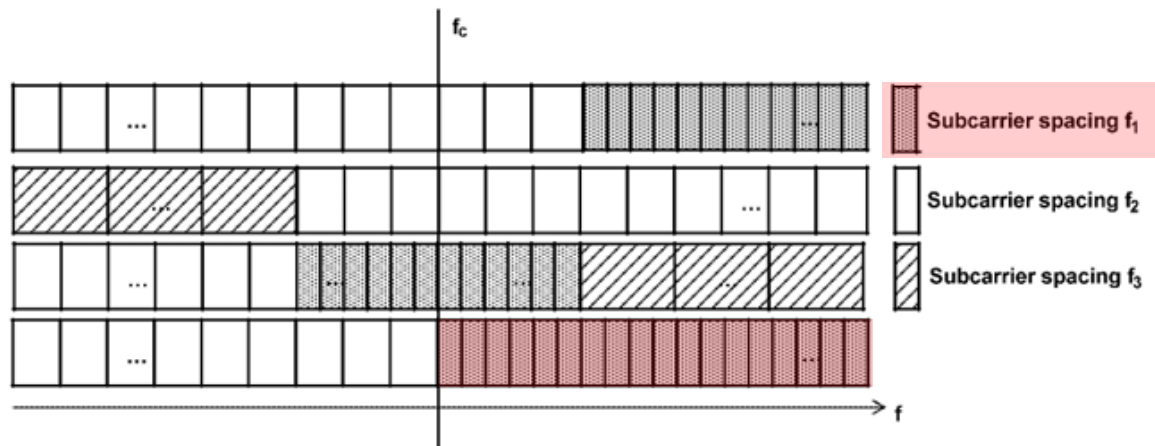


Fig. 2

Ex-1009-Jiang, Fig. 2; 5:32-66; Ex-1011-JiangPCT, Fig. 2; [0033].

Jiang discloses that in another embodiment, the “**sub-band bandwidth information for at least one of the numerologies**” “can be indicated by a start position of a sub-band and an end position of the sub-band.” Ex-1009-Jiang, 8:26-32; Ex-1011-JiangPCT, [0045]. Jiang discloses that these bands are “frequency bands,” Ex-1009-Jiang, 1:58-63; Ex-1011-JiangPCT, [0002] and a POSITA would have understood that this “**start position of a sub-band**” is necessarily a “*first frequency location*.” Ex-1002-Bims, ¶¶184-187. A POSITA would also have understood that the “**end position of the sub-band**” is thus necessarily an additional frequency location. Ex-1002-Bims, ¶187. Jiang also discloses that the information for a first numerology comprises “*a first bandwidth*” as a POSITA would have understood the **start and end frequencies of the sub-band**, Ex-1009-Jiang, 8:26-

32; Ex-1011-JiangPCT, [0045], **comprises a first bandwidth**. Ex-1002-Bims, ¶¶187-189.

As described in §VIII(C) above, it would have been obvious to a POSITA to incorporate Jiang’s teachings into Islam’s system because it is “easy” to indicate the start and end position and can help to reduce signaling complexity. Ex-1002-Bims, ¶¶188-189.

3. [1b]

Islam teaches that the PDCCH, which contains bandwidth assignments, is associated with the PDSCH or PUSCH. Islam discloses that “RB allocation [] can, for example be sent using a **Physical Downlink/Uplink Control channel (PDCCH or PUCCH)** which may be part of every TTI and may appear in the first few OFDM symbols of the TTI.” Ex-1008-Islam, [0104]. Islam discloses that for the selected sub-bands, “RB allocation ... can for example be sent using a Physical Downlink/Uplink Control channel (PDCCH or PUCCH)” Ex-1008-Islam, [0104]. Islam further discloses a UE comprising an “RB Allocation Processor 462” that “processes a signal containing an RB allocation received over the air, for example using one of the methods described here.” 1008-Islam, [0082].

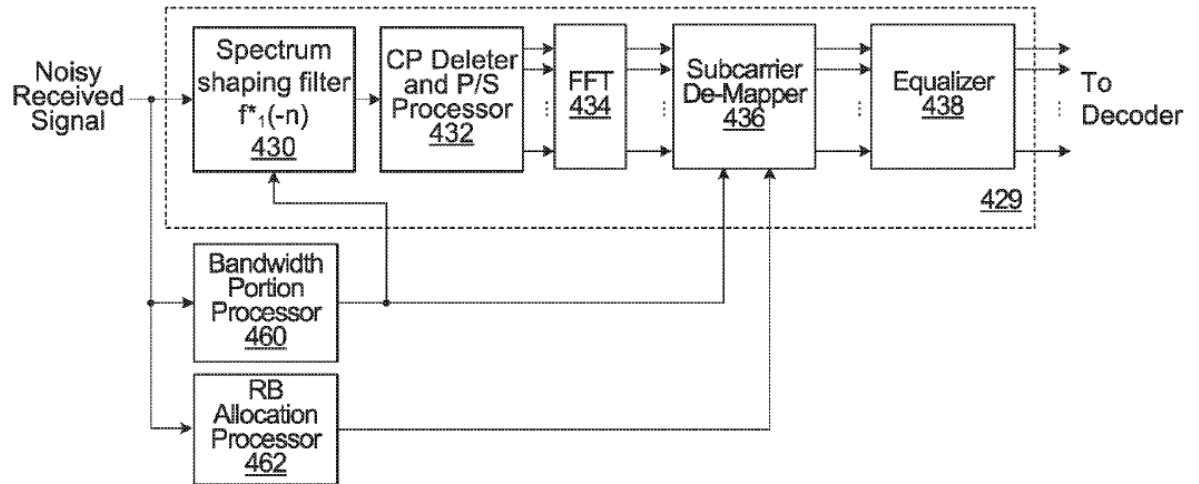


FIG. 7B

Ex-1008-Islam, Fig. 7B. Therefore, a POSITA would have understood that Islam teaches a UE equipped to detect a PDCCH. Ex-1002-Bims, ¶190. Moreover, a POSITA familiar with 3GPP standards such as LTE and 5G would also have understood that a PDCCH is associated with the PDSCH or the PUSCH. Ex-1002-Bims, ¶190.

As discussed above for 1[a], a POSITA would have understood that the PDCCH is associated with the PDSCH as the PDCCH informs the UE about the resource allocation of DL-SCH on the PDSCH. Ex-1002-Bims, ¶191.

4. [1c]

Although Islam teaches that the UE receives information for the first numerology, it does not expressly disclose “*deriving, by the UE, a **first bandwidth portion** based on the **first frequency location** and the **first bandwidth** for the **first numerology**.*” However, Jiang teaches this limitation. Jiang discloses an apparatus

that “could be implemented at a **terminal device, for example UE or other like terminal devices**” and that “[t]he apparatus comprises an information receiving module and a numerology multiplexing module. The information receiving module is configured to receive information about at least two numerologies in common downlink transmission resource.” Ex-1009-Jiang, 2:19-30; Ex-1011-JiangPCT, [0004]. Jiang also discloses indicating “a bandwidth” “by a start position of a sub-band and an end position of a sub-band.” Ex-1009-Jiang, 8:23-38; Ex-1011-JiangPCT, [0045]. When there is no guard band or the guard band is fixed, “only the end position of the last sub-band or the start position of the current sub-band is enough to distinguish the band.” Ex-1009-Jiang, 8:35-36; Ex-1011-JiangPCT, [0045]. Jiang also discloses that position information “can also be **deduced by UE** according to the system bandwidth and the number of multiplexed numerologies,” Ex-1009-Jiang, 11:52-58; Ex-1011-JiangPCT, [0059], thus teaching the claimed “*deriving, by the UE, a first bandwidth portion.*” Ex-1002-Bims, ¶¶192-194. A POSITA would have understood that the teachings from various embodiments of Jiang could be combined. Ex-1009-Jiang, 17:14-19; Ex-1011-JiangPCT, [00101]; Ex-1002-Bims, ¶193.

As described above in §VIII(C), it would have been obvious to combine the teachings in Jiang regarding “*deriving, by the UE, a first bandwidth portion*” with the wireless communication system disclosed in Islam. Ex-1002-Bims, ¶194.

5. [1d]

Islam discloses that “[i]n LTE, as discussed above, a frame structure is employed that is not flexible, and fixed resource block definitions are used.” Ex-1008-Islam, [0003]. Islam discloses that for the selected sub-bands, “**RB allocation** ... can for example be sent using a Physical Downlink/Uplink Control channel (PDCCH or PUCCH) which may be part of every TTI and may appear in the first few OFDM symbols of the TTI.” Ex-1008-Islam, [0104]. As explained for 1[a] and 1[b], a POSITA, who would be familiar with the LTE standards, would have understood that the PDCCH necessarily is transmitting **RB allocation information** for a PDSCH, as required by LTE. Ex-1002-Bims, ¶195. Islam further discloses that a “network (typically a base station) signals to the UE which numerology to use.” Ex-1008-Islam, [0036]. Fig. 7A discloses that the base station has a “Bandwidth Portion Assigner 426” and an “RB Allocator 428”:

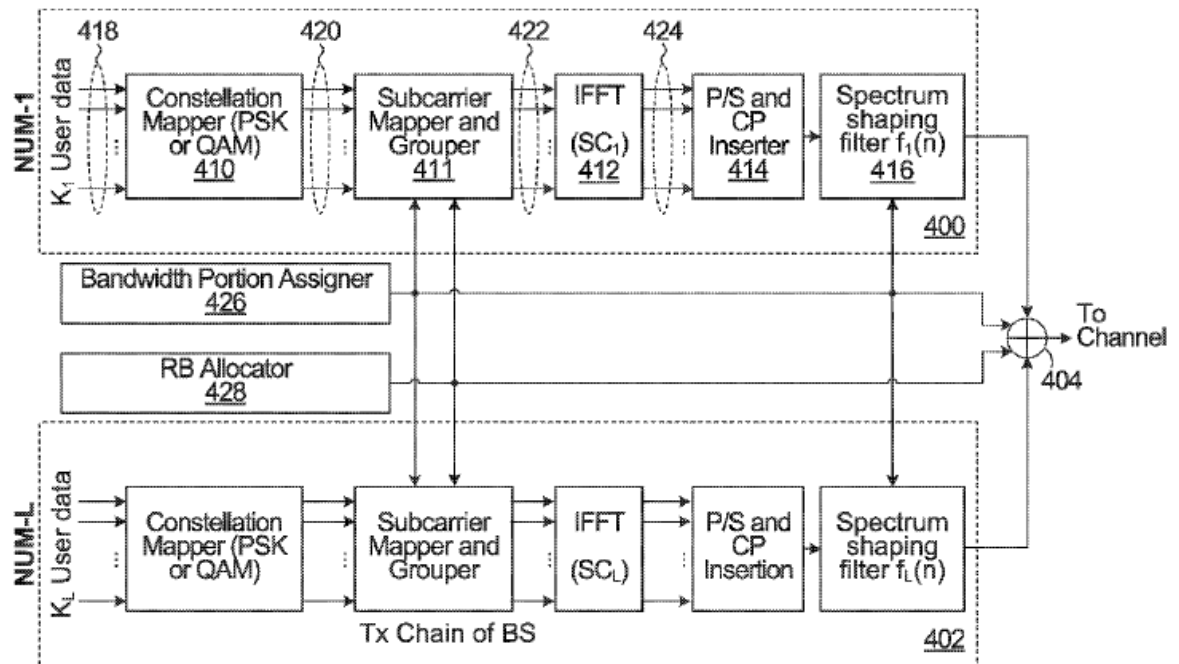


FIG. 7A

Ex-1008-Islam, Fig. 7A, [0036]. A POSITA would have understood that Islam discloses that the RB allocation information is thus “scheduled by the network.” Ex-1002-Bims, ¶195.

Islam also discloses, “For RB allocation, in some embodiments, a bandwidth portion selection field is used to indicate which bandwidth portions assigned to a numerology will be used for a given UE. [and] **an RB allocation field indicates RB allocation within a specified bandwidth.**” Ex-1008-Islam, [0056].

Islam further discloses, “[t]he **allocation of RBs** within the bandwidth specified by one or more of the mechanisms described herein can be performed in any suitable manner.” Ex-1008-Islam, [0091]. Islam discloses that “one of the methods provided by LTE can be used, as summarized in table 9.4”:

TABLE 9.4

Methods for indicating Resource Block (RB) allocation.			
Method	UL/DL	Description	Number of bits required (see text for definitions)
Direct bitmap	DL	The bitmap comprises 1 bit per RB. This method is the only one applicable when the bandwidth is less than 10 resource blocks.	N_{RB}^{DL}
Bitmap: 'Type 0'	DL	The bitmap addresses Resource Block Groups (RBGs), where the group size (2, 3 or 4) depends on the system bandwidth.	$\lceil N_{RB}^{DL}/P \rceil$
Bitmap: 'Type 1'	DL	The bitmap addresses individual RBs in a subset of RBGs. The number of subsets (2, 3, or 4) depends on the system bandwidth. The number of bits is arranged to be the same as for Type 0, so the same DCI format can carry either type of allocation.	$\lceil N_{RB}^{DL}/P \rceil$
Contiguous allocations: 'Type 2'	DL or UL	Any possible arrangement of contiguous RB allocations can be signalled in terms of a starting position and number of RBs.	$\lceil \log_2(N_{RB}^{DL} N_{RB}^{DL} + 1) \rceil$ or $\lceil \log_2(N_{RB}^{UL} (N_{RB}^{UL} + 1)) \rceil$

Ex-1008-Islam, [0092]. Islam further discloses a UE comprising an “RB Allocation Processor 462” that “processes a signal containing an RB allocation received over the air, for example using one of the methods described here.” 1008-Islam, [0082].

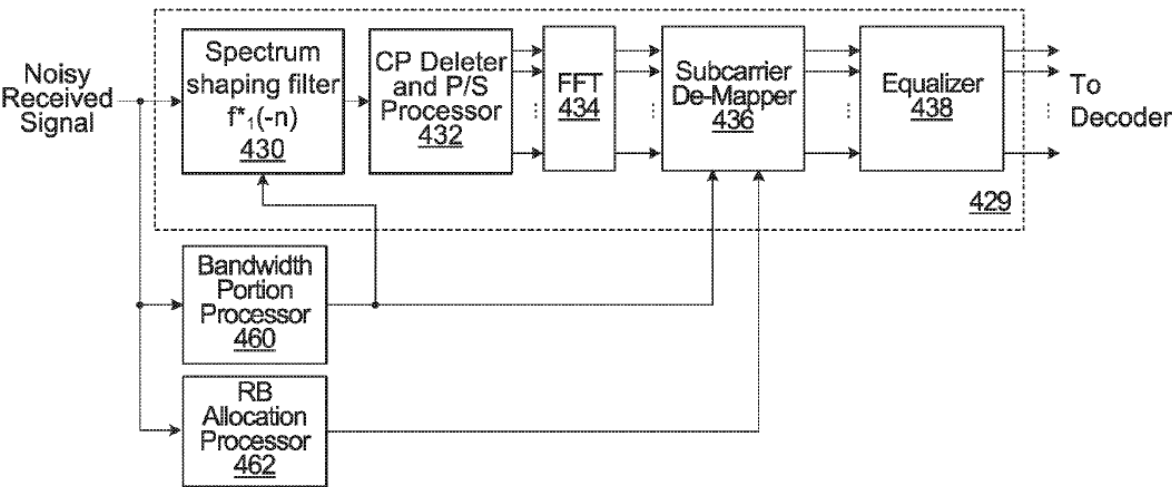


FIG. 7B

Ex-1008-Islam, Fig. 7B. Therefore, a POSITA would have understood that Islam

teaches a UE that can derive a **resource allocation** scheduled by a network. Ex-1002-Bims, ¶¶196-197. Moreover, a POSITA familiar with 3GPP standards such as LTE and 5G would also have understood that a PDCCH is used by a **UE** to derive a resource allocation for the PDSCH and PUSCH. Ex-1002-Bims, ¶197. In view of the teachings in Islam, a POSITA would have understood that Islam teaches that the **RB allocation** can be transmitted over the PDCCH to the UE for the UE to derive the “**resource allocation**” for the downlink data PDSCH. Ex-1002-Bims, ¶198.

6. [1e]

Islam discloses that “one of the methods provided by LTE can be used” for resource allocation “as summarized in table 9.4”:

TABLE 9.4

Methods for indicating Resource Block (RB) allocation.			
Method	UL/DL	Description	Number of bits required (see text for definitions)
Direct bitmap	DL	The bitmap comprises 1 bit per RB. This method is the only one applicable when the bandwidth is less than 10 resource blocks.	N_{RB}^{DL}
Bitmap: ‘Type 0’	DL	The bitmap addresses Resource Block Groups (RBGs), where the group size (2, 3 or 4) depends on the system bandwidth.	$\lceil N_{RB}^{DL}/P \rceil$
Bitmap: ‘Type 1’	DL	The bitmap addresses individual RBs in a subset of RBGs. The number of subsets (2, 3, or 4) depends on the system bandwidth. The number of bits is arranged to be the same as for Type 0, so the same DCI format can carry either type of allocation.	$\lceil N_{RB}^{DL}/P \rceil$
Contiguous allocations: ‘Type 2’	DL or UL	Any possible arrangement of contiguous RB allocations can be signalled in terms of a starting position and number of RBs.	$\lceil \log_2(N_{RB}^{DL} N_{RB}^{DL} + 1) \rceil$ or $\lceil \log_2(N_{RB}^{UL} (N_{RB}^{UL} + 1)) \rceil$

Ex-1008-Islam, [0092]. Accordingly, Islam teaches “*resource allocation within the first bandwidth portion is done via a bit map.*” Ex-1002-Bims, ¶199.

E. Claim 2

Islam discloses, “**system bandwidth** is divided into bandwidth portions, and the bandwidth portions are used as the unit of assignment for assigning sub-bands to numerologies.” Ex-1008-Islam, Abstract. Islam also discloses, “RB allocation to a **user equipment (UE)** is performed using an RB allocation indicator bitmap. **The size of the RB allocation indicator bitmap is proportional to system bandwidth.**” Ex-1008-Islam, [0003]. Islam’s Fig. 2 discloses “an example of [] how a system bandwidth can be decomposed into fixed sized bandwidth portions.”:

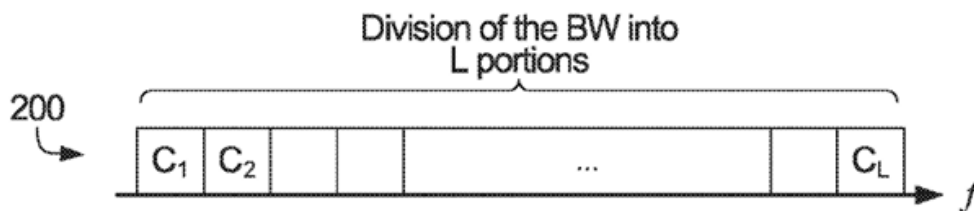


FIG. 2

Ex-1008-Islam, Fig. 2, [0010]. Islam further discloses that “[a]n embodiment of the invention provides a mechanism of flexibly assigning portions of an available system bandwidth, referred to above as sub-bands, to a numerology, and **conveying this assignment to a UE.**” Ex-1008-Islam, [0037]. Islam further discloses a UE comprising a “bandwidth portion processor 460 that processes a signal containing a bandwidth assignment received over the air” and the “output of the bandwidth

portion processor 460 is passed to the spectrum shaping filter 430 and the subcarrier de-mapper 436.” 1008-Islam, [0081].

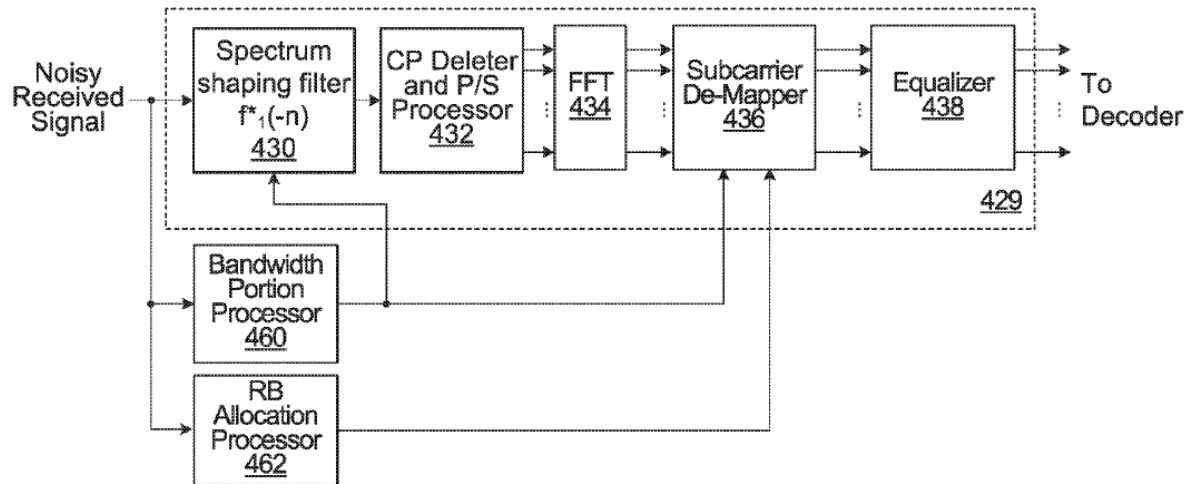


FIG. 7B

Ex-1008-Islam, Fig. 7B. A POSITA would have understood that the system bandwidth is conveyed to, processed, and thus configured by, the UE. Ex-1002-Bims, ¶¶200-201.

Jiang also teaches that when sub-band bandwidth information is conveyed to a UE “such as the start and end of the bandwidth,” “[t]he start of the first sub-band and the end of the last sub-band may be ignored if they correspond to the start and end of the system bandwidth.” Ex-1009-Jiang, 8:26-32; Ex-1011-JiangPCT, [0045]; Ex-1002-Bims, ¶201.

F. Claim 4

Islam does not expressly disclose “the first frequency location is an index of a resource block.” Jiang teaches this limitation. Jiang discloses that these bands are

“frequency bands,” Ex-1009-Jiang, 1:58-63; Ex-1011-JiangPCT, [0002], and a POSITA would have understood that Jiang’s “start position of a sub-band” is necessarily a first frequency location. Ex-1002-Bims, ¶202. Jiang also discloses that “[t]he start and end position of the sub-band can be at PRB [physical resource block] level” as “it is easy to indicate the start and end positions with the PRB number,” Ex-1009-Jiang, 8:39-44; Ex-1011-JiangPCT, [0046]. A POSITA would have understood that the PRB number providing the start and end positions” teaches that the “*first frequency location is an index of a resource block.*” Ex-1002-Bims, ¶202.

As described in §VIII(C), it would have been obvious to a POSITA to incorporate Jiang’s teachings into Islam’s system because it was identified as one “easy” way to indicate the start and end position and can help to reduce signaling complexity. Ex-1002-Bims, ¶203.

G. Claim 8

As discussed for 1[a], Jiang teaches the “first bandwidth” and the “first frequency location.” Islam discloses, “[i]n some embodiments, **higher level radio resource control (RRC) signaling is used for one or both of numerology assignment.**” Ex-1008-Islam, [0038]. It would have been obvious to combine the teachings of Jiang regarding higher level radio resource control signaling with the system of Islam because Jiang explicitly teaches a well-known routine way of transmitting signaling information for numerology and bandwidth assignments,

while Islam does not expressly disclose certain conventional details regarding signaling and messaging in LTE, as these were well established in the 3GPP standards and well known to a POSITA. Ex-1002-Bims, ¶¶204-205.

H. Claim 9

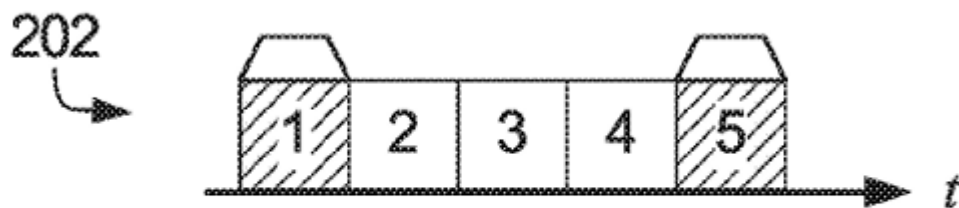
Islam discloses that “dynamic signaling, for example on a dynamic control channel, is used for one or both of numerology assignment and sub-band bandwidth assignment to an assigned numerology” to “be able to quickly and dynamically change the assignment.” Ex-1008-Islam, [0038]. Islam further discloses an example of a dynamic control channel (PDCCH) and discloses that the PDCCH may be “part of every TTI” Ex-1008-Islam, [0038], [0104]. A POSITA would have understood that this allows for quicker assignment changes than using more static channels such as RRC. Ex-1002-Bims, ¶206. As explained for [1a], Jiang discloses that the sub-band numerology assignments comprise “*the first bandwidth and the first frequency location*.” In view of the above disclosures in Islam, a POSITA would have understood that “*the first bandwidth and the first frequency location*” in the proposed combination of Islam and Jiang would have been indicated by a “*physical control channel*” as taught in Islam. Ex-1002-Bims, ¶206.

I. Claim 10

See claim 9.

J. Claim 11

Islam discloses assigning “*maximum bandwidth to the first numerology*”: “An example of this approach is depicted in Fig. 3 generally indicated at 202, where a bandwidth of 100 MHz is divided into $L=5$ bandwidth portions ... Example of possible contiguous selections: {**12345** ...}.”

**FIG. 3**

Ex-1008-Islam, [0041], Fig. 3. A POSITA would have understood the disclosed “**12345**” selection, corresponding to all 5 bandwidth portions shown in Figure 3, would have constituted the “*maximum bandwidth*.” Ex-1002-Bims, ¶208.

K. Claim 12

See claim 11.

L. Claim 13**1. [13p]**

See Claim [1p].

2. [13a], [13b], [13c], 13[d]

Islam discloses a **UE**, Ex-1008-Islam, [0036]-[0037]), but Islam does not explicitly disclose the internal structure of the UE. Jiang discloses these limitations. Jiang discloses, “[t]he apparatus 1200 can be implemented at a terminal device, for example UE, or other like terminal devices.” Ex-1009-Jiang, Fig. 12, 14:17-19; Ex-1011-JiangPCT, Fig. 12, [0079]. Jiang further discloses, “[T]he components of apparatuses 1100 and 1200 may be respectively implemented by **a circuit**, a **processor** or any other appropriate selection device. ... In some embodiments of the present disclosure, apparatus 1100 and 1200 may comprise **at least one processor**. ... Apparatuses 1100 and 1200 may further comprise **at least one memory ... The at least one memory may be used to store program of computer executable instructions. . . [which] may be configured, with the at least one processor, to cause apparatuses 1100 and 1200 to at least perform operations** according to the method as discussed with reference to FIGS. 1 to 10 respectively” Ex-1009-Jiang, 15:13-18; 26-43; Ex-1011-JiangPCT, [0089]-[0090].

It would have been obvious to combine the disclosure in Jiang regarding the structure of a **UE** with the wireless communication system disclosed in Islam. Ex-1002-Bims, ¶¶211-213.

3. [13d-1]

See Claim [1a].

4. [13d-2]

See Claim [1b].

5. [13d-3]

See Claim [1c].

6. [13d-4]

See Claim [1d].

7. [13d-5]

See Claim [1e].

M. Claim 14

See claim [2a].

N. Claim 15

See claim [13d-1].

O. Claim 17

See claim [1a].

IX. Ground 3: Claims 3, 5 and 16 would have been obvious based on Islam in view of Jiang, Miao, and the knowledge of a POSITA.

A. Miao

Miao, U.S. Patent No. 10,849,170, is the national stage entry of PCT/US2016/205492, which published on April 13, 2017, as WO2017/062061 (“MiaoPCT”). Miao is prior art under at least AIA 35 U.S.C. §102(a)(2). *See also* 35 U.S.C. §102(d); *Penumbra*. Miao is presumptively prior art as it is the national

stage entry of a PCT document that is prior art to the '759 Patent. To facilitate efficient review, Petitioner provides parallel citations to Miao and MiaoPCT herein.

B. Scope, Content, and Rationale for Combining Prior Art

Islam, Jiang, Miao are highly similar as all disclose improvements to 3GPP wireless communication systems. A POSITA would have been motivated to combine Islam and Jiang's teachings (as described in Ground 2) regarding a wireless communication system and numerology signaling with Miao's teachings regarding multiple physical downlink control channels because Islam and Jiang are 3GPP wireless communication system and Miao provides well-known routine details regarding control channels in a 3GPP wireless communication system. Miao discloses that "eNB 901 may reconfigure the UE-specific search space with multiple xPDCCH sets ... each such PDCCH set may be allocated with a specific resource partition." Ex-1010-Miao, 12:36-39; Ex-1012-MiaoPCT, [0081]. Miao further discloses that "the xPDCCH in a set may schedule downlink data packets and/or uplink data packets transmitted in the resource partition corresponding to the xPDCCH set." Ex-1010-Miao, 12:62-64, Ex-1012-MiaoPCT, [0087]. Islam and Jiang focus on numerology and do not expressly disclose certain conventional details regarding control and scheduling channels in LTE, as these were well established in the 3GPP standards and well known to a POSITA. Ex-1002-Bims, ¶¶222-224 (citing 3GPP standard).

A POSITA would reasonably expect Islam's wireless communication system to maintain conventional functionality, except where Islam's proposed enhancements modify that functionality. Ex-1002-Bims, ¶225.

C. Claim 3⁸

1. [3a]

Islam's discloses "[i]n sub-band 100, a numerology with a 7.5 kHz subcarrier spacing is used. **In sub-band 102, a numerology with a 15 kHz subcarrier spacing is used,**" as shown in Fig. 1 below:

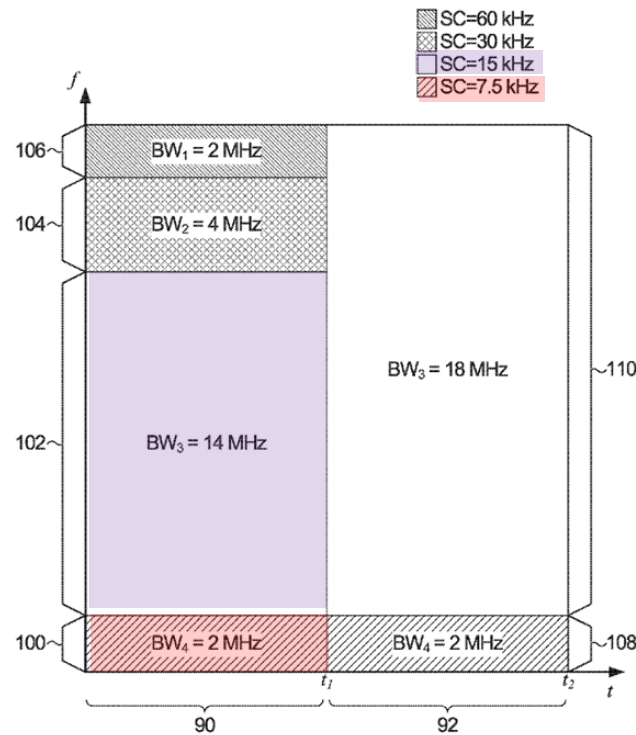


FIG. 1

⁸ See also Ground 2, Claim 1.

Ex-1008-Islam, Fig. 1, [0035]. Islam discloses that in some embodiments, “The remaining bandwidth portions may be assigned to **one or more other numerologies**.” Ex-1008-Islam, [0040]; Ex-1002-Bims, ¶226.

Islam does not expressly disclose receiving “*a **second frequency location** and a **second bandwidth** for the **second numerology***.” However, Jiang expressly discloses this limitation. Jiang discloses that “[t]he apparatus [UE] comprises [a] receiving module [] configured to receive information **about at least two numerologies**.” Ex-1009-Jiang, 2:19-30; Ex-1011-JiangPCT, [0004]. Jiang discloses that the “information about at least two numerologies can include the information for different numerologies” including “**sub-band bandwidth information for at least one of the numerologies**,” Ex-1009-Jiang, 5:12-21 Ex-1011-JiangPCT, [0031]. Jiang’s Fig. 2 illustrates “**two numerologies with the subcarrier spacing f_1 and subcarriers spacing f_2 are multiplexed on the same band**”:

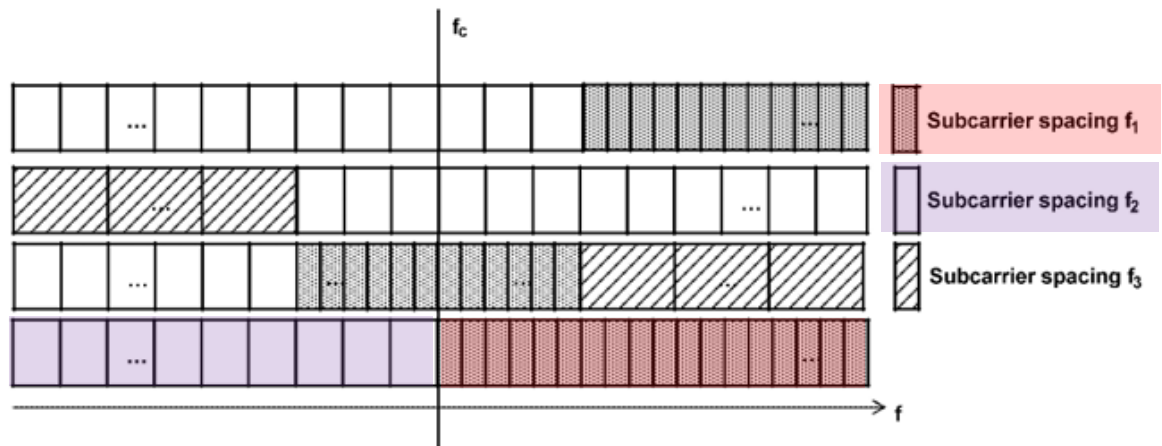


Fig. 2

Ex-1009-Jiang, Fig. 2; 5:32-66; Ex-1011-JiangPCT, Fig. 2; [0033].

Jiang also discloses that the “**sub-band bandwidth information for at least one of the numerologies**” “can be indicated by a start position of a sub-band and an end position of the sub-band.” Ex-1009-Jiang, 8:26-32; Ex-1011-JiangPCT, [0045]. Jiang discloses that these bands are “frequency bands,” Ex-1009-Jiang, 1:58-63; Ex-1011-JiangPCT, [0002], and a POSITA would have understood that this “**start position of a sub-band**” teaches a “**second frequency location.**” Ex-1002-Bims, ¶¶227-228. A POSITA would also understand that the “**end position of the sub-band**” teaches another frequency location. Ex-1002-Bims, ¶228. Jiang also discloses that the information for the second numerology comprises “**a second bandwidth**” as a POSITA would have understood the **start and end frequencies of the sub-band,**

Ex-1009-Jiang, 8:26-32; Ex-1011-JiangPCT, [0045], **comprise a second bandwidth**. Ex-1002-Bims, ¶228.

As described in §VIII(C), it would have been obvious to a POSITA to incorporate Jiang’s teachings into Islam’s system because it is “easy” to indicate the start and end position and can help to reduce signaling complexity. Ex-1002-Bims, ¶¶229-230.

2. [3b]

Islam discloses that “RB allocation [] can, for example be sent using a **Physical Downlink/Uplink Control channel (PDCCH or PUCCH)** which may be part of every TTI.” Ex-1008-Islam, [0104]. A POSITA would have understood that each TTI has a different PDCCH. Ex-1002-Bims, ¶231. Islam explains that for the selected sub-bands, “RB allocation ... can for example be sent using a Physical Downlink/Uplink Control channel (PDCCH or PUCCH)” Ex-1008-Islam, [0104]. As discussed in §VIII(D)(2), a POSITA would have understood that the PDCCH is associated with the PDSCH as the PDCCH informs the UE about the resource allocation of DL-SCH on the PDSCH. Ex-1002-Bims, ¶231. Therefore, Islam discloses that the “*second PDCCH is associated with the second PDSCH or the second PUSCH.*” Ex-1002-Bims, ¶231. Although Islam teaches a PDCCH is associated with a PDSCH or PUSCH, it does not expressly disclose “*detecting a second PDCCH.*” Miao does provide such teachings. Ex-1002-Bims, ¶¶231-232.

Miao discloses “extended Physical Downlink Control Channel (xPDCCH) for 5G Radio Access Technology” Ex-1010-Miao, 2:4-7; Ex-1012-MiaoPCT, [0007]. Miao discloses that “eNB 901 may reconfigure the UE-specific search space with **multiple xPDCCH sets ... each such PDCCH set may be allocated with a specific resource partition.**” Ex-1010-Miao, 12:36-39; Ex-1012-MiaoPCT, [0081]. Miao further discloses that “the xPDCCH in a set may schedule downlink data packets and/or uplink data packets transmitted in the resource partition corresponding to the xPDCCH set.” Ex-1010-Miao, 12:62-64, Ex-1012-MiaoPCT, [0087]. In view of Miao’s disclosure of configuring “**multiple xPDCCH sets,**” a POSITA would have understood that the **UE** would have detected a “second PDCCH” associated with a “second PDSCH” or the “second PUSCH.” Ex-1002-Bims, ¶232.

A POSITA would have been motivated to implement Miao’s teachings regarding configuring “multiple xPDCCH sets,” in Islam’s system to enable the **UE** to detect a “**second PDCCH**” associated with a “**second PDSCH**” or the “**second PUSCH.**” Ex-1002-Bims, ¶233. As described above in §IX(C), Miao provides well-known routine details regarding control channels, while Islam and Jiang focus on numerology and does not expressly disclose certain conventional details regarding control and scheduling channels in LTE, as these were well established in the 3GPP standards and well known to a POSITA. Ex-1002-Bims, ¶233. Thus, Islam, in view

of Jiang, Miao, and the knowledge of POSITA renders obvious this limitation. Ex-1002-Bims, ¶233.

3. [3c]

Although Islam teaches that the UE receives information for the second numerology, it does not expressly disclose “*deriving, by the UE, a second bandwidth portion based on the second frequency location and the second bandwidth for the second numerology.*” However, Jiang discloses this limitation. As described for 3[a] above, Jiang discloses “*the second frequency location and the second bandwidth for the second numerology.*” Jiang discloses an apparatus that “**could be implemented at a terminal device, for example UE**” and that “[t]he receiving module is configured to receive information about at **least two numerologies.**” Ex-1009-Jiang, 2:19-30; Ex-1011-JiangPCT, [0004]. Jiang discloses indicating “a bandwidth” “by a start position of a sub-band and an end position of a sub-band.” Ex-1009-Jiang, 8:23-38; Ex-1011-JiangPCT, [0045]. When there is no guard band or the guard band is fixed, “only the end position of the last sub-band or the start position of the current sub-band is enough to distinguish the band.” Ex-1009-Jiang, 8:35-36; Ex-1011-JiangPCT, [0045]. Jiang also discloses that position information “can also be deduced by UE according to the system bandwidth and the number of multiplexed numerologies.” Ex-1009-Jiang, 11:52-58; Ex-1011-JiangPCT, [0059]. A POSITA also would have understood Jiang’s disclosures to teach the claimed “*deriving, by*

the UE, a second bandwidth portion” because Jiang teaches that the **UE** can derive these boundaries based upon the position information received at the **UE** and because Jiang discloses a second frequency location and a second bandwidth. Ex-1002-Bims, ¶¶234-235.

As described above in §VIII(C), it would have been obvious to combine the teachings in Jiang regarding “*deriving, by the UE, a second bandwidth portion*” with the wireless communication system disclosed in Islam. Ex-1002-Bims, ¶¶235-236.

4. [3d]

Islam discloses that for the selected sub-bands, “RB allocation ... can for example be sent using a Physical Downlink/Uplink Control channel (PDCCH or PUCCH) which may be part of every TTI.” Ex-1008-Islam, [0104]. As explained for 3[a] and 3[b], a POSITA, who would have been familiar with the LTE standards, would have understood that the PDCCH necessarily is transmitting RB allocation information for a PDSCH, as required by LTE. Ex-1002-Bims, ¶237. As explained for 3[c], Islam in view of Jiang and the knowledge of POSITA discloses “*deriving, by the UE, a second bandwidth portion based on the second frequency location and the second bandwidth for the second numerology.*” Ex-1002-Bims, ¶237. Islam further discloses that a “*network*” “signals to the **UE** which numerology to use.” Ex-1008-Islam, [0036].

Islam also discloses, “**For RB allocation, in some embodiments, a bandwidth portion selection field is used to indicate which bandwidth portions assigned to a numerology will be used for a given UE**” and “**an RB allocation field indicates RB allocation within a specified bandwidth.**” Ex-1008-Islam, [0056].

Islam further discloses, “[t]he allocation of RBs within the bandwidth specified by one or more of the mechanisms described herein can be performed in any suitable manner.” Ex-1008-Islam, [0091]. Islam specifies that “one of the methods provided by LTE can be used, as summarized in Table 9.4”:

TABLE 9.4

Methods for indicating Resource Block (RB) allocation.			
Method	UL/DL	Description	Number of bits required (see text for definitions)
Direct bitmap	DL	The bitmap comprises 1 bit per RB. This method is the only one applicable when the bandwidth is less than 10 resource blocks.	N_{RB}^{DL}
Bitmap: ‘Type 0’	DL	The bitmap addresses Resource Block Groups (RBGs), where the group size (2, 3 or 4) depends on the system bandwidth.	$\lceil N_{RB}^{DL}/P \rceil$
Bitmap: ‘Type 1’	DL	The bitmap addresses individual RBs in a subset of RBGs. The number of subsets (2, 3, or 4) depends on the system bandwidth. The number of bits is arranged to be the same as for Type 0, so the same DCI format can carry either type of allocation.	$\lceil N_{RB}^{DL}/P \rceil$
Contiguous allocations: ‘Type 2’	DL or UL	Any possible arrangement of contiguous RB allocations can be signalled in terms of a starting position and number of RBs.	$\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)) \rceil$ or $\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL} + 1)) \rceil$

Ex-1008-Islam, [0092]. A POSITA would have understood that Islam discloses that the RB allocation can be transmitted over the PDCCH to the UE for the UE to derive

the second “*resource allocation*” for the downlink data PDSCH. Ex-1002-Bims, ¶¶238-239.

Islam does not explicitly disclose a second resource allocation scheduled by a second network, but Islam discloses the use of OFDM and that the network “signals to the UE which numerology to use.” Ex-1008-Islam, [0002], [0036]. A POSITA would have understood that a UE that receives OFDM transmissions is connected to more than one carrier, and thus receives “*a second resource allocation scheduled by a second network.*” Ex-1002-Bims, ¶240].

Miao also discloses this limitation. Miao discloses that the baseboard circuitry in a **UE** “may handle various radio control functions that enable communication with **one or more radio networks via the RF circuitry 1606.**” Ex-1010-Miao, 22:64-67; Ex-1012-MiaoPCT, [00160]. Miao further discloses, “[f]or example, in some embodiments, the baseband circuitry 1604 may support communication with **an evolved universal terrestrial radio access network (EUTRAN) and/or other wireless metropolitan area networks (WMAN), a wireless local area network (WLAN), a wireless personal area network (WPAN).**” Ex-1010-Miao, 23:36-44; Ex-1012-MiaoPCT, [00162]. A POSITA would have understood that that Miao teaches that a UE may receive “*a second resource allocation scheduled by a second network.*” Ex-1002-Bims, ¶¶241-242.

A. Claim 5

1. [5a]

See Claim [3a].

2. [5b]

As explained above for Ground 2, Claim 9, Islam, Jiang, and the knowledge of a POSITA render obvious using PDCCH to dynamically signal “sub-band bandwidth assignment” to a numerology, such as “second bandwidth and the second frequency location.” Moreover, a POSITA familiar with 3GPP standards such as LTE and 5G would also have understood that a PDCCH is used by a UE to derive a resource allocation for the PDSCH and PUSCH. Ex-1002-Bims, ¶244. Therefore, a POSITA would have understood that Islam in view of Jiang, Miao, and the knowledge of POSITA, teaches the claimed “*deriving, by the UE, a second resource allocation for a second PDSCH or a second PUSCH for the second numerology within a second bandwidth portion based on the PDCCH, the second frequency location and the second bandwidth.*” Ex-1002-Bims, ¶244.

B. Claim 16⁹

See claim 5[a], and [5b].

⁹ See also Ground 2, Claim 13.

X. Non-Institution Under 35 U.S.C. §§ 314(a) or 325(d) Would Be Improper

Petitioner has stipulated (*see* Ex-1016) that it will not pursue grounds that are or reasonably could have been raised in this proceeding in connection with a challenge to the validity of the '759 patent in the co-pending district court litigation. *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) (precedential). Therefore, the Board should not issue a discretionary denial based on *Fintiv. Id.*

The references identified in this Petition were not before the Examiner during prosecution and were not cited by the Examiner. The references in Petitioner's Grounds were not cited by the Examiner in any Office Action or provided in the Applicant's Information Disclosure Statement. Thus, a discretionary denial of institution under 35 U.S.C. §325(d) would be misplaced.

Date: August 13, 2024

Respectfully Submitted,

/s /Trenton A. Ward

Trenton A. Ward (Reg. No. 59,157)

Lead Counsel

GREENBERG TRAURIG, LLP

WORD COUNT AND CERTIFICATION UNDER 37 C.F.R. § 42.24(d)

This Petition complies with the requirements of 37 C.F.R. § 42.24. As calculated by the word count feature of Microsoft Word, it contains 13,976 words, excluding the words contained in the following: Table of Contents, Table of Authorities, List of Exhibits, Mandatory Notices, Certification Under § 42.24(d), and Certificate of Service. This Petition complies with the 14,000 word limit (37 C.F.R. § 42.24(a)(1)(i)).

/s /Trenton A. Ward

Trenton A. Ward (Reg. No. 59,157)

Lead Counsel

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CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing **Petition for *Inter Partes* Review**, the associated **Power of Attorney**, and **Exhibits 1001-1016** were served by FedEx Priority Overnight on the correspondence address of record indicated in the Patent Office's Patent Center system for U.S. Patent No. 10,785,759:

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I further certify that a courtesy copy of the above-identified materials were served on litigation counsel by electronic means upon the foregoing individuals:

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