

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Xiaobo Zhang
U.S. Patent No.: 10,912,081 Attorney Docket No. 50095-0227IP1
Issue Date: February 2, 2021
Appl. Serial No.: 15/972,167
Filing Date: May 6, 2018
Title: METHOD AND DEVICE USED FOR WIRELESS
COMMUNICATION IN UE AND BASE STATION

Mail Stop Patent Board

Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 10,912,081 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104.....	4
	A. Grounds for Standing Under 37 C.F.R. § 42.104(a).....	4
	B. Challenge Under 37 C.F.R. § 42.104(b) and Relief Requested	4
	C. Claim Construction	5
III.	PRIOR ART BACKGROUND	8
	A. Overview of Multiple-Input and Multiple-Output (MIMO) and Antenna Beam Switching	8
	B. Chen (U.S. Pat. No. 11,039,470)	9
	C. 3GPP – Long Term Evolution – Release 14.....	12
	D. Dahlman	19
IV.	THE '081 PATENT	27
	A. The Prior Art Teaches the '081 Patent Claims	27
	B. Prosecution History.....	29
	C. IPR History	30
V.	STATEMENT OF PRECISE RELIEF REQUESTED	30
	A. Prior Art	30
	B. Challenges.....	31
VI.	LEVEL OF ORDINARY SKILL IN THE ART	31
VII.	THE CHALLENGED CLAIMS ARE UNPATENTABLE.....	32
	A. GROUND 1A – Chen in view of 3GPP renders claims 1-12 obvious...32	
	1. Claim 1	32
	2. Claim 2	63
	3. Claim 3	66
	4. Claim 4	67
	5. Claim 5	68
	6. Claim 6	70
	7. Claim 7	71
	8. Claim 8	71
	9. Claim 9	71
	10. Claim 10	73
	11. Claim 11	74
	12. Claim 12	76

B.	GROUND 1B – Chen in view of Dahlman renders claims 1-12 obvious..	
		77
1.	Claim 1	77
2.	Claim 2	83
3.	Claim 3	83
4.	Claim 4	84
5.	Claim 5	84
6.	Claim 6	85
7.	Claim 7	85
8.	Claim 8	85
9.	Claim 9	85
10.	Claim 10	85
11.	Claim 11	86
12.	Claim 12	86
VIII.	TRIAL SHOULD BE INSTITUTED.....	87
IX.	CONCLUSION AND FEES	87
X.	MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1).....	88
A.	Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1).....	88
B.	Related Matters Under 37 C.F.R. § 42.8(b)(2)	88
C.	Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3).....	89
D.	Service Information	89

LIST OF EXHIBITS

APPLE-1001	U.S. Patent No. 10,912,081
APPLE-1002	U.S. Patent No. 10,912,081 File History
APPLE-1003	Declaration of Dr. Robert Akl
APPLE-1004	U.S. Patent No. 11,039,470 to Chen et al. (“Chen”)
APPLE-1005	RESERVED
APPLE-1006	3GPP TR 25.892 V6.0.0 (2004-06) Technical Report (3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility Study for Orthogonal Frequency Division Multiplexing (OFDM) for UTRAN enhancement (Release 6)) (“TR-25.892”).
APPLE-1007	3GPP TS 36.213 version 12.11.0 Release 12 (2016-11) Technical Specification (Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer Procedures) (“TS-36.213”).
APPLE-1008	3GPP TS 36.321 version 12.6.0 Release 12 (2015-07) Technical Specification (Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) Protocol Specification) (“TS-36.321”).
APPLE-1009	Wu, Hao. “Accurate determination of transport block size for 5G new radio.” <i>Electronics Letters</i> 56.9 (2020): 459-462 (“Wu”).
APPLE-1010	Sandrasegaran, Kumbesan, Huda Adibah Mohd Ramli, and Riyaj Basukala. “Delay-prioritized scheduling (DPS) for real time traffic in 3GPP LTE system.” <i>2010 IEEE wireless communication and networking conference</i> . IEEE, 2010 (“Sandrasegaran”).

APPLE-1011	RESERVED
APPLE-1012	International Patent Publication No. WO 2018/201861 to Chen et al. (“Chen-PCT”), including certified English translation and certification ¹
APPLE-1013	Chinese Patent Application Publication No. CN 108809488 to Chen et al. (“Chen Priority”), ² including certified English translation and certification
APPLE-1014	3GPP Declaration of Friedhelm Rodermund
APPLE-1015	First Amended Complaint, <i>Apex Beam Technologies LLC v. Apple Inc.</i> , Case No. 6:24-cv-00223-ADA-DIG (May 2, 2024 WDTX)
APPLE-1016	Complaint, <i>Apex Beam Technologies LLC v. Apple Inc.</i> , Case No. 6:24-cv-00223-ADA-DIG (April 29, 2024)
APPLE-1017	Proof of Service of Complaint, <i>Apex Beam Technologies LLC v. Apple Inc.</i> , Case No. 6:24-cv-00223-ADA-DIG
APPLE-1018	RESERVED
APPLE-1019	3GPP TS 36.211 V12.5.0 (2015-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (Release 12)
APPLE-1020	3GPP TS 36.212 V12.4.0 (2015-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio

¹ Citations to Chen are made to the English translation.

² Citations to Chen Priority are made to the English translation.

Access (E-UTRA); Multiplexing and channel coding
(Release 12)

- APPLE-1021 3GPP TSG RAN WG1 Meeting #89, Hangzhou, China 15th – 19th May 2017, R1-1707475, CATT, “Discussion on DL beam management” (“CATT”)
- APPLE-1022 3GPP TSG RAN WG1 Contribution File Directory
https://www.3gpp.org/ftp/tsg_ran/wg1_rl1/TSGR1_89/Docs
- APPLE-1023 Dahlman et al., 4G LTE-Advanced Pro and The Road TO 5G (3d ed. 2016) (“Dahlman”)
- APPLE-1024 3GPP TS 36.201 V14.1.0 (2017-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description (Release 14)
- APPLE-1025 3GPP TS 36.211 V14.2.0 (2017-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (Release 14)
- APPLE-1026 3GPP TS 36.212 V14.2.0 (2017-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 14)
- APPLE-1027 3GPP TS 36.213 V14.2.0 (2017-03) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 14)
- APPLE-1028 3GPP TS 36.331 V14.2.2 (2017-04) 3rd Generation Partnership Project; Technical Specification Group Radio

Access Network; Evolved Universal Terrestrial Radio
Access (E-UTRA); Radio Resource Control (RRC);
Protocol specification (Release 14)

APPLE-1029	Declaration of June Ann Munford
APPLE-1030	Memorandum: Interim Processes for PTAB Workload Management (“Stewart Memorandum”)
APPLE-1031	PTAB-IPR2023-00599, Paper 12, Patent Owner’s Response
APPLE-1032	PTAB-IPR2023-00599, Paper 9, Decision Granting Institution
APPLE-1033	Patent Trial and Appeal Board (PTAB) Boardside Chat Interim processes relating to institution in AIA proceedings (April 24, 2025) <i>available at</i> https://www.uspto.gov/sites/default/files/documents/boardside_chat_interim_process_for_aia_institution_decisions_.pdf
APPLE-1034	IPR2023-00599, EX2004, Deposition Transcript of Miguel Gomez, March 12, 2024

LISTING OF CLAIMS

Claim 1	
[1.pre]	A method in a User Equipment (UE) for wireless communication, comprising:
[1.a]	receiving a second radio signal;
[1.b]	receiving a first radio signal;
[1.c]	wherein the first radio signal is transmitted within a first time unit,
[1.d]	a first bit block is used for generating the first radio signal, and
[1.e]	the first radio signal comprises G multicarrier symbols;
[1.f]	the second radio signal is transmitted within the first time unit, and
[1.g]	the second radio signal is used for determining a time-domain resource occupied by the G multicarrier symbols;
[1.h]	as for any one given multicarrier symbol of the G multicarrier symbols, the multi-antenna related receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by the given multicarrier symbol with respect to a first time point in time domain;
[1.i]	when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second radio signal is used for determining the multi-antenna related receiving for the given multicarrier symbol; and
[1.j]	when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving for the given multicarrier symbol is related to the multi-antenna related receiving for the second radio signal;
[1.k]	the first time point is one time point within the first time unit; and
[1.l]	G is a positive integer.

Claim 2	
[2.a]	The method according to claim 1, comprising: receiving first information, wherein the first information is used for determining the first time point; or
[2.b]	receiving third information, wherein the third information is used for determining a candidate scheme for the multi-antenna related receiving corresponding to the G multicarrier symbols.
Claim 3	
[3]	The method according to claim 2 comprising: transmitting second information, wherein the second information is used for determining the first time point.
Claim 4	
[4]	The method according to claim 1 comprising: transmitting second information; wherein the second information is used for determining the first time point.
Claim 5	
[5.pre]	A method in a base station device for wireless communication, comprising:
[5.a]	transmitting a second radio signal;
[5.b]	transmitting a first radio signal;
[5.c]	wherein the first radio signal is transmitted within a first time unit,
[5.d]	a first bit block is used for generating the first radio signal, and
[5.e]	the first radio signal comprises G multicarrier symbols;
[5.f]	the second radio signal is transmitted within the first time unit, and
[5.g]	the second radio signal is used for determining a time-domain resource occupied by the G multicarrier symbols;

[5.h]	as for any one given multicarrier symbol of the G multicarrier symbols, the multi-antenna related receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by the given multicarrier symbol with respect to a first time point in time domain;
[5.i]	when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second radio signal is used to determine the multi-antenna related receiving for the given multicarrier symbol; and
[5.j]	when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving for the given multicarrier symbol is related to the multi-antenna related receiving for the second radio signal;
[5.k]	the first time point is one time point within the first time unit; and
[5.l]	G is a positive integer.
Claim 6	
[6.a]	The method according to claim 5, comprising: transmitting first information, wherein the first information is used for determining the first time point; or
[6.b]	transmitting third information, wherein the third information is used for determining a candidate scheme for the multi-antenna related receiving corresponding to the G multicarrier symbols.
Claim 7	
[7]	The method according to claim 6 comprising: receiving second information, wherein the second information is used for determining the first time point.

Claim 8	
[8]	The method according to claim 5, comprising: receiving second information; wherein the second information is used for determining the first time point.
Claim 9	
[9.pre]	A UE for wireless communication, comprising:
[9.a]	a first transceiver module, to receive a second radio signal and a first radio signal;
[9.b]	wherein the first radio signal is transmitted within a first time unit,
[9.c]	a first bit block is used for generating the first radio signal, and
[9.d]	the first radio signal comprises G multicarrier symbols;
[9.e]	the second radio signal is transmitted within the first time unit, and
[9.f]	the second radio signal is used for determining a time-domain resource occupied by the G multicarrier symbols;
[9.g]	as for any one given multicarrier symbol of the G multicarrier symbols, the multi-antenna related receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by the given multicarrier symbol with respect to a first time point in time domain;
[9.h]	when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second radio signal is used to determine the multi-antenna related receiving for the given multicarrier symbol; and
[9.i]	when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving for the given multicarrier symbol is related to the multi-antenna related receiving for the second radio signal;
[9.j]	the first time point is one time point within the first time unit; and

[9.k]	G is a positive integer.
Claim 10	
[10.a]	The UE according to claim 9, wherein the first transceiver module receives first information, the first information being used for determining the first time point; or,
[10.b]	the first transceiver module transmits second information, the second information being used for determining the first time point; or,
[10.c]	the first transceiver module receives third information, the third information being used for determining a candidate scheme for the multi-antenna related receiving corresponding to the G multicarrier symbols.
Claim 11	
[11.pre]	A base station device for wireless communication, comprising:
[11.a]	a second transceiver module, to transmit a second radio signal and a first radio signal;
[11.b]	wherein the first radio signal is transmitted within a first time unit,
[11.c]	a first bit block is used for generating the first radio signal, and
[11.d]	the first radio signal comprises G multicarrier symbols;
[11.e]	the second radio signal is transmitted within the first time unit, and
[11.f]	the second radio signal is used for determining a time-domain resource occupied by the G multicarrier symbols;
[11.g]	as for any one given multicarrier symbol of the G multicarrier symbols, the multi-antenna related receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by the given multicarrier symbol with respect to a first time point in time domain;

[11.h]	when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second radio signal is used to determine the multi-antenna related receiving for the given multicarrier symbol; and
[11.i]	when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving for the given multicarrier symbol is related to the multi-antenna related receiving for the second radio signal;
[11.j]	the first time point is one time point within the first time unit; and
[11.k]	G is a positive integer.
Claim 12	
[12.a]	The base station device according to claim 11, wherein the second transceiver module transmits first information, the first information being used for determining the first time point; or,
[12.b]	the second transceiver module receives second information, the second information being used for determining the first time point; or,
[12.c]	the second transceiver module transmits third information, the third information being used for determining a candidate scheme for the multi-antenna related receiving corresponding to the G multicarrier symbols.

TABLE OF AUTHORITIES

Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005)

Wellman, Inc. v. Eastman Chem. Co., 642 F.3d 1355 (Fed. Cir. 2011)

Source Vagabond Sys. Ltd. v. Hydrapak, Inc., 753 F.3d 1291 (Fed. Cir. 2014)

Adams Respiratory Therapeutics, Inc. v. Perrigo Co., 616 F.3d 1283 (Fed. Cir. 2010)

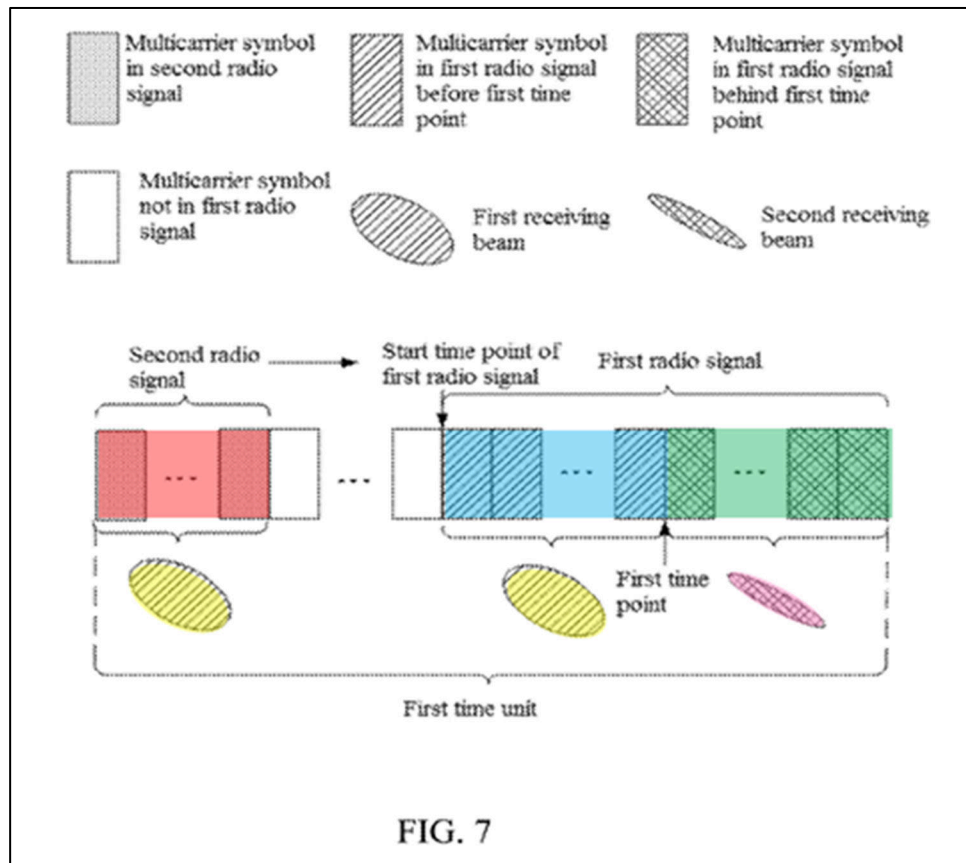
Vitronics Corp. v. Conception, Inc., 90 F.3d 1576 (Fed. Cir. 1996)

Brown v. 3M, 265 F.3d 1349 (Fed. Cir. 2001)

I. INTRODUCTION

Apple Inc. (“Apple” or “Petitioner”) petitions for IPR of claims 1-12 (“Challenged Claims”) of U.S. Patent No. 10,912,081 (“the ’081 Patent”). As explained in this Petition, there exists a reasonable likelihood that Petitioner will prevail with respect to at least one of the Challenged Claims.

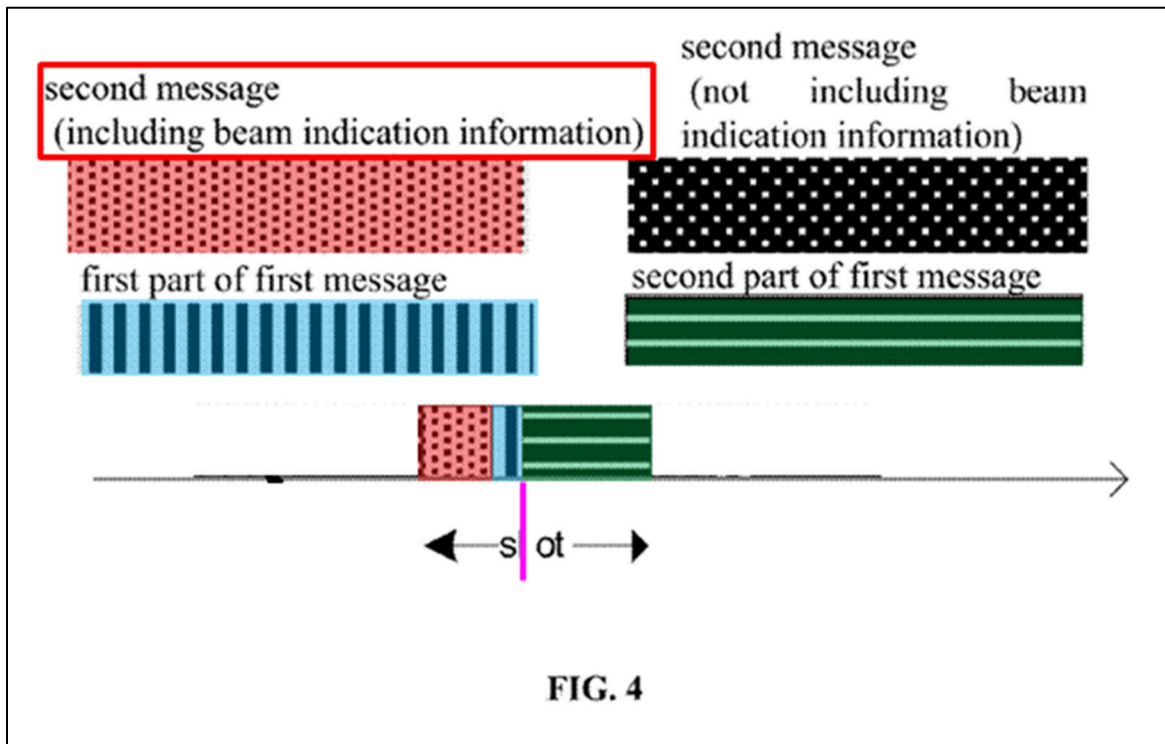
The Challenged Claims are directed to methods and devices for wireless communication, and relate to a procedure of transmitting a **second radio signal** (e.g., **control information**) and a **first radio signal** (e.g., **user data**) from a base station to a user equipment (UE), which can be a mobile device. As shown in annotated FIG. 7 below, the UE uses a **first beam** (e.g., a wide beam) to receive a first portion of the first radio signal before a **first time point**, and a **second beam** (e.g., a narrow beam) to receive a second portion of the first radio signal behind the **first time point**.



During prosecution, the Applicant argued that the prior art did not disclose these features. *See* APPLE-1002, 195-201. However, this procedure was well known in the art before the earliest claimed priority date of the '081 Patent.

For example, Chen discloses the same procedure. Chen describes sending a **second message (second radio signal)** using a default reception beam (maps to the first reception beam, wide oval in Figure 7), where the **second message** includes an indication of a reception beam (maps to second reception beam, narrow oval in Figure 7) for receiving one or more parts of the data message (first radio signal – **first part, second part**). *E.g.*, APPLE-1004, 10:64-16:3; APPLE-1013,

[0123], [0145]. FIG. 4 illustrates the beam switching of Chen:



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4

The first message can include a **first part** and a **second part**. APPLE-1004, 14:31-33; APPLE-1013, [0145]. Chen describes that “when the second message includes the parameter indication information [i.e., beam indication information], the first part may be decoded in accordance with the default receiver parameter [first or default beam], and the second part may be decoded in accordance with the target receiver parameter indicated by the parameter indication information [second or target beam].” APPLE-1004, 15:64-16:3; APPLE-1013, [0124], [0144]-[0165].

Additionally, Chen expressly describes that because the first part and the

second part belong to a same message (first radio signal), “the receiving end device may perform symbol-level processing on each of the first part and the second part.” APPLE-1004, 15:35-38; APPLE-1013, [0152] (“In addition, because the first part content and the second part content belong to the same message, the receiving end may execute symbol-level processing separately on the first part content and the second part content.”). As set forth below, these disclosures would have been integrated with 3GPP or Dahlman to render obvious the Challenged Claims. The Board should thus institute review and cancel the Challenged Claims.

II. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

A. Grounds for Standing Under 37 C.F.R. § 42.104(a)

Apple certifies that the '081 Patent is available for IPR. The present petition is being filed within one year of service of a complaint against Apple. *Apex Beam Technologies LLC v. Apple Inc*, 6-24-cv-00223 (WDTX), filed April 29, 2024.

Apple is not barred or estopped from requesting this review.

B. Challenge Under 37 C.F.R. § 42.104(b) and Relief Requested

Petitioner requests an IPR of the Challenged Claims on the grounds set forth in the table shown below, and requests that each of the Challenged Claims be found unpatentable. An explanation of how these claims are unpatentable under the statutory grounds identified below is provided in the form of detailed description and claim charts that follow, indicating where each element can be

found in the cited prior art, and the relevance of that prior art. Additional explanation and support for each ground of rejection is set forth in Exhibit APPLE-1003, the Declaration of Dr. Robert Akl, referenced throughout this Petition.

Ground	'081 Patent Claims	Basis for Rejection
Ground 1A	1-12	§103: Chen in view of 3GPP
Ground 1B	1-12	§103: Chen in view of Dahlman

APPLE-1003, ¶¶104-105.

C. Claim Construction

All claim terms should be construed according to the *Phillips* standard. *Phillips*, 415 F.3d 1303; 37 C.F.R. §42.100. Petitioner submits that no claim terms need be construed to resolve issues of controversy in the present Petition.³ *Wellman*, 642 F.3d at 1361; APPLE-1003, ¶¶95-103.

In IPR2023-00599, Patent Owner proposed the following constructions:⁴

Claim Term	PO's Proposed Construction
radio signal	“signal that transmits particular radio information”
“the second radio signal is used for	“the second radio signal is used for

³ Petitioner reserves the right to argue in an appropriate forum that certain limitations in the challenged claims are indefinite.

⁴ IPR2023-00599, Paper 12, at 13, 18.

determining a time-domain resource occupied by the G multicarrier symbols”	determining a time-domain resource occupied by <i>each of</i> the G multicarrier symbols”
--	---

Resolution of these constructions would not inform the applicability of the grounds presented in this IPR. The prior art describes a (second) radio signal that transmits particular (control) information. The prior art also describes that the control information in the second radio signal is used for determining the time-domain resources for each of the G multicarrier symbols in the first message (first radio signal). Thus, construction is neither necessary nor warranted in this case.

More, Petitioner does not agree with the Patent Owner’s constructions. First, as acknowledged by the Board in the previous IPR, the ’081 Patent uses the term “signal” broadly. IPR2023-00599, Paper 9, 17 (citing ’081 Patent, 12:1-4, 12:49-50, FIG. 13). A POSITA would have recognized that a control message carries multiple different types of information, including downlink control information, downlink scheduling assignments, uplink scheduling grants, power-control commands, and reception parameter indication information. *E.g.*, APPLE-1004, 10:25-35; APPLE-1023, 151; APPLE-1003, ¶¶95-103.

Second, adding the “each of” language to “the second radio signal is used for determining a time-domain resource occupied by the G multicarrier symbols” is an improper attempt to inject words into the claim, practice routinely rejected by

the Federal Circuit. *E.g.*, *Source Vagabond Sys.*, 753 F.3d at 1299. Here, the addition of “each of” before “the G multicarrier symbols” does not contribute to understanding the claim, is inconsistent with the ’081 patent, and would improperly exclude preferred embodiments. APPLE-1001, 20:65-67. *E.g.*, *Adams Respiratory Therapeutics, Inc.*, 616 F.3d at 1290; *Vitronics Corp.* 90 F.3d at 1583–84. Moreover, this proposal merely add words that should be done by amendment, but does not do anything to clarify the claim element. To the contrary, this construction only adds confusion to a limitation that does not require clarification. APPLE-1003, ¶¶95-103.

For example, when discussing the FIG. 7 embodiment specifically, the ’081 Patent states that “the second radio signal indicates the start time point of the first radio signal in the first time unit, and the start time point is used for determining the time domain resource occupied by the first radio signal in the first time unit.” APPLE-1001, 18:6-10. Apex’s proposal is inconsistent with (and would exclude) this preferred embodiment. APPLE-1003, ¶¶95-103.

Knowledge of the start time point of a set of symbols is sufficient to know the time-domain resource occupied by each of the subsequent symbols. APPLE-1003, ¶¶95-103. As discussed herein (and as was acknowledged previously by Apex’s expert), 3GPP messages have a certain number of symbols and each symbol occupies a specific length of time. *E.g.*, APPLE-1023, §§4.2.3.1, 6.4;

APPLE-1024 §4.2.1; APPLE-1034, 18:12-15; APPLE-1003, ¶¶95-103. In addition, the control message indicates the number of symbols reserved for control information, so the receiver knows the starting position of the symbols for the data. APPLE-1023, §§4.2.3.1, 6.4. Once you know the start time of the first symbol in a set of consecutive symbols, you know the start time of the second symbol, and so on. APPLE-1003, ¶¶95-103; APPLE-1034, 21:3-20. Thus, it is possible to determine the time domain resource of the other symbols within a set of consecutive symbols (and whether each of them is before or behind a first time point) once the time domain resource of the first symbol is known. APPLE-1003, ¶¶95-103.

For at least these reasons, the Board should not adopt the above proposals, and instead, apply the plain-and-ordinary meaning to the claims.

III. PRIOR ART BACKGROUND

A. Overview of Multiple-Input and Multiple-Output (MIMO) and Antenna Beam Switching

The concept of using multiple antennas to transmit and receive radio signals between a user equipment (UE) and a base station (i.e., multiple-input and multiple-output (MIMO) radio communications) has been well known for many years. APPLE-1004, 1:27-41; APPLE-1013, [0002]; APPLE-1023, §3.1, 3.4; APPLE-1003, ¶¶54-88. In these radio communications, radio signals can be

transmitted by forming one or more beams using the antennas. *Id.* Beams can have different configurations that impact various characteristics of the communication between the UE and the base station. *Id.*

For example, a wider beam is generally known to provide a greater area of coverage but may produce a relatively lower quality signal for a given amount of transmitted power. APPLE-1003, ¶¶54-55. On the other hand, a narrower beam may generally produce a higher quality signal while providing less coverage. *Id.* Thus, in some cases, it may be desirable to switch from one beam to another during communication between the UE and the base station depending on the particular situation. *Id.* This process is known as beam switching. *Id.* Such “beam switching” was well known in the art before the earliest claimed priority date of the ’081 Patent, May 8, 2017.⁵ *Id.*; *see also* APPLE-1021, 8-9, FIG. 6; APPLE-1014, ¶¶54-55.

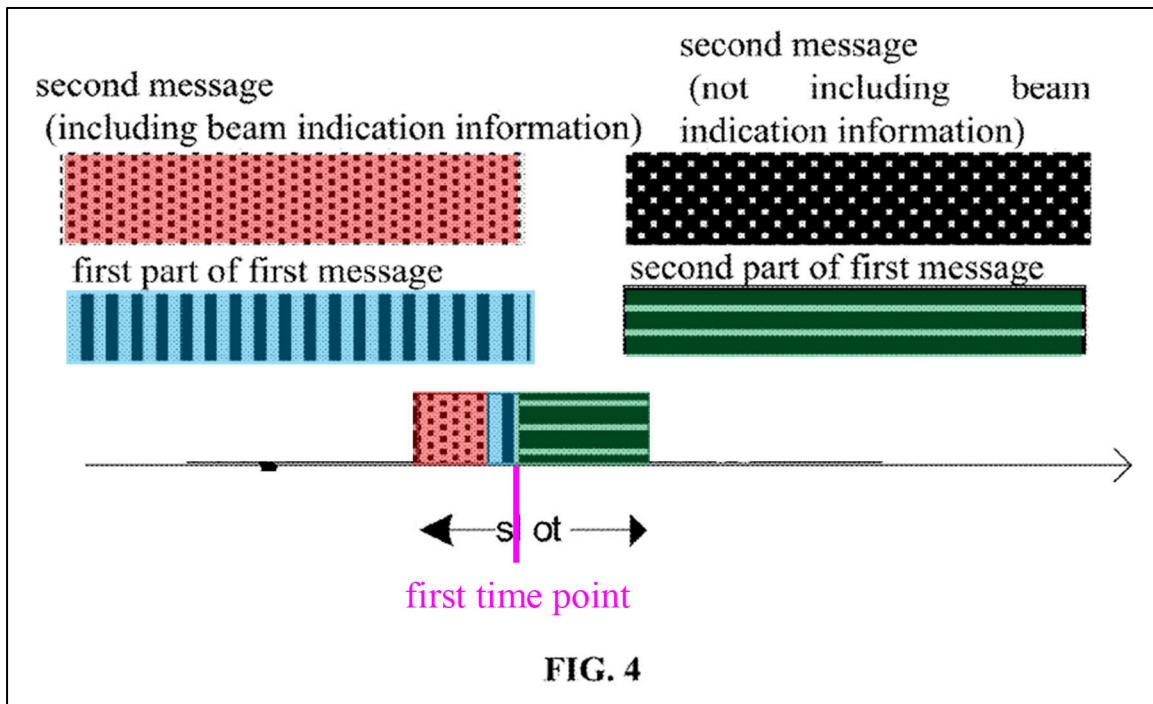
B. Chen (U.S. Pat. No. 11,039,470)

Chen (APPLE-1004) discloses a method for beam switching within a time slot. APPLE-1004, 10:39-11:9; APPLE-1013, [0124]-[0125], [0128]. Chen describes communication that supports multi-antenna systems, including a base

⁵ Petitioner reserves the right to challenge the priority date here and/or in other proceedings.

station communicating with a User Equipment (UE). APPLE-1004, 1:22-42, 3:36-42, 3:60-4:3, 9:65-10:6 (transmitting end device may be a base station, such as a Long Term Evolution (LTE) or New Radio base station); APPLE-1013, [0002], [0118]; APPLE-1003, ¶¶56-62. The base station can use a control message to notify the UE of a change in receiver parameters, including a change in the beam. *E.g.*, APPLE-1004, 10:40-11:9; APPLE-1013, [0123]-[0125].

Chen discloses that a first message (shown in two parts in FIG. 4) and a second message are transmitted from a base station to a UE. APPLE-1004, 10:10-19, FIGS. 2,4; APPLE-1013, [0119]-[0123], [0128], FIGS. 2,4. The “first message” can be a “data” message and the “second message” can be a “control message or a scheduling message.” APPLE-1004, 10:20-29; APPLE-1013, [0123]. Thus, the second message is sent/received before the first message. APPLE-1004, 10:10-19, FIG. 2; APPLE-1013, [0120]-[0122]. The second message includes the parameter indication information, which the UE uses to switch from its current configuration to the indicated configuration for receiving transmissions from the base station. *E.g.*, APPLE-1004, 10:40-11:9; APPLE-1013, [0124], [0128], [0151]. This configuration is illustrated in FIG. 4, shown below:



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

APPLE-1003, ¶¶56-62.

The first/data message is shown having two parts. APPLE-1004, 14:57-60; APPLE-1013, [0151]. The **first part** is decoded in accordance with the default receiver parameters, and then, the **second part** is decoded in accordance with the target receiver parameter indicated by the parameter indication information.

APPLE-1004, 15:64-16:3; *see also id.*, 10:38-43 (describing decoding the **first part** using the default parameter and switching to the target parameter for decoding the **second part**), 11:18-37 (describing that the default receiver parameter may be just the receiver parameter currently used by the receiving end device”); APPLE-1013, [0128]-[0130]; APPLE-1003, ¶¶56-62. “In addition, the

first part and the **second part** [of the first message] belong to a same message, so the receiving end device may perform symbol-level processing on each of the first part and the second part.” APPLE-1004, 15:35-38; APPLE-1013, [0152].

Chen issued on June 15, 2021 and claims priority to PCT Pub. No. WO2018/201861, published November 8, 2018 (APPLE-1012, “Chen-PCT”), and claims priority to Chinese Application No. 201710307962.5 (APPLE-1013, “Chen Priority”) filed May 4, 2017. APPLE-1001, Face. Chen is entitled to its priority application filing date of May 4, 2017. Consequently, Chen is prior art to the ’081 Patent under 35 U.S.C. §102(a)(2). Support in the Chinese priority application for material relied on in Chen is set forth in the sections below, substantiating Chen’s entitlement to its priority application filing date. APPLE-1003, ¶¶56-62.

Chen is analogous art to the ’081 Patent because, like the ’081 Patent, Chen is directed to a wireless communication system for transmitting/receiving radio signals between a base station and a UE, and methods for switching a receiving beam during a single time slot. *E.g.*, APPLE-1004, 9:33-10:43, 11:19-37, FIGS. 1,2,4; APPLE-1013, [0118], [0128], FIGS. 1,2,4; APPLE-1001, 1:16-20; APPLE-1003, ¶¶56-62.

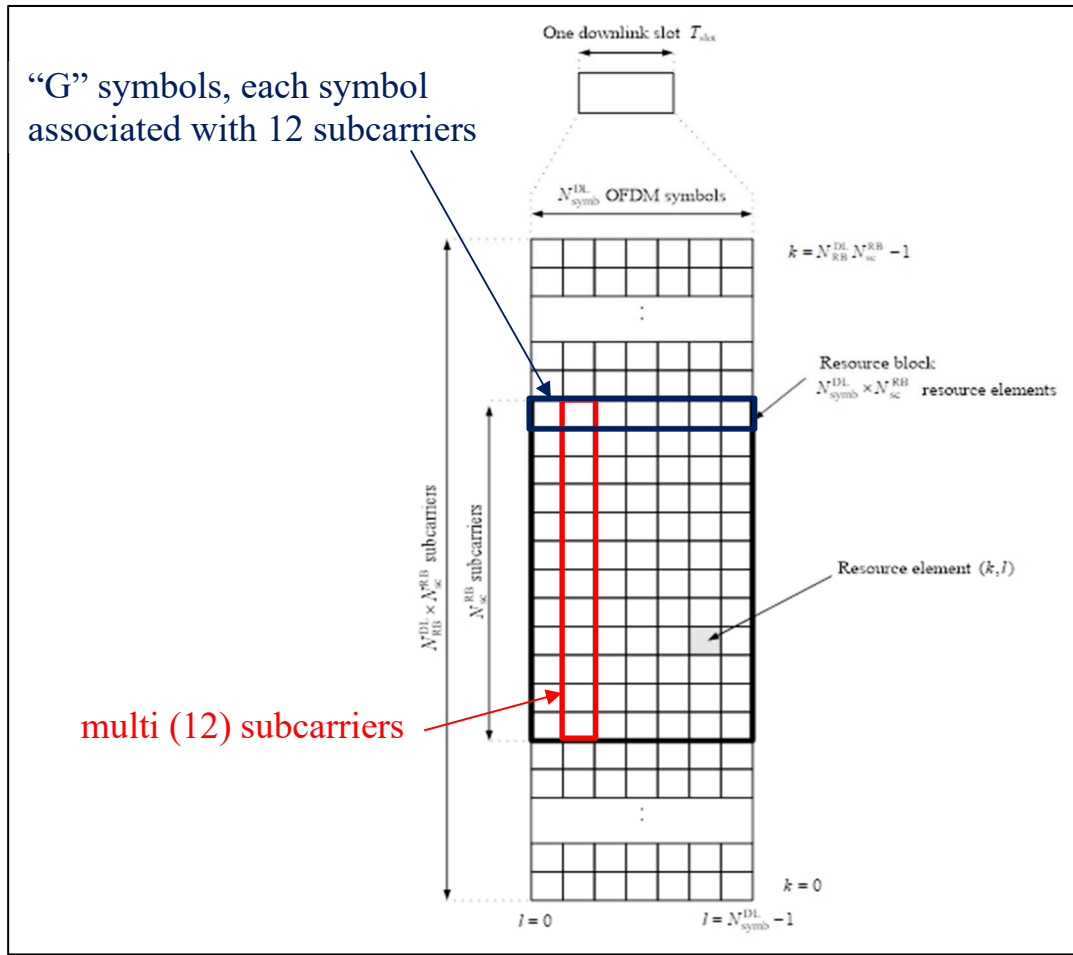
C. 3GPP – Long Term Evolution – Release 14

The Third Generation Partnership Project (3GPP) LTE standard, Release 14 (3GPP for short) includes multiple Technical Specifications (TS), each describing

standardized techniques for implementing Evolved Universal Terrestrial Radio Access (E-UTRA) technologies, including TS 36.201 (APPLE-1024), TS 36.211 (APPLE-1025), TS 36.212 (APPLE-1026), TS 36.213 (APPLE-1027), and TS 36.331 (APPLE-1028). APPLE-1003, ¶¶63-71. In this Petition, references to “3GPP” are references to this collection of cited technical specifications. 3GPP provides explanations of the concepts and terminologies customary to 3GPP LTE technology and often omitted in patents.

LTE radio access network (“RAN”) technology as described in the 3GPP standard uses orthogonal frequency division multiplexing (OFDM). APPLE-1024, §4.2.1. As described by 3GPP, the “multiple access scheme for the LTE physical layer is based on Orthogonal Frequency Division Multiplexing (OFDM).” *Id.* The resource blocks include an integer number of multicarrier symbols, each symbol having a predetermined duration. *Id.*; APPLE-1003, ¶¶63-71.

According to 3GPP, a “transmitted signal in each slot is described by one or several resource grids of $N_{RB}^{DL}N_{sc}^{RB}$ subcarriers and N_{symb}^{DL} OFDM symbols.” APPLE-1025, §6.2.1. The OFDM resource grid is illustrated by the following schematic:



APPLE-1025, Figure 6.2.2-1: Downlink resource grid (annotated), §6.2.1-6.2.3

As described by 3GPP, a physical resource block in one downlink slot is defined as

N_{symb}^{DL} consecutive OFDM symbols in the time domain and N_{sc}^{RB} consecutive subcarriers in the frequency domain, where N_{symb}^{DL} and N_{sc}^{RB} are given by Table

6.2.3-1:

Table 6.2.3-1: Physical resource blocks parameters

Configuration		N_{sc}^{RB}	N_{symb}^{DL}
Normal cyclic prefix	$\Delta f = 15$ kHz	12	7
	$\Delta f = 7.5$ kHz		6
Extended cyclic prefix	$\Delta f = 7.5$ kHz	24	3
	$\Delta f = 1.25$ kHz	144	1

“G” symbols, where G is an integer

Multiple subcarriers for each of G symbols

“The number of OFDM symbols in a slot depends on the cyclic prefix length and subcarrier spacing configured and is given in Table 6.2.3-1.” APPLE-1025, §6.2.1. “A physical resource block thus consists of $N_{symb}^{DL} \times N_{sc}^{RB}$ resource elements, corresponding to one slot in the time domain and 180 kHz in the frequency domain.” APPLE-1025, §6.2.3; APPLE-1003, ¶¶63-71.

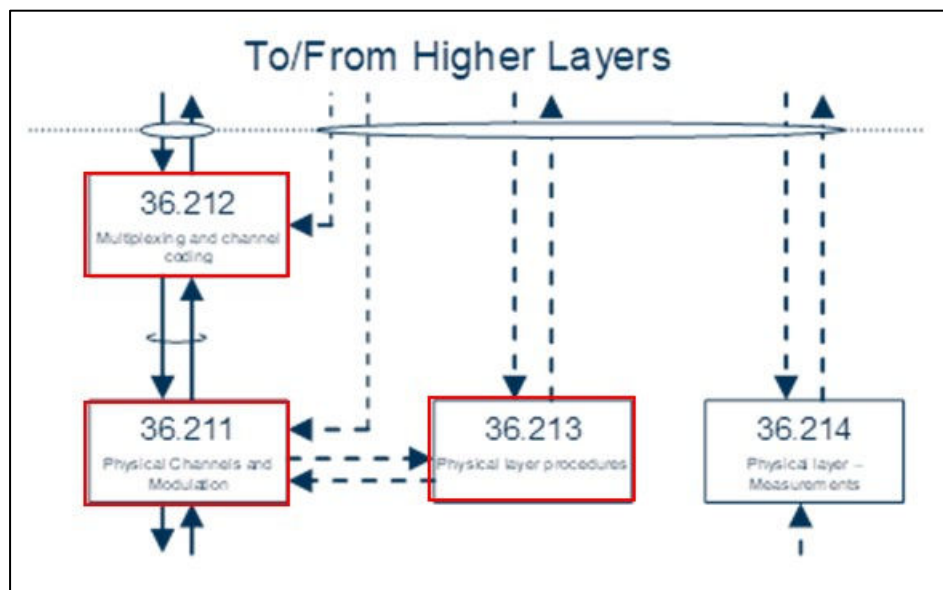
For Physical Downlink Shared Channel (PDSCH) transmissions, the resource allocation is indicated by the downlink control information (DCI) communicated on the Physical Downlink Control Channel (PDCCH). APPLE-1026, §4.2; APPLE-1027, §7.1.6. The starting OFDM symbols for the PDSCH is given by index $l_{DataStart}$, which is indicated by DCI in PDCCH. APPLE-1027, §7.1.6.4. The total number of symbols for each slot is known from a resource allocation field depending on the PDCCH DCI format. APPLE-1027, §7.1.6. Specifically, a “resource allocation field in each [PDCCH] includes two parts, a

resource allocation header field and information consisting of the actual resource block assignment.” *Id.* With the starting position of PDSCH and the total number of resource elements per slot, the UE knows the symbol position for each time domain resource for the message received on PDSCH. APPLE-1003, ¶¶63-71.

A POSITA would have understood that each TS is part of a collection of documents that make up the 3GPP Standard (i.e., each TS is considered to be a portion of one larger document. APPLE-1003, ¶¶63-71. The 3GPP TS are collectively considered as a set of teachings related to the implementation of LTE E-UTRA technology. *Id.* Where one TS does not provide details of particular parameters and procedures, or where it specifically references another TS, a POSITA would have had reason to turn to that TS for more information. *Id.* For example, TS 36.213 describes Physical Layer Procedures, and expressly references TS 36.201, TS 36.211, TS 36.212, and TS 36.331. APPLE-1027, Title, §2; APPLE-1003, ¶¶63-71.

TS 36.201 provides a general overview of each of TS 36.201, 36.211, 36.212, and 36.213, and a POSITA implementing the LTE Physical Layer would have been motivated to review TS 36.201 to understand where to look for standardized procedures. APPLE-1024, §5 (“Document structure of LTE physical layer specification”); APPLE-1003, ¶¶63-71. TS 36.201 provides a general overview of the content of each of the LTE Physical Layer Technical

Specification. APPLE-1024, §5. The “LTE physical layer specification” is considered to be one document. *E.g., id.*; APPLE-1003, ¶¶63-71. As described in TS36.201, the “physical layer specification consists of a general document (TS 36.201), and five documents (TSs 36.211, 36.212, 36.213, 36.214 and 36.216).” APPLE-1024, §5. 36.201 also provides information pertaining to other layers of the LTE protocol: “The relation between the physical layer specifications in the context of the higher layers is shown in Figure 2.” *Id.* Figure 2, showing relationship between physical layer technical specifications, is reproduced below:



APPLE-1024, Figure 2 (showing relationship between documents)

A POSITA reviewing each technical specification is directly referred to other technical specifications for additional information. APPLE-1003, ¶¶63-71. For example, a POSITA reviewing TS 36.211 concerning resource blocks in the downlink (§6.2.3 – Resource blocks) and mapping to resource elements (§6.3.5)

would have been expressly directed to look to TS 36.213. APPLE-1003, ¶¶63-71. Likewise, a POSITA reviewing TS 36.211 for downlink physical channels (§6.1.1), downlink scheduling assignment (§6.2.3), and resource mapping for PDCCH (§6.8.5) would have been directed to TS 36.212. A POSITA would have also been motivated to rely on TS 36.331, which discusses the “Radio Resource Control protocol for the radio interface between UE and E-UTRAN.” APPLE-1028, §1; APPLE-1003, ¶¶63-71. TS 36.331 expressly refers to TS 36.211, 36.212, and 36.213. APPLE-1028, §2; APPLE-1003, ¶¶63-71.

3GPP-LTE is analogous art because the '081 Patent expressly describes LTE and LTE-Advanced. APPLE-1001, 10:30-34. 3GPP-LTE is analogous art to Chen for similar reasons. *E.g.*, APPLE-1004, 9:65-10:3 (describing the base station as an LTE eNB); APPLE-1013, [0118]. A POSITA would have found it obvious to look to and use standardized RAN technology features when implementing Chen because Chen expressly states its applicability to 3GPP-LTE. *Id.*; APPLE-1003, ¶¶63-71. For similar reasons, a POSITA would have had a reasonable expectation of success applying features from 3GPP because such features were well known, standardized features for constructing and transmitting OFDM-based messages across a 3GPP-compliant wireless link. APPLE-1003, ¶¶63-71; *see also*, §§VII.A.1.[1.d]-[1.e], [1.i], [1.g], *infra*.

Each of the 3GPP TS documents is prior art as of their release dates, which

are summarized as follows:

APPLE-1024	3GPP TS 36.201 V14.1.0, March 23, 2017;
APPLE-1025	3GPP TS 36.211 V14.2.0, March 23, 2017;
APPLE-1026	3GPP TS 36.212 V14.2.0, March 23, 2017;
APPLE-1027	3GPP TS 36.213 V14.2.0, March 23, 2017;
APPLE-1028	3GPP TS 36.331 V14.2.2, April 20, 2017.

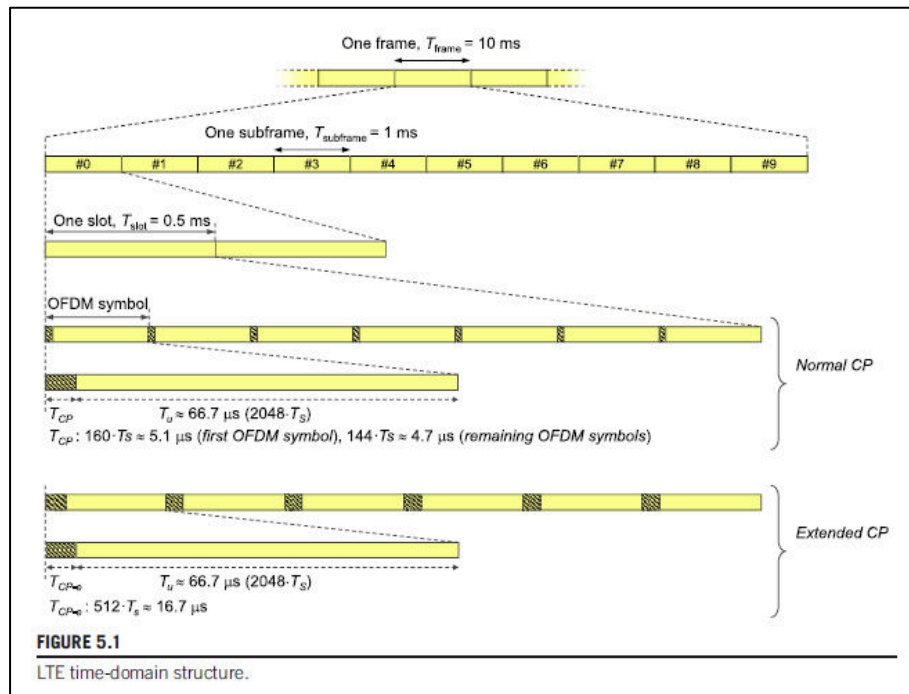
APPLE-1014, *passim*; APPLE-1003, ¶¶63-71.

D. Dahlman

Dahlman is a book that “describes LTE, developed in 3GPP (Third-Generation Partnership Project) and providing true fourth-generation (4G) broadband mobile access.” APPLE-1023, xv. Dahlman provides detailed explanations of the concepts and terminologies customary in the telecommunication space, which are often not described in detail in patents or technical documents, as they are assumed to be understood by the readers of such documents. APPLE-1003, ¶¶72-82. 3GPP represents the knowledge of a POSITA accumulated up to the dates of those documents. *Id.*

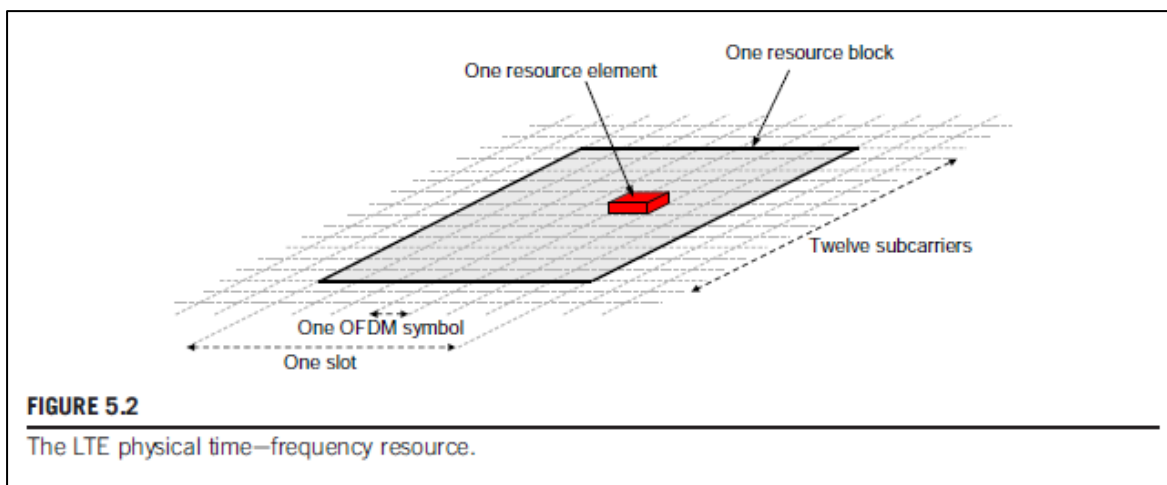
For example, OFDM is a well-known concept that utilizes multicarrier symbols, and Dahlman describes the LTE downlink transmission scheme that uses OFDM. APPLE-1023, §3.1.1; APPLE-1003, ¶¶72-82. Dahlman illustrates the LTE time-domain structure in FIG. 5.1 and the physical transmission resource grid

in FIG. 5.2, reproduced below:



APPLE-1023, FIG. 5.1

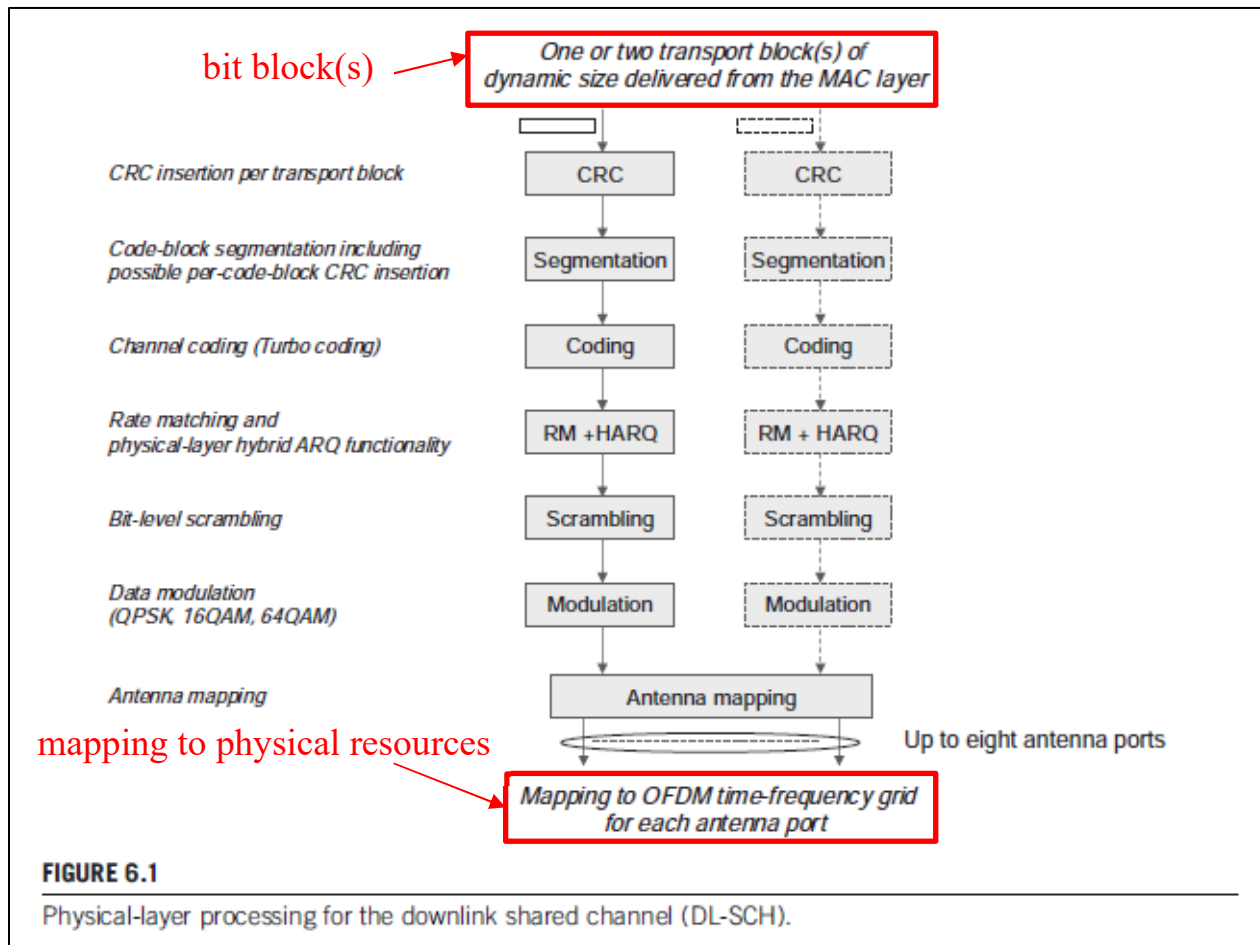
Per Dahlman, each slot consists of “a number of OFDM symbols including cyclic prefix.” APPLE-1023, §5.1. Resource elements are grouped into resource blocks, as shown in FIG. 5.2:



APPLE-1023, FIG. 5.2

According to Dahlman, in LTE, “each resource block consists of 12 consecutive subcarriers in the frequency domain and one 0.5 ms slot in the time domain. Each resource block thus consists of $7 \text{ [symbols]} \bullet 12 \text{ [subcarriers]} = 84$ resource elements in the case of a normal cyclic prefix and $6 \text{ [symbols]} \bullet 12 \text{ [subcarrier]} = 72$ resource elements in the case of an extended cyclic prefix.” APPLE-1023, §5.1 (where the number of symbols is either 6 or 7—an integer); APPLE-1003, ¶¶72-82.

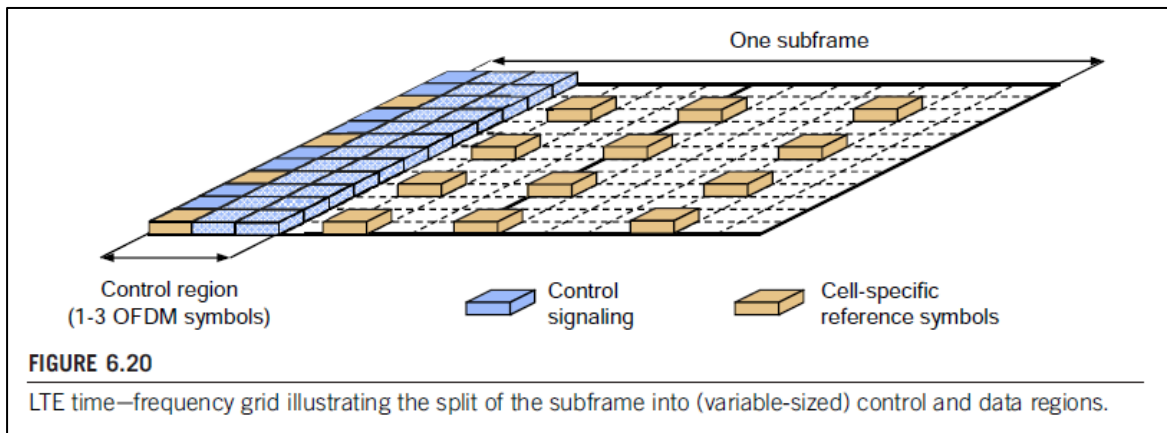
Per Dahlman, radio signals are formed from bit blocks. For example, the downlink shared channel processing is shown in FIGS. 6.1:



APPLE-1023, FIG. 6.1

As shown in FIG. 6.1, transport blocks are processed and mapped to physical time-frequency resources for each antenna port. APPLE-1023, §6.1.1-6.1.2, FIG. 6.1; APPLE-1003, ¶¶72-82.

Per Dahlman, in LTE, downlink subframes can include a control region occupying “an integer number of OFDM symbols, more specifically one, two, or three OFDM symbols,” as shown in FIG. 6.20:



APPLE-1023, FIG. 6.20

According to Dahlman, for an OFDM subframe in LTE, “each subframe can therefore be said to be divided into a control region followed by a data region, where the control region corresponds to the part of the subframe in which the L1/L2 control signaling is transmitted.” Dahlman §6.4. “The reason for transmitting the control signaling at the beginning of the subframe is to allow for devices to decode downlink scheduling assignments as early as possible.” *Id.*; APPLE-1003, ¶¶72-82.

Downlink control information includes information pertaining to the control message itself. APPLE-1023, §§4.2.3.1, 6.4. Specifically, Physical Control Format Indicator Channel (PCFICH) informs the device “about the size of the control region.” *Id.*; *see also id.* §6.4.1 (“The PCFICH indicates the instantaneous size of the control region in terms of the number of OFDM symbols—that is, indirectly where in the subframe the data region starts.”). The PDCCH is “used for

downlink scheduling assignments.” *Id.*; APPLE-1003, ¶¶72-82.

Dahlman is analogous art to both the '081 Patent and Chen. As mentioned above, both the 081 Patent and Chen are pertinent to 3GPP-LTE. *Supra*, §III.C (Prior art background, 3GPP). APPLE-1003, ¶¶72-82. Chen’s focus is on using beam reception parameter in control information for symbol-level beam switching for receiving data on PDSCH. *E.g.*, APPLE-1004, FIG. 4 and accompanying text; APPLE-1014, FIG. 4 and accompanying text. Accordingly, Chen is silent as to the basics of LTE downlink signaling, such as how radio signals are formed and the content of the downlink control information. APPLE-1003, ¶¶72-82. A POSITA reading Chen, however, would have turned to other resources for those fundamental aspects, such as Dahlman, to implement the techniques of Chen. *Id.* Dahlman, being a textbook used by engineering professors including Professor Akl, would have been an obvious choice. *Id.*

Chen unequivocally states that the base station is an LTE eNB that communicates with a UE, such as a mobile phone. APPLE-1004, 9:60-67; APPLE-1013, [0118]. Thus, a POSITA implementing the beam switching features of Chen would have looked for the LTE fundamentals taught by Dahlman to form and transmit the first message (first radio signal) and the second message (second radio signal). APPLE-1003, ¶¶72-82. A POSITA would have also found it obvious to include standard DCI in the second message (second radio signal), as

taught by Dahlman. *Id.*

A POSITA would have had a reasonable expectation of success implementing the standardized techniques described by Dahlman because such techniques were well-known, established techniques for creating radio signals in LTE, and Dahlman presents these standardized techniques in a pedagogical manner. APPLE-1003, ¶¶72-82.

It was well known to a POSITA that LTE base stations use multicarrier symbols, e.g., OFDM symbols, to support communications for different carriers. APPLE-1003, ¶¶72-82. For example, per Dahlman, an OFDM resource grid includes a positive integer number of OFDM symbols for each subcarrier in a data message. *Id.*

Likewise, it was well known at that time that DCI included information for the UE to determine the symbols for the downlink shared channel. APPLE-1003, ¶¶72-82. For example, as taught by Dahlman, in LTE, the PCFICH in the downlink control signaling includes the instantaneous number of symbols for the control region, thereby allowing the UE to indirectly determine the starting point of the data region. *E.g.*, APPLE-1023, §6.4.1. In addition, the UE knows the number of symbols per slot, and therefore, knows from the PCFICH the symbols for each multicarrier symbol in the data region. APPLE-1003, ¶¶72-82.

A POSITA would have been motivated to implement LTE's standardized

teachings, as taught by Dahlman, of a data message using multicarrier symbols (e.g., OFDM symbols) into Chen's method. APPLE-1003, ¶¶72-82. Chen discloses a wireless communication system where a base station transmits control and data messages to the UE within a single time slot in accordance with LTE. *See e.g.*, APPLE-1004, 9:63-10:3, 13:25-29, 15:64-16:3, FIG. 4; APPLE-1013, [0118], [0144], [0155], FIG. 4. Chen and Dahlman disclose that the data includes multiple symbols in the time domain. APPLE-1004, 15:35-38; APPLE-1013, [0152]. The multiple symbols are a positive integer number of multicarrier symbols. APPLE-1023, §5.1; APPLE-1003, ¶¶72-82.

A POSITA would therefore have found it obvious to combine Chen and Dahlman for implementing LTE's standardized use of an integer number of multicarrier symbols in Chen's method, because this was a well-known, standardized procedure, as taught by Dahlman. APPLE-1003, ¶¶72-82. A POSITA would have understood that LTE, as taught by Dahlman, simply provides additional details and explanation about how Chen's data message is generated and modulated in time and frequency domains, and, thus, would have found it obvious to look to the conventional procedure described in Dahlman to understand and implement the details not expressly described in Chen's method. *Id.*

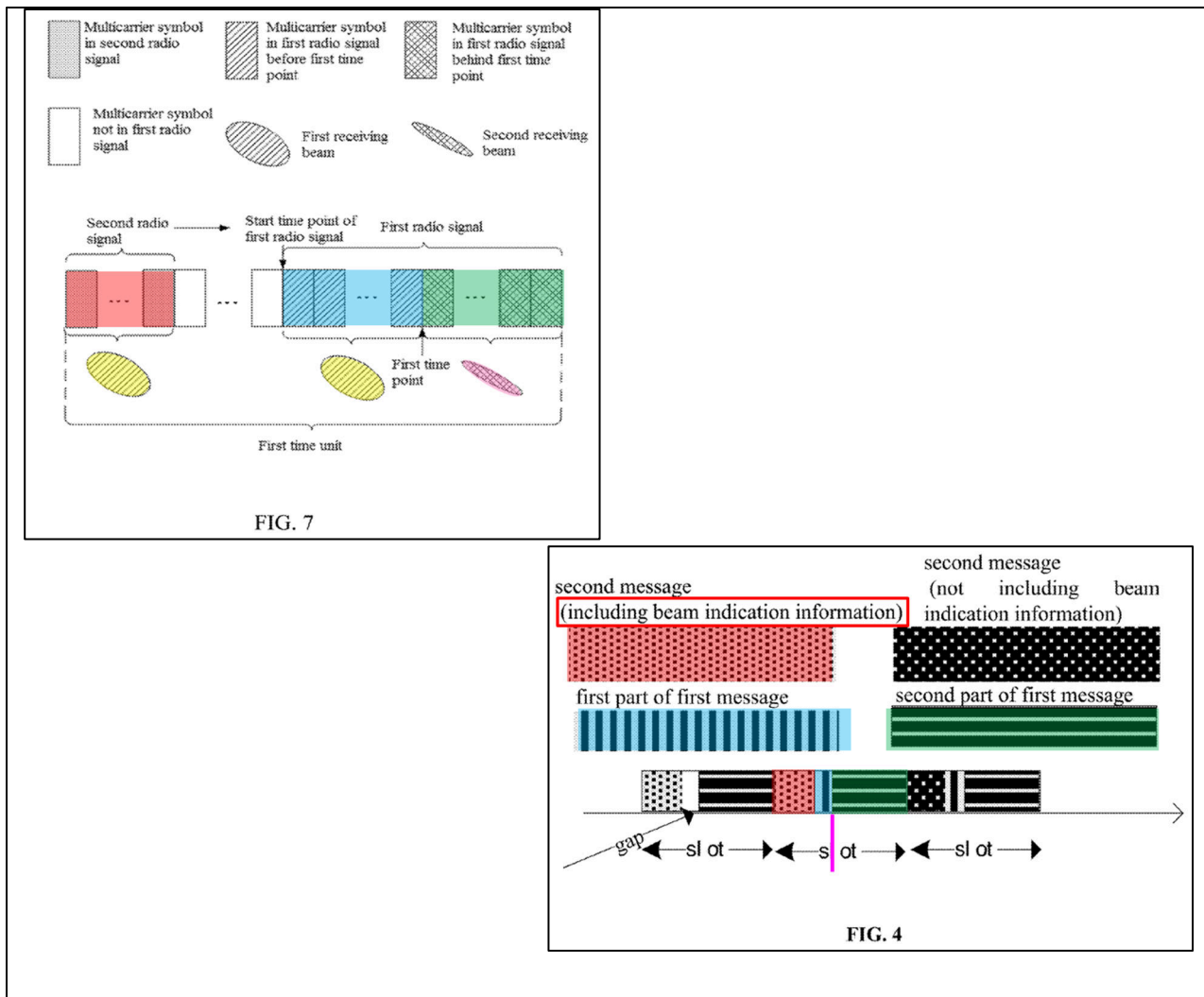
A POSITA would have been motivated to implement standardized resource allocation using integer (G) multicarrier symbols in Chen's method because of the

multicarrier symbol transmission methods, for example, increased bandwidth efficiency, increased speed, and low sensitivity to channel fading. APPLE-1003, ¶¶72-82. Thus, a POSITA would have been motivated to implement LTE's bit block and multicarrier symbols because of these well-known advantages provided by 3GPP's standardized techniques. *Id.*; *see KSR*, 550 U.S. at 417 (“[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 unless its actual application is beyond his or her skill.”), 421; *Uber*, 957 F.3d at 1338-41.

IV. THE '081 PATENT

A. The Prior Art Teaches the '081 Patent Claims

Viewed against this backdrop of the prior art, the '081 Patent describes methods and devices for wireless communications between a UE and a base station that use known procedures. APPLE-1003, ¶¶89-91. Just like Chen, the '081 Patent discloses switching a receiving beam during a transmission period between the UE and the base station. APPLE-1001, 17:16-18:29; APPLE-1003, ¶¶89-91. And just like Chen, the '081 Patent contemplates a transmission scheme in which the UE receives a second radio signal (e.g., **control information**) and a first radio signal (e.g., **user data**), as shown in annotated FIG. 7 below. APPLE-1001, 17:16-18:29; APPLE-1003, ¶¶89-91.



APPLE-1001, FIG. 7 (annotated); APPLE-1004, FIG. 4 (annotated)

APPLE-1003, ¶¶89-91.

Also, like Chen, the '081 Patent discloses a first receiving beam (depicted above as a “wide yellow oval”) used for receiving the **second radio signal** and **symbols of the first radio signal** before the **first time point**, and a second receiving beam (depicted above as “narrow pink oval”) used for receiving the **symbols of the first radio signal** behind (i.e., after) the **first time point**. APPLE-

1001, 17:65-67, 18:13-18.

As mentioned above, in Chen, the **second message** and the **first part** of the first message are decoded according to the same, default receiver parameter, but the **second part** of the first message is decoded based on the receiver parameter indicated by the **second message**.⁶ APPLE-1004, 15:64-16:3; APPLE-1013, [0155]-[0162]. And like the '081 Patent, Chen performs the beam selection at the symbol level. *Id.*, 15:35-38; APPLE-1013, [0152]; APPLE-1003, ¶¶89-91.

As explained in more detail below, nothing differentiates the claims of the '081 Patent from the prior art.

B. Prosecution History

The Examiner was not aware of the prior art applied in this Petition when the claims were allowed. Chen discloses the limitations the Applicant argued were

⁶ A POSITA reading Chen would have recognized the advantages of using a wide beam for receiving the control/scheduling information (second radio signal), which include the higher likelihood of reception of the beam parameter indication information, in addition to other control information. Likewise, a POSITA would have recognized that it would have made more sense to only switch to a narrow beam after receiving and decoding the second message, so that the receiver can correctly implement the appropriate beamforming. APPLE-1003, ¶¶92-93.

not in the prior art. Chen, in combination with standard 3GPP features, renders the claims obvious, and they should never have been allowed. APPLE-1003, ¶¶92-93.

C. IPR History

The '081 Patent was the subject of an instituted IPR trial (IPR2023-00599), which terminated after oral hearing when the parties settled. APPLE-1032. IPR2023-00599 involved Chen as an obviousness ground in combination with WO2017/083489 to Lee. *Id.* Chen is used in two obviousness grounds in this petition, the first in combination with the 3GPP standard, and the second in combination with Dahlman.

V. STATEMENT OF PRECISE RELIEF REQUESTED

A. Prior Art

Chen issued on June 15, 2021 and claims priority to Chinese Application No. 201710307962.5 filed May 4, 2017, is prior art to the '081 Patent under 35 U.S.C. §§ 102(a)(1)-(2). Chen is entitled to its priority application filing date of May 4, 2017. APPLE-1003, ¶¶56-62. Support in the Chinese priority application for each citation relied upon from Chen is set forth in the sections below, thus substantiating Chen's entitlement to its Chinese priority application filing date. *Id.*

Each of the 3GPP Release 14 Technical Specifications relied on in this petition were publicly available before the priority date of the '081 Patent:

Exhibit	Technical Specification	Date of Public Availability
---------	-------------------------	-----------------------------

APPLE-1024	3GPP TS 36.201 V14.1.0	2017-03-23
APPLE-1025	3GPP TS 36.211 V14.2.0	2017-03-23
APPLE-1026	3GPP TS 36.212 V14.2.0	2017-03-23
APPLE-1027	3GPP TS 36.213 V14.2.0	2017-03-23
APPLE-1028	3GPP TS 36.331 V14.2.2	2017-04-20

APPLE-1014, ¶¶20-24 (declaring the public availability of each of the TS documents above). Each 3GPP TS is prior art under 35 U.S.C. § 102(a)(1). A POSITA would have been imbued with the information contained within each of the 3GPP Technical Specifications. APPLE-1003, ¶¶50-53.

Dahlman has a copyright date of 2016 and was publicly available as of (at least) July 25, 2016. APPLE-1029, ¶9. Dahlman is prior art at least under 35 U.S.C. §102(a)(1).

B. Challenges

Ground	Challenged Claims	Basis	Prior Art
1	1-12	§ 103	Chen in view of 3GPP ⁷
2	1-12	§ 103	Chen in view of Dahlman

VI. LEVEL OF ORDINARY SKILL IN THE ART

⁷ 3GPP here refers to the combination of TS 36.201, 36.211, 36.212, and 36.213.

A person of ordinary skill in the art would have a bachelor's degree in electrical engineering, computer engineering, computer science, or a similar field, along with two years of experience designing or developing wireless networks, including multiple-input multiple-output (MIMO) technology. Additional education might substitute for some of the experience, and additional substantial experience might substitute for some of the educational background. APPLE-1003, ¶¶50-53. A POSITA would also have familiarity with the 3GPP LTE standards, and would have understood how to search through the available Technical Specifications for implementing RAN technologies. *Id.*

VII. THE CHALLENGED CLAIMS ARE UNPATENTABLE

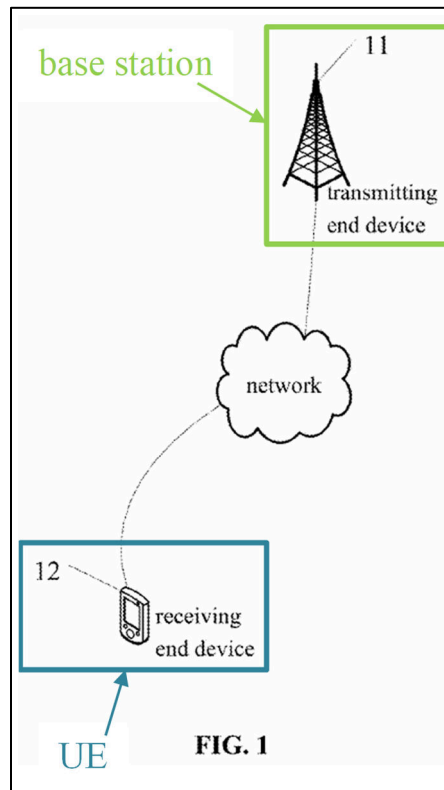
A. GROUND 1A – Chen in view of 3GPP renders claims 1-12 obvious

Generally, Chen discloses a UE that receives and uses a beam selection parameter for symbol-level determination of the beam selection to receive a radio signal. APPLE-1003, ¶¶56-62, 106. A POSITA would be well aware this was in the context of 3GPP cellular communications, and thus Chen at least implicitly discloses other claimed features, such as OFDM, channel coding, and DCI. *Id.* But to avoid any doubt, Ground 1A includes the express teachings 3GPP. Thus, the Chen/3GPP combination (Chen/3GPP) renders claims 1-12 obvious. *Id.*

1. Claim 1

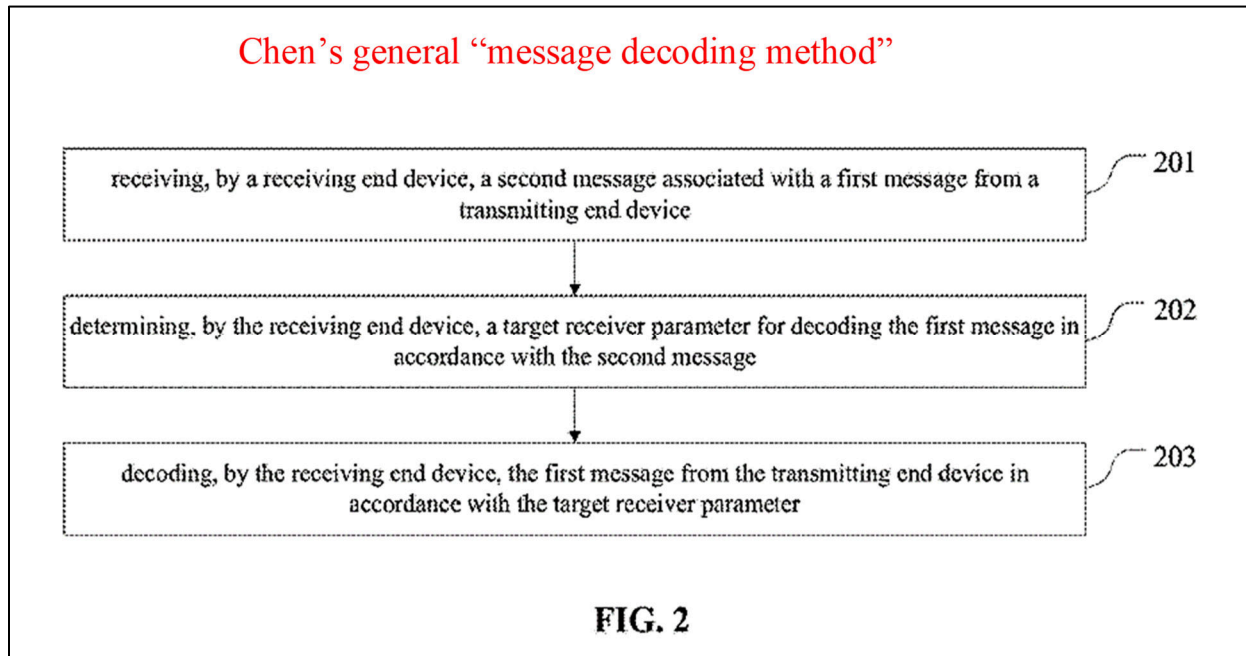
[1.pre]

To the extent the preamble is limiting, Chen/3GPP renders it obvious. APPLE-1003, ¶¶107-108. As shown in annotated FIG. 1 below, a wireless network includes a transmitting end device (base station) and a receiving end device (UE). APPLE-1004, 9:39-41; APPLE-1013, [0118]; *see also* APPLE-1004, 9:60-63; APPLE-1013, [0118] (explaining that the “terminal may be a User Equipment (UE)”). The base station can be an LTE eNB. APPLE-1004, 9:65-10:6; APPLE-1013, [0118].



APPLE-1004, FIG. 1 (annotated); APPLE-1013, FIG. 1.

The wireless communication method implemented by the UE includes “receiving a second message associated with a first message” from a base station, as shown in FIG 2 below. APPLE-1004, 10:10-19; APPLE-1013, [0120]-[0122].



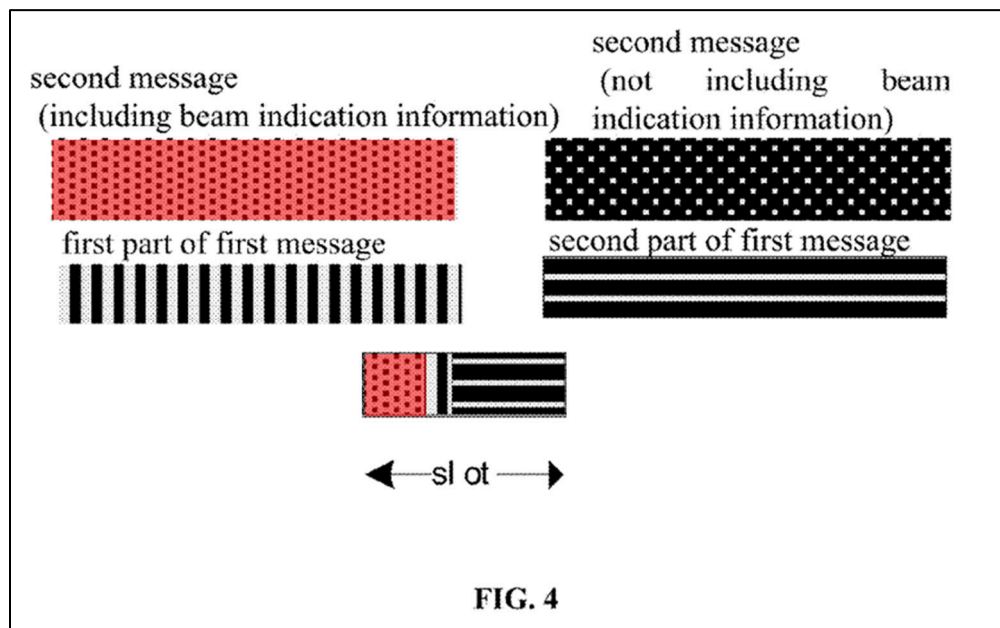
APPLE-1004, FIG. 2 (annotated); APPLE-1013, FIG. 2.

APPLE-1003, ¶¶107-108.

[1.a]

Chen/3GPP renders [1.a] obvious. The UE receives a **second message** (“**second radio signal**”) from the base station. APPLE-1004, 10:12-14, FIGS. 2, 4; APPLE-1013, [0120], [0123], FIGS. 2, 4, APPLE-1003, ¶¶109-112. A POSITA would have recognized that a message sent from a base station and received at a UE in a 3GPP-LTE RAN would have been a radio signal. APPLE-1003, ¶¶109-112.

Annotated FIG. 4 below illustrates three examples of time slots including messages transmitted from the base station to the UE. APPLE-1003, ¶¶109-112; APPLE-1004, 13:25-29, 15:64-16:3, FIG. 4; APPLE-1013, FIG. 4, [0150]-[0156]. In the indicated slot⁸ below, the UE receives a **second message** that may carry the beam indication information. APPLE-1004, 13:25-29, 15:64-16:3; APPLE-1013, [0151]-[0162]; APPLE-1003, ¶¶109-112.



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

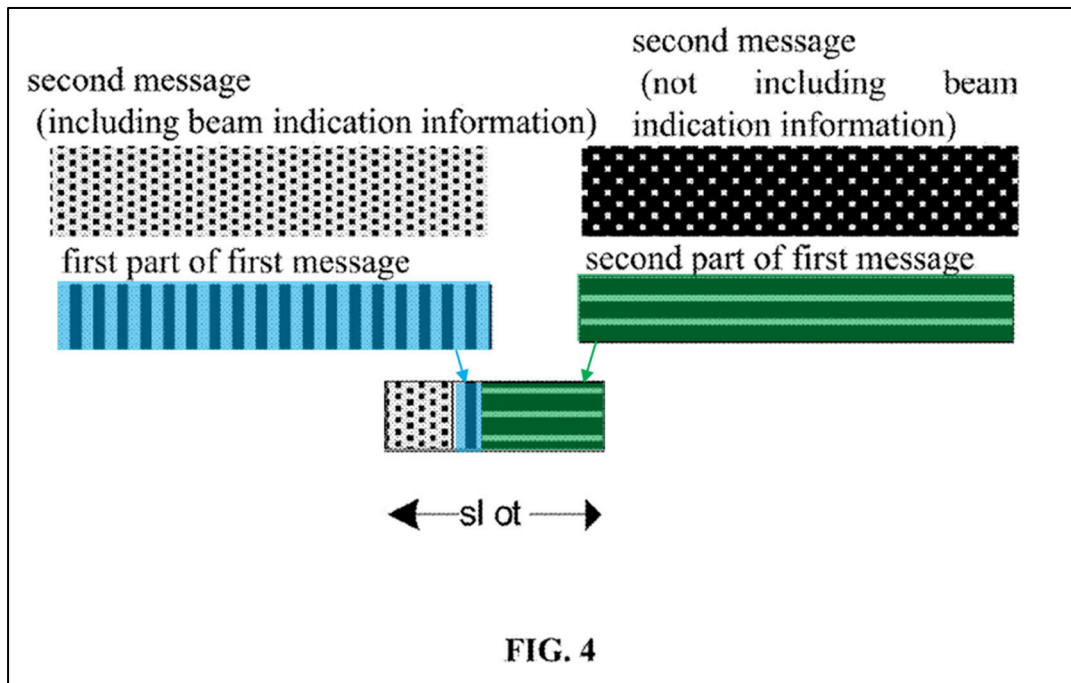
⁸ The second slot is the applicable slot from FIG. 4 because it includes both the **second message** including beam indication information AND the first message that includes a first part and second part. APPLE-1004, 13:25-29, 15:64-16:3; APPLE-1013, [0151]-[0168]; APPLE-1003, ¶¶109-112.

The **second message** “may be understood as a message for notifying a receiver of the [UE], e.g., a control message or a scheduling message.” APPLE-1004, 10:25-29, 14:65-15:2 (“describing that the second message carries “downlink scheduling information associated with the reception of the first message); APPLE-1013, [0123]. The **second message** “includes the parameter indication information,” which can be a beam indication. APPLE-1004, 10:48:57, 12:58-61, 15:64-65; APPLE-1013, [0124], [0126], [0128], [0140]; APPLE-1003, ¶¶109-112.

The second message (second radio signal) is transmitted by the base station and received by the UE before the first message (first radio signal). APPLE-1004:10-19, 12:28-31; APPLE-1013, [0123]-[0124], [0135]; APPLE-1003, ¶¶109-112.

[1.b]

Chen/Dahlman renders [1.b] obvious. As shown in FIG. 4 below, the UE receives a first message (“first radio signal”) from the base station. APPLE-1004, 10:20-22, FIGS. 2, 4; APPLE-1013, [0120], [0123], FIGS. 2, 4; APPLE-1003, ¶¶113-116.



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

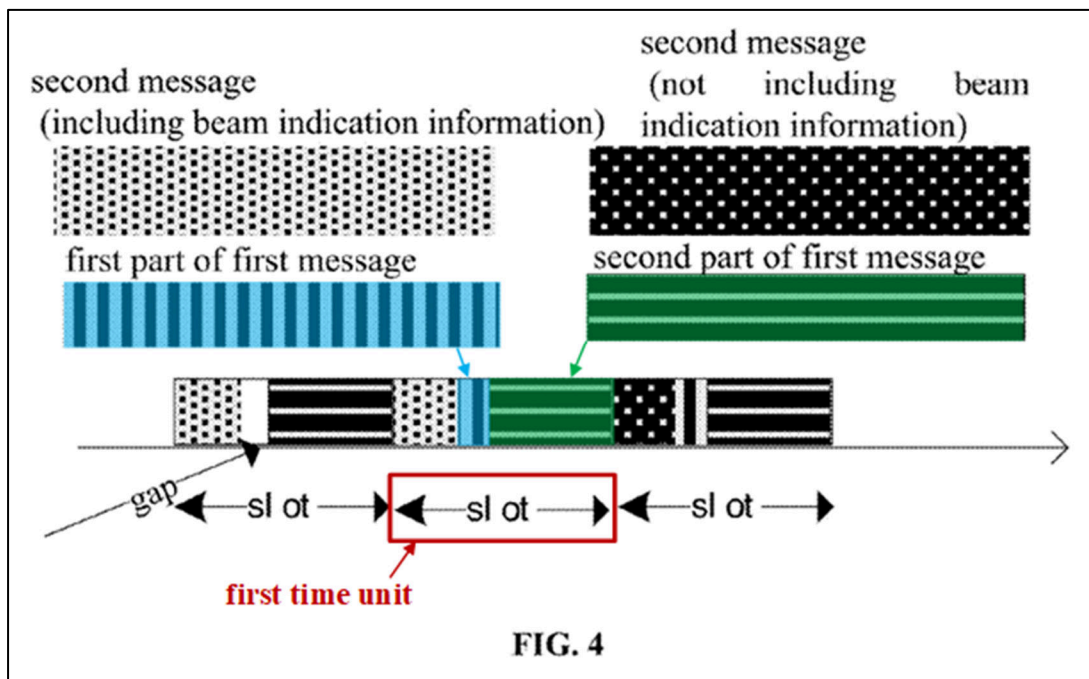
In FIG. 4, the UE receives a first message within the indicated slot. *Id.*; APPLE-1003, ¶¶113-116.

The first message may be a data message. APPLE-1004, 10:20-25; APPLE-1013, [0123]; APPLE-1003, ¶¶113-116. “[T]he first message includes the first part and the second part consecutive in the time domain,” where “because the first part content and the second part content belong to the same message, the receiving end device may execute symbol-level processing separately on the first part content and the second part content.” APPLE-1004, 14:57-60, 15:35-38; APPLE-1013, [0145], [0150], [0152]. In addition, “[t]he first part of the first message may be located immediately after the second message, i.e., there is no gap between the

first part and the second message, and the second part of the first message may be located immediately after the first part.” APPLE-1004, 15:29-34; APPLE-1013, [0151]. Thus, Chen’s first message constitutes the claimed “first radio signal.” APPLE-1003, ¶¶113-116.

[1.c]

Chen/3GPP renders [1.c] obvious. The ’081 Patent states that the “first time unit” can be “a time slot.” APPLE-1001, 2:27. And as shown in annotated FIG. 4, the first message (“first radio signal”) is transmitted within a slot (“**first time unit**”). APPLE-1004, FIG. 4; APPLE-1013, FIG. 4; APPLE-1003, ¶¶117-116.



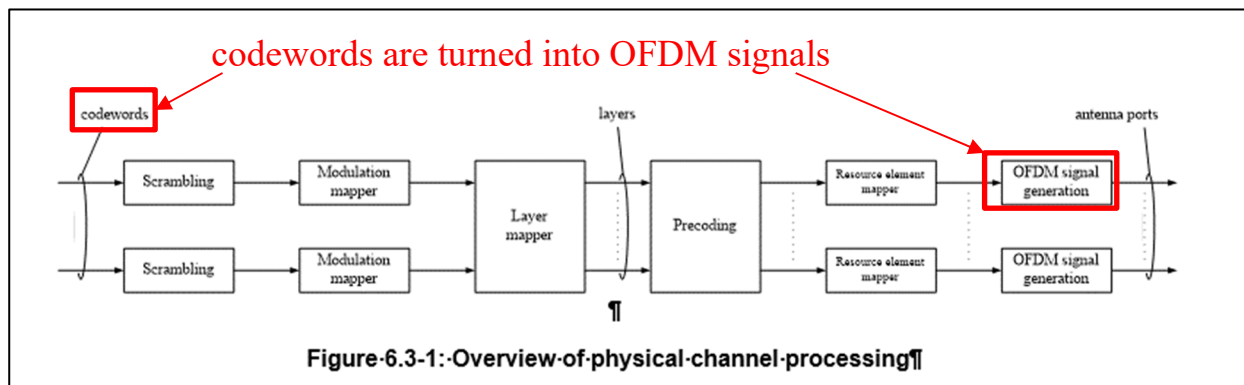
APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

APPLE-1003, ¶¶117-116.

[1.d]

Chen/3GPP renders [1.d] obvious. APPLE-1003, ¶¶119-123. Chen focuses on using beam reception parameters in control information for symbol-level beam switching for receiving data on PDSCH. *E.g.*, APPLE-1004, FIG. 4 and accompanying text; APPLE-1003, ¶¶119-123. Accordingly, Chen is silent as to the basics of how radio signals are constructed. APPLE-1003, ¶¶119-123. A POSITA would have found it obvious in view of the 3GPP standard for a first bit block to be used for generating the first message of Chen. APPLE-1003, ¶¶119-123.

For example, 3GPP provides a “General structure for downlink physical channels.” APPLE-1025, §6.3. The physical channel processing is shown schematically below:



APPLE-1025, FIG. 6.3-1 (annotated)

The physical layer processing of codewords includes scrambling, modulation, layer mapping, precoding, and mapping to resource elements for

OFDM signal generation. *Id.* For example, for each codeword q , “the **block of bits** $b^{(q)}(0), \dots, b^{(q)}(M_{\text{bit}}^{(q)} - 1)$, where $M_{\text{bit}}^{(q)}$ is the number of bits in codeword q **transmitted on the physical channel in one subframe**, shall be scrambled prior to modulation, resulting in a **block of scrambled bits**.” APPLE-1025, §6.3.1 (emphasis added). “For each codeword q , the **block of scrambled bits** ...shall be modulated,” which results in “a block of complex-valued modulation symbols.” APPLE-1025, §6.3.2 (emphasis added); APPLE-1003, ¶¶119-123.

“For each of the antenna ports used for transmission of the physical channel, the block of complex-valued symbols” are mapped “to resource elements (k,l) ,” where k is the frequency domain index and l is the time domain index. APPLE-1025, §§6.2.2, 6.3.5. Thus, in 3GPP, radio signals (including the claimed first radio signal) are formed from a block of bits (first bit block). APPLE-1003, ¶¶119-123.

A POSITA reading Chen would have found it obvious to apply the standardized techniques described in 3GPP TS 36.211 for creating a radio signal from a bit block to form the first message of Chen. APPLE-1003, ¶¶119-123. Chen unequivocally states that the base station may be an LTE eNB that communicates with a UE, such as a mobile phone. APPLE-1004, 9:60-67; APPLE-1013, [0118]. Thus, a POSITA implementing the beam switching features

of Chen would have found it obvious to turn to the standardized techniques described by 3GPP TS 36.211 to create the first message (first radio signal). APPLE-1003, ¶¶119-123. A POSITA would have had a reasonable expectation of success implementing the standardized techniques because such techniques were well-known, established techniques for creating radio signals in LTE. APPLE-1003, ¶¶119-123.

[1.e], [1.l]

Chen/3GPP renders [1.e] and [1.l] obvious. APPLE-1003, ¶¶124-131. Radio signals comprise G multicarrier symbols, where G is a positive integer. As described by 3GPP, a physical resource block is defined as N_{symb}^{DL} consecutive OFDM symbols in the time domain and N_{sc}^{RB} consecutive subcarriers in the frequency domain, where N_{symb}^{DL} and N_{sc}^{RB} are given by Table 6.2.3-1:

Table 6.2.3-1: Physical resource blocks parameters

Configuration		N_{sc}^{RB}	N_{symb}^{DL}
Normal cyclic prefix	$\Delta f = 15$ kHz	12	7
	$\Delta f = 15$ kHz		6
Extended cyclic prefix	$\Delta f = 7.5$ kHz	24	3
	$\Delta f = 1.25$ kHz	144	1

“G” symbols, where G is a positive integer

Multiple subcarriers for each of G symbols

APPLE-1025, §6.2.3. As can be seen, the number of symbols N_{sym}^{DL} is a positive integer selected from the set {1, 3, 6, 7} depending on the cyclic prefix and subcarrier spacing (Δf). APPLE-1003, ¶¶124-131.

Indeed, it was well known to a POSITA that LTE base stations use multicarrier symbols, e.g., OFDM symbols, to support communications for different carriers. APPLE-1003, ¶¶124-131 (citing APPLE-1025 (TS 36.211), 59-62; citing APPLE-1026 (TS 36.212), 87; APPLE-1006 (TR-25.892), 18). For example, as discussed above in Section III.C, *supra*, 3GPP discloses an OFDM resource grid that includes a positive integer number of OFDM symbols for each subcarrier in a data message. APPLE-1024, §4.2.1; APPLE-1025 §6.2; APPLE-1003, ¶¶124-131.

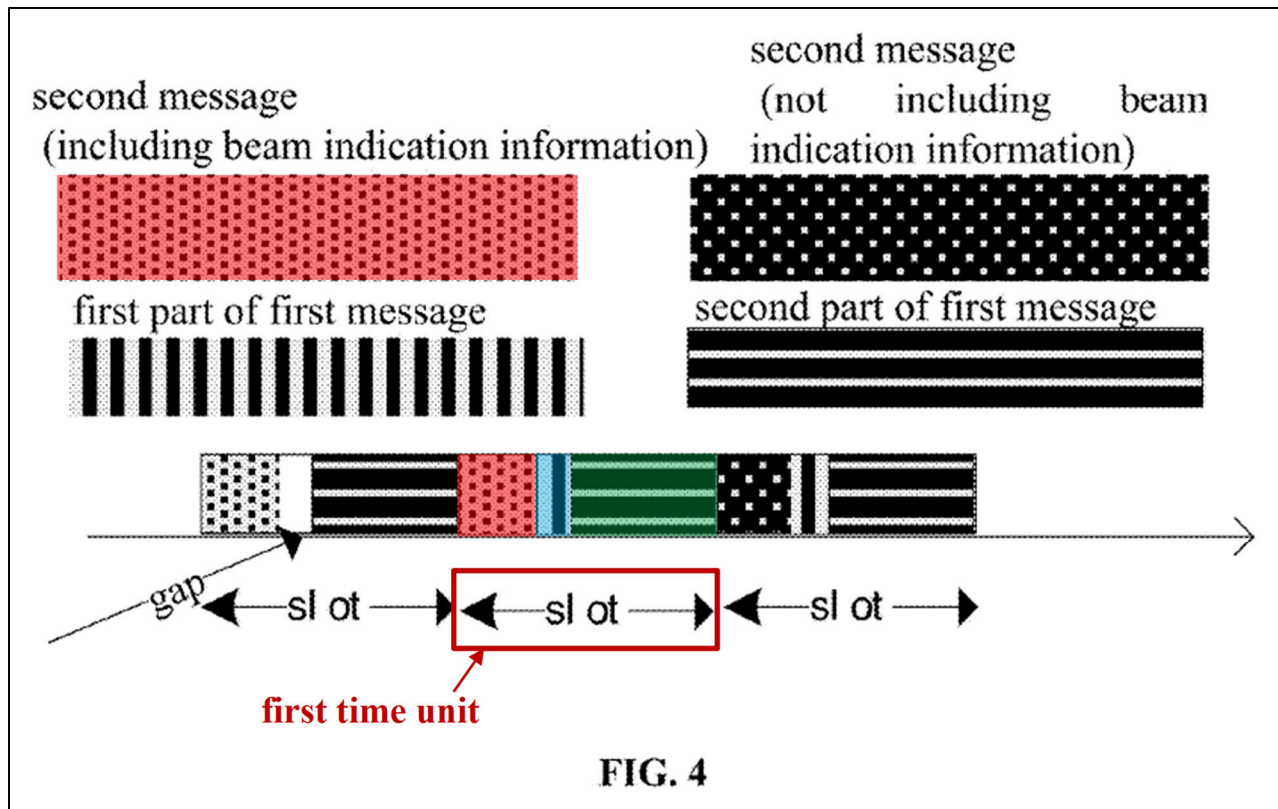
As discussed above, Chen's focus is on using beam reception parameter in control information for symbol-level switching of a beam parameter. *E.g.*, APPLE-1004, FIG. 4 and accompanying text; APPLE-1013, FIG. 4 and accompanying text; APPLE-1003, ¶¶124-131. Accordingly, Chen is silent as to the basics of how bits are mapped to resource elements for transmitting radio signals from the base station. APPLE-1003, ¶¶124-131. A POSITA reading Chen, however, would have found it obvious to apply the standardized techniques described in 3GPP TS 36.211 for mapping resource elements to bits to transmit radio signal of Chen. *E.g.*, APPLE-1025, §6.3.5; APPLE-1003, ¶¶124-131. Chen

unequivocally states that the base station may be an LTE eNB that communicates with a UE, such as a mobile phone. APPLE-1004, 9:60-67; APPLE-1013, [0118]. Chen discloses that the base station transmits control and data messages to the UE within a single time slot in accordance with LTE. *See, e.g.*, APPLE-1004, 9:63-10:3, 13:25-29, 15:64-16:3, FIG. 4; APPLE-1013, [0118], [0144], [0155], FIG. 4. Chen and 3GPP disclose that the data includes multiple symbols in the time domain. APPLE-1004, 15:35-38; APPLE-1013, [0152]. 3GPP discloses that the multiple symbols are a positive integer number of multicarrier symbols, as discussed above. Thus, a POSITA implementing the beam switching features of Chen would have found it obvious to turn to the standardized techniques described by 3GPP to form and transmit the first message (first radio signal) using an integer number of multicarrier symbols, where each symbol is linked to a set of different subchannels, because this was a well-known, conventional procedure, as taught by the 3GPP standard. *E.g.*, APPLE-1025, §6.3.5; APPLE-1003, ¶¶124-131. A POSITA would have understood that 3GPP simply provides additional details and explanation about how Chen's data message is generated and modulated in time and frequency domains, and, thus, would have found it obvious to look to the conventional procedure described in 3GPP to understand and implement the details not expressly described in Chen's method. APPLE-1003, ¶¶124-131.

A POSITA would have further been motivated to implement standardized resource allocation using integer (G) multicarrier symbols in Chen’s method because of the multicarrier symbol transmission methods, for example, increased bandwidth efficiency, increased speed, and low sensitivity to channel fading. APPLE-1003, ¶¶124-131. Thus, a POSITA would have been motivated to implement 3GPP’s bit block and multicarrier symbols because of these well-known advantages provided by 3GPP’s standardized techniques. *Id.*; see *KSR*, 550 U.S. at 417 (“[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 unless its actual application is beyond his or her skill.”), 421; *Uber*, 957 F.3d at 1338-41. A POSITA would have also had a reasonable expectation of success implementing the standardized techniques because such techniques were well-known, established techniques for creating radio signals in LTE. APPLE-1003, ¶¶124-131.

[1.f]

As shown in annotated FIG. 4 below, Chen’s **second message** (“second radio signal”) is transmitted within the same slot (“**first time unit**”) as the first message (“first radio signal”). APPLE-1004, FIG. 4; APPLE-1013, FIG. 4; APPLE-1003, ¶132.



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

[1.g]

Chen/3GPP renders [1.g] obvious. APPLE-1003, ¶¶133-136. For example, in the combination, Chen discloses that “[t]he **second message** may be understood as a message for notifying a receiver of the receiving end device, e.g., a **control message** or a **scheduling message**.” APPLE-1004, 10:25-29; APPLE-1013, [0123]. Chen also describes the second message as “carrying downlink scheduling information associated with the reception of the first message.” *Id.*, 14:66-15:1; APPLE-1003, ¶¶133-136.

Also in the combination, 3GPP describes that for PDSCH transmissions, the resource allocation is indicated by DCI communicated on the PDCCH. APPLE-1027, §7.1.6; APPLE-1025, §§6.3-6.4; APPLE-1026, §§4.2, 5.3.3. The starting OFDM symbols for the PDSCH is given by index $l_{DataStart}$, which is indicated by DCI in PDCCH. APPLE-1027, §7.1.6.4. The total number of symbols for each slot is known from a resource allocation field depending on the PDCCH DCI format. APPLE-1027, §7.1.6. Specifically, a “resource allocation field in each [PDCCH] includes two parts, a resource allocation header field and information consisting of the actual resource block assignment.” *Id.* With the starting position of PDSCH and the total number of resource elements per slot, a POSITA would have understood that the UE knows the symbol position for each time domain resource for the message received on PDSCH. APPLE-1003, ¶¶133-136.

Given that Chen’s base station is an LTE eNB (APPLE-1004, 9:65-10:3, APPLE-1013, [0118]), a POSITA would have understood and found it obvious for Chen’s control message and/or scheduling message to include downlink control information indicating a time-domain resource occupied by each of the G multicarrier symbols in the received data message (“first message”). APPLE-1003, ¶¶133-136. A POSITA implementing Chen’s control message or scheduling message would have found it obvious to use standardized techniques described by 3GPP for conveying resource allocation information for receiving and decoding a

data message in the PDSCH of the same slot. *Id.* A POSITA would have had a reasonable expectation of success applying the standardized techniques of 3GPP in Chen because Chen uses an LTE eNB base station and the downlink control information included in control messages and scheduling messages were well-known techniques at that time. *Id.*

It was well known that a control message provides, among other things, scheduling information and time-domain resource information for determining the time-domain resource of symbols in data transmission schemes such as Chen's. APPLE-1003, ¶¶133-136. Further, as discussed for claim [1e], Chen's method includes G multicarrier symbols, as taught by 3GPP. *Id.* Thus, the control message in Chen's method is "used for determining a time-domain resource occupied by the G multicarrier symbols." *Id.*

[1.h]

In the combination, Chen/3GPP renders element [1.h] obvious. APPLE-1003, ¶¶137-155. Relevantly, in 3GPP communications, a base station transmits messages over the air using radio frequency beams emitted from one or more antennas. APPLE-1004, 1:27-41; APPLE-1013, [0002]; APPLE-1023, §3.1.4, 3.4; APPLE-1003, ¶¶137-155. These beams can have different configurations, which may impact various characteristics of the communication between the base station and UEs. APPLE-1004, 1:27-41; APPLE-1013, [0002]; APPLE-1023, §3.1.4, 3.4;

APPLE-1003, ¶¶137-155. For example, a wider beam serves a correspondingly wider geographic area, but the wider distribution of available transmit power yields a relative decrease in beam power and a corresponding decrease in the quality of the resulting transmission signal. APPLE-1004, 1:27-41; APPLE-1013, [0002]; APPLE-1023, §3.1.4, 3.4; APPLE-1003, ¶¶137-155. By contrast, a narrower beam focuses the available transmit power to yield a relatively high quality signal across a narrower geographic area and thus less coverage. APPLE-1004, 1:27-41; APPLE-1013, [0002]; APPLE-1023, §3.1.4, 3.4; APPLE-1003, ¶¶137-155.

When a base station changes the transmit beam characteristics (e.g., if addressing a need for improved quality by focusing transmit power, or if addressing a need for wider geographic coverage), according to Chen, the base station can transmit the changed beam configurations, to enable UEs to make corresponding changes to maintain alignment with base station transmission, thus improving receiver/decoding accuracy. *E.g.*, APPLE-1004, 10:30-11:9; 15:64-16:3; APPLE-1013, [0124]-[0125], [0137]-[0144], [0155]; APPLE-1003, ¶¶137-155. Chen explains that base stations can add an indication of the new beam parameter into the control portion of a transmitted message. APPLE-1004, 10:30-11:9; 15:64-16:3; APPLE-[0124]-[0125], [0137]-[0144], [0155]; APPLE-1003, ¶¶137-155. After receiving and decoding the control information, UEs can then switch the beam parameter to align with the indicated parameter, to enable more

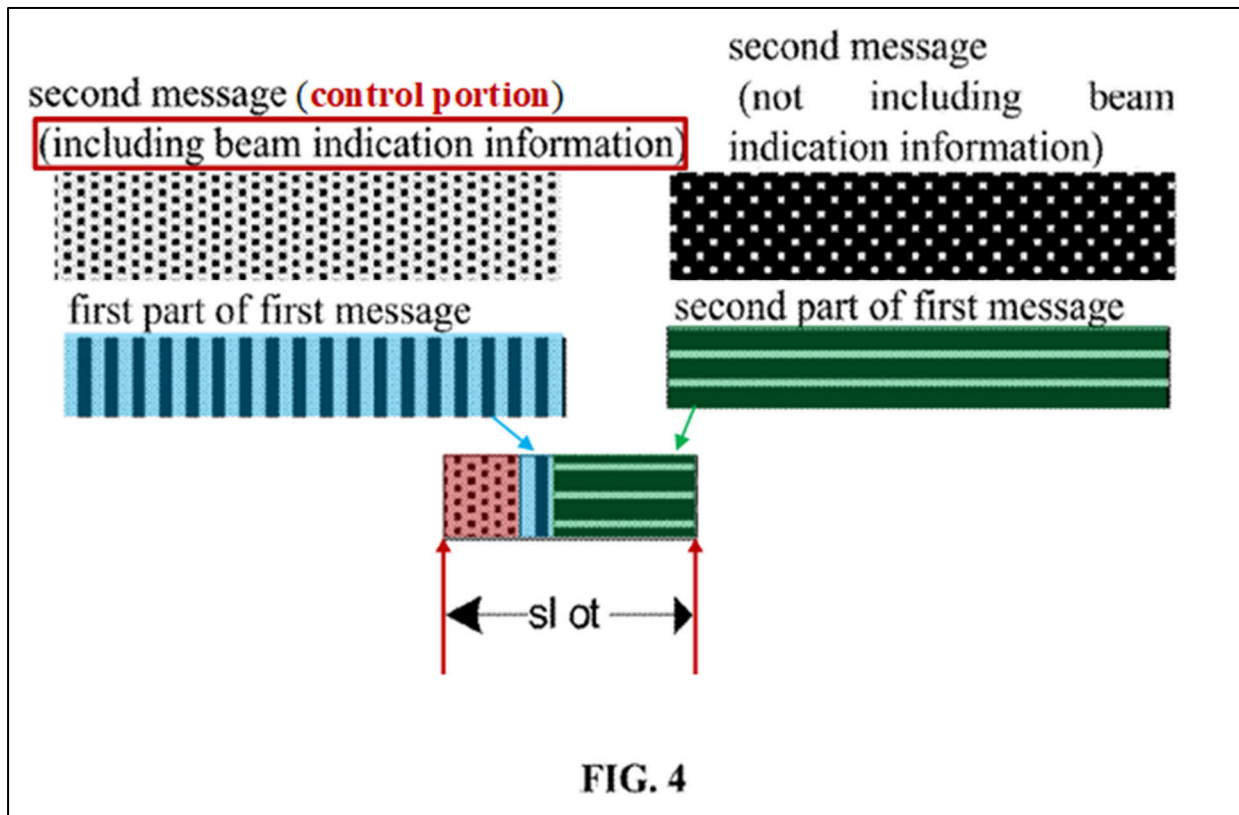
accurate receipt/decoding of data thereafter received from the transmitting base station. APPLE-1004, 10:30-11:9; 15:64-16:3; APPLE-[0124]-[0125], [0137]-[0144], [0155]; APPLE-1003, ¶¶137-155.

However, Chen recognizes that during UE processing/decoding of new beam parameters, the UE continues to receive transmissions and thus data that is transmitted using the new beam. APPLE-1004, 14:31-47, FIG. 4; APPLE-1013, [0145]-[0155], FIG.4; APPLE-1003, ¶¶137-155. This stands to reason since, to fully utilize available bandwidth, communications are not stalled. APPLE-1003, ¶¶137-155. And yet, this results in data being received before the UE has fully decoded the control portion, and thus data being received before the UE can identify much less reconfigure itself to align with a new beam configuration profile used to send the implicated data. APPLE-1004, 14:31-47, FIG. 4; APPLE-1013, [0145]-[0155], FIG.4; APPLE-1003, ¶¶137-155. Indeed, Chen acknowledges instances when at least some of the data portion is received using the original beam, and the remainder of the data portion is received using the new beam, despite both following receipt of a control portion indicating parameters for the new beam. APPLE-1004, 14:31-47, FIG. 4; APPLE-1013, [0145]-[0155], FIG.4; APPLE-1003, ¶¶137-155.

The consequence is clear – less accuracy by the UE until it has decoded the control portion to identify the new reception beam parameters and updated itself to

receive/decode accounting for the new reception beam characteristics. APPLE-1003, ¶¶137-155. While some time is necessary for the UE to decode the relevant control portion, more rapid adoption by the UE of new reception beam characteristics thereafter leads desirably to more accuracy. *Id.*

As discussed elsewhere in this Petition, 3GPP messages are transmitted using frequency-domain and time-domain resources. *See, e.g., supra* §VII.A.1.[1.e],[1.l]. A symbol is the smallest granularity for a time-domain resource in 3GPP; and an integer number of symbols makes up one “slot.” APPLE-01025, §6.2.1 (describing that one downlink slot is defined as N_{symb}^{DL} consecutive symbols in the time domain); APPLE-1003, ¶¶137-155. Chen offers FIG. 4, annotated below, to describe how the above beam switching process is achieved during one slot:



APPLE-1004, FIG. 4 (annotated)

The annotations to FIG. 4 above highlight Chen's use of a default beam parameter for decoding the control portion (red) and data portion symbols received while the UE is decoding the control portion (blue). APPLE-1004, 15:64-16:47; APPLE-1013, [0155]; APPLE-1003, ¶¶137-155. The annotation also highlights Chen's use of a second beam parameter for decoding data portion symbols received after the UE decodes the control portion and applies the beam parameter indicated in the therein (green). APPLE-1004, 15:64-16:47; APPLE-1013, [0155]; APPLE-1003, ¶¶137-155.

Also, by way of background, while a portion of a 3GPP message carries data, another portion carries control/scheduling information. *E.g.*, APPLE-1004, 10:20-29; APPLE-1013, [0123]. Chen and the '081 Patent each identify these portions, but they use different terms:

	Portion with data	Portion with Control Information
Chen	First message	Second message
'081 Patent	First radio signal	Second radio signal

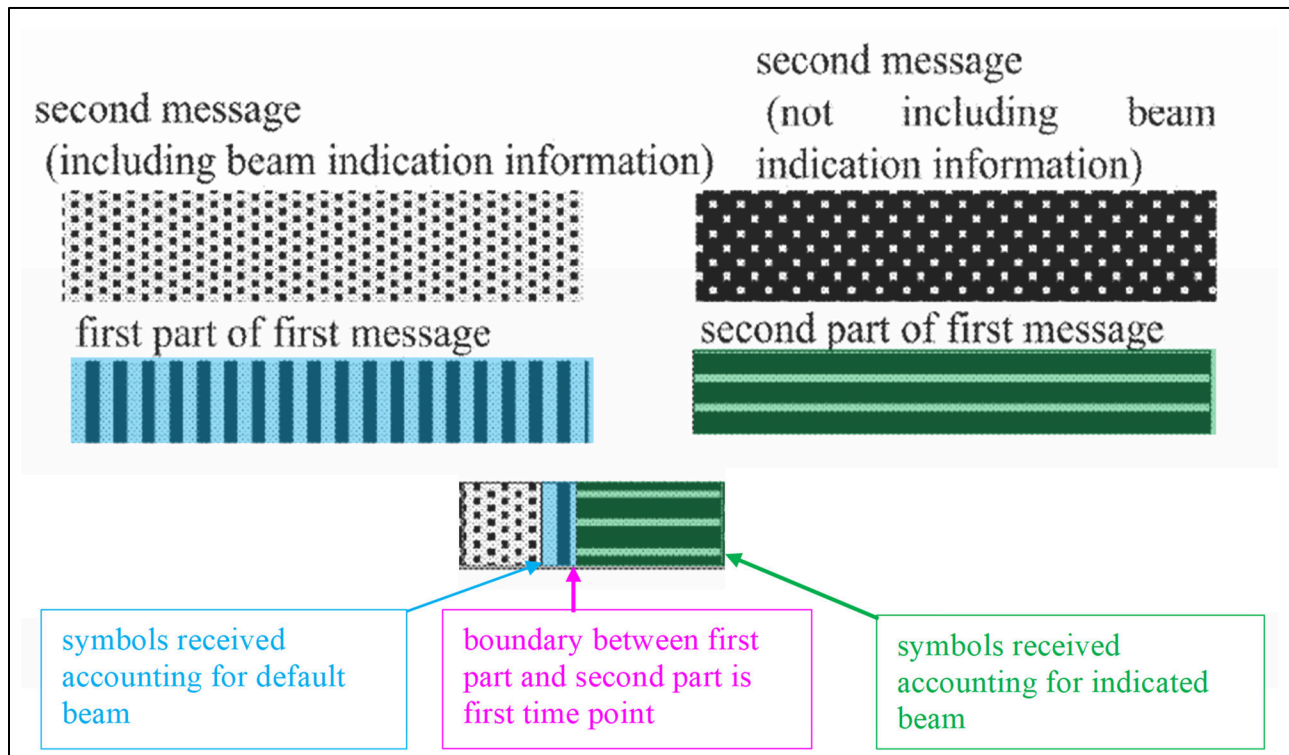
In both the '081 Patent and Chen, data portion has first and second parts, which are consecutive in the time-domain, such that each part is composed of symbols within the same slot. *E.g.*, APPLE-1001, 2:27-28, FIG. 7; APPLE-1004, 14:31-34, FIG. 4; APPLE-1013, [0123], [0145], FIG. 4. Also, with the first part and the second part of the data portion being part of the same message, the UE can perform “symbol-level processing” on each of the first part and the second part. APPLE-1004, 15:35-37; APPLE-1013, [0152]; APPLE-1003, ¶¶137-155.

Returning to the elements of [1.h]:

- (a) **as for any one given multicarrier symbol of the G multicarrier symbols, the ... receiving for the given multicarrier symbol is related to the relative position of a time-domain resource occupied by the given multicarrier symbol with respect to a first time point in time domain**

As noted above, each symbol that makes up a first part of the data portion

(i.e., “first message” in Chen) is received and decoded accounting for a legacy/default beam that was earlier applied to decode the immediately-preceding control portion of the message within its slot. APPLE-1004, 15:64-16:47, FIG. 4; APPLE-1013, [0155], FIG. 4; APPLE-1003, ¶¶137-155. And each symbol that makes up a second part of the data portion is received accounting for the indicated reception beam parameter, which is indicated by the control portion (i.e., “second message” in Chen). APPLE-1004, 15:64-16:47, FIG. 4; APPLE-1013, [0155], FIG. 4; APPLE-1003, ¶¶137-155. Chen’s transition, a UE change from accounting for the default (or currently used) beam to instead accounting for the updated beam, occurs after receiving the last symbol of the first part of the data portion. APPLE-1004, 15:64-16:47, FIG. 4; APPLE-1013, [0155], FIG. 4; APPLE-1003, ¶¶137-155. The transition point between the last symbol of the first part and the first symbol of the second part is the claimed as the “first time point.” APPLE-1003, ¶¶137-155. And, the UE receives/decodes each symbol before the first time point by accounting for the default beam, and the UE instead receives/decodes each symbol after the first time point by accounting for the updated beam configuration. Thus, the receiving of each one of the G multicarrier symbols is related to the time domain resource that symbol occupies relative to (before or after) the first time point. This is shown in the annotation of FIG. 4, below:



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4

(b) the receiving is “multi-antenna related”

Chen’s UE is a multi-antenna system. APPLE-1004, 1:22-27, 10:66-11:4; APPLE-1013, [0002]; APPLE-1003, ¶¶137-155. Chen explains that the “communication device supports a multiple antenna system.” APPLE-1004, 1:22-41; APPLE-1013, [0002]. This multi-antenna system “supports multiple beams, and different beams may have different coverage ranges.” *Id.* Thus, Chen/3GPP describes or renders obvious multi-antenna receiving. APPLE-1003, ¶¶137-155.

(c) Switching Opportunities Can Be Dynamic or Preconfigured

Latencies are expected when receiving, decoding, and acting upon information received across the wireless link. APPLE-1003, ¶¶137-155.

Examples of latencies include delays for signal reception and buffering, delays for performing channel estimation and decoding (which depends on signal quality), and, if necessary, delays for satisfying acknowledgement requests and performing cyclic redundancy checks. *E.g.*, APPLE-1023, §§6.4, 8.1, 9.4; APPLE-1021, 8-9; APPLE-1003, ¶¶137-155. The latencies associated with decoding the received control information can vary depending on the circumstances, and based on network configurations such as UE configuration/capability, channel conditions and scheduler configurations. *E.g.*, APPLE-1023, §§6.4, 8.1, 9.4; APPLE-1021, 8-9; APPLE-1003, ¶¶137-155.

In addition, the way that the reception beam is indicated can contribute to delays. APPLE-1003, ¶¶137-155. For example, when the reception beam is indicated explicitly, the payload size of the control information increases, leading to increased UE decoding time. *Id.* Alternatively, the reception beam can be indicated implicitly, by sending information that enables the UE to identify the beam without express beam identification. *Id.* Last, the way the UE decodes the control information can also contribute to delays. For example, “blind decoding” can contribute to delays in implementing control information. *E.g.*, APPLE-1023, §§6.4, 8.1, 9.4; APPLE-1021, 8-9; APPLE-1003, ¶¶137-155.

It would have been obvious to a POSITA that Chen would be subject to many/all of the aforementioned factors, resulting in varying levels of delays in

decoding and implementing the reception beam indicated in the control portion.

APPLE-1003, ¶¶137-155. Indeed, Chen describes that when the second message (control portion) explicitly indicates the reception beam, the payload of the second message may be relatively larger than when it does not include that information.

APPLE-1004, 15:1-9; APPLE-1013, [0151]. The UE may or may not be provided with *a priori* information about the payload of the second message. *Id.* When the UE does is not provided with payload information, it decodes the second message in a “blind manner in accordance with different possible payloads.” APPLE-1004, 15:9-26, 16:48-63; APPLE-1013, [0151], [0163]. This blind decoding can involve multiple decoding attempts based on different presumptions of the size of the payload of the second message. APPLE-1004, 15:9-26; APPLE-1013, [0151]; APPLE-1003, ¶¶137-155.

Chen accounts for these delays by dividing the data portion into first and second parts that are consecutive in the time domain. *E.g.*, APPLE-1004, 15:9-26; APPLE-1013, [0145], [0150], [0158]. To decode the first part, the UE uses the default beam parameter (i.e., the same beam parameter used to decode the control portion). APPLE-1004, 15:64-66; APPLE-1013, [0155]. In this way, while decoding and before applying the indicated beam parameter, a Chen UE continues to process (receive and decode) transmitted data without interruption. Chen, 11:46-51 (recognizing the benefits of continuing to use the default parameters for

at least some of the data portion); Chen Priority, [0131]. And yet, once the UE decodes the control portion, it can decode the second part based on the indicated beam parameter. APPLE-1004, 15:66-16:3; APPLE-1013, [0155]; APPLE-1003, ¶¶137-155.

It would be obvious for the UE to apply the indicated beam parameter without delay, once decoded. APPLE-1003, ¶¶137-155. Doing so minimizes how much of the data portion (i.e., how many symbols of the first part) the UE decodes using the incorrect or outdated reception parameters. *Id.*; see also, APPLE-1021, 8-9.

In addition, decoding the first part using the default beam and applying the indicated beam dynamically to decode the second part, there would be no gap between the control portion and any of the data portion, thereby minimizing data loss and increasing system throughput. *E.g.*, APPLE-1021, 8-9; APPLE-1003, ¶¶137-155.

And performing the reception beam parameter switching dynamically promotes system flexibility, as it allows the UE to account for various sources of delay, and to increase switching opportunities when compared to a pre-configured switching time. *E.g.*, APPLE-1004, 12:3-5; APPLE-1013, [0133], [0174]; APPLE-1021, 8-9.

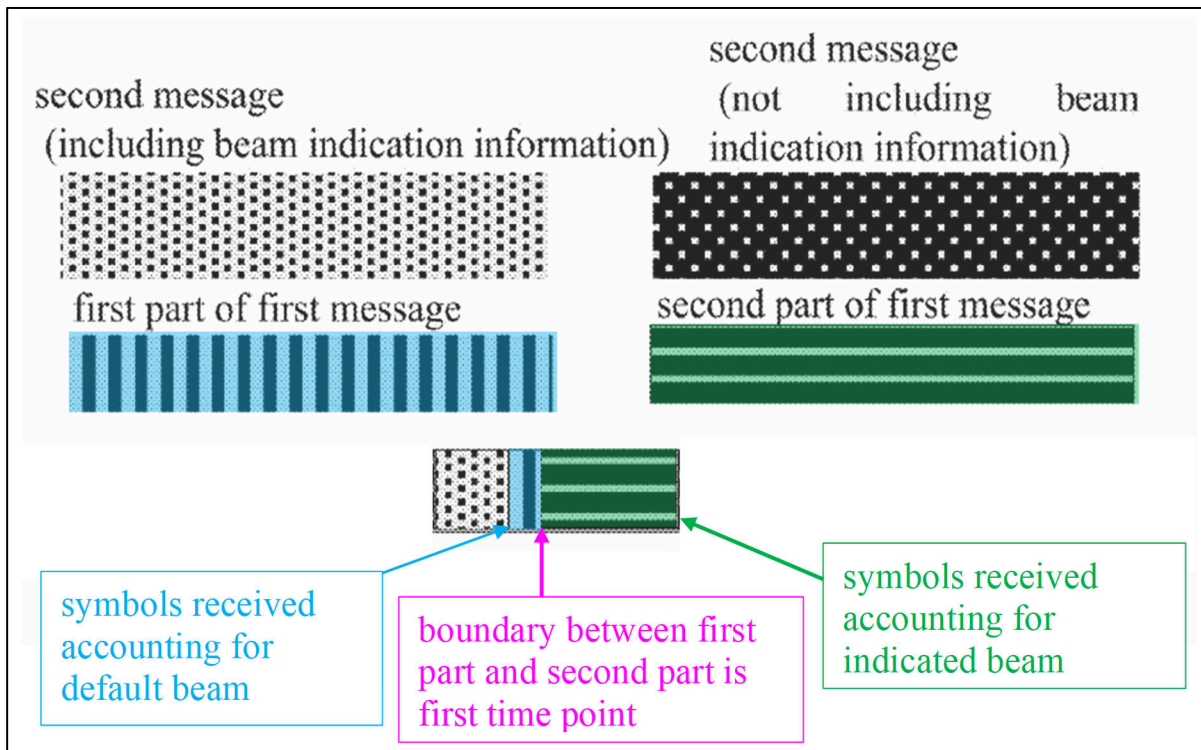
Alternatively, it would have also been obvious to a POSITA to indicate the

first time point for switching the beam parameter implicitly or explicitly using known techniques. APPLE-1003, ¶¶137-155. For example, Chen describes dividing the data portion into a first part and a second part. APPLE-1004, 15:1-34; APPLE-1013, [0145], [0150]. This division can be performed dynamically to account for variability in the delays, as discussed above; or the time point for switching can be predetermined to allow the UE to apply the indicated reception beam information after a predetermined number of symbols. *Id.*, *see also id.*, FIG. 4 and accompanying text; APPLE-1003, ¶¶137-155. For example, it was well known in LTE to use radio resource control (RRC) signaling to exchange information pertaining to the communication link, including UE capability information. APPLE-1028, §6.3.2. Likewise, it would have been obvious to include the first time point in the DCI in the second message (second radio signal) that also includes other information pertaining to downlink scheduling grant and size of the control region. APPLE-1021, 8-9; APPLE-1003, ¶¶137-155.

[1.i]

Chen/3GPP renders [1.i] obvious. APPLE-1003, ¶¶156-158. As discussed for claim [1h], Chen's method discloses that, when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the receiver parameter (e.g., reception beam) of the UE is switched based on the parameter indication information included in the **second message** ("**second radio**

signal”). APPLE-1004, 15:64-16:3 (when the second message includes the parameter indication information, the second part may be decoded in accordance with the target receiver parameter indicated by the parameter indication), 14:31-34 (the first part and a second part are consecutive in the time domain, and the first part may be located ahead of the second part); APPLE-1013, [0145], [0155]; APPLE-1003, ¶¶156-158. In particular, as shown in annotated FIG. 4 below, Chen discloses that when “the **second message** may include ... the parameter indication information,” where “the receiver parameter indicated by the parameter indication information may serve as the target receiver parameter.” APPLE-1004, 11:18-23; *see also id.*, 11:23-27, 11:52-55, 11:66-12:2 (the target receiver parameter includes the target reception beam indicated by the parameter indication information); APPLE-1013, [0124], [0128], [0132], [0143]. The “reception beam indicated by the parameter indication information may be a receiver parameter different from a receiver parameter currently used by the receiving end device, and **at this time**, it is necessary for the receiving end device to **switch** the receiver parameter.” APPLE-1004, 11:23-28, FIG. 4; APPLE-1013, [0128], FIG. 4:



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

APPLE-1003, ¶¶156-158.

Thus, in Chen, when the time-domain resource occupied by the given multicarrier symbol is behind the first time point, the second message (“second radio signal”) is used for determining the multi-antenna related receiving (e.g., the reception beam) for the given multicarrier symbol. APPLE-1003, ¶¶156-158.

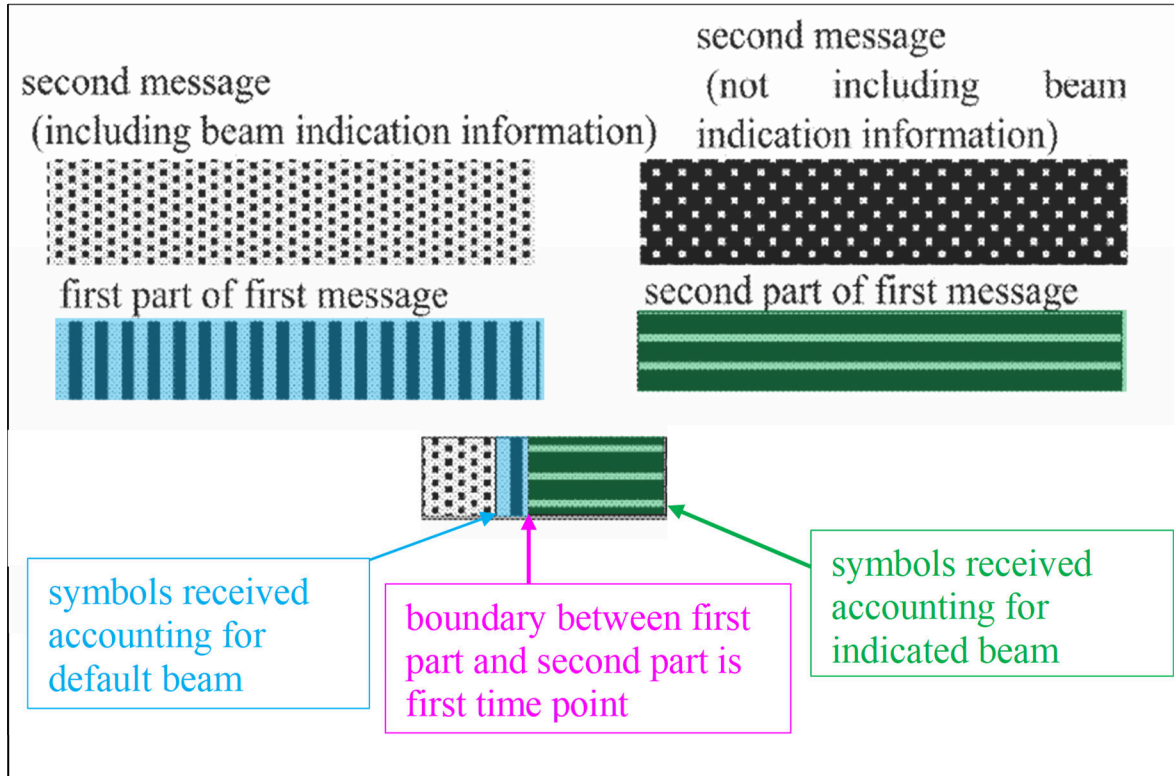
A POSITA would have understood that the given multicarrier symbol being “behind the first time point” means that the given multicarrier symbol occurs after the first time point. *See, supra*, §IV.B (discussing examiner’s application of prior art vis-à-vis before or behind first time point); APPLE-1003, ¶¶156-158. Put

simply, the claim uses the term “behind” and the term “before” to mean opposite directions in the time domain, where before is clearly earlier in time than the first time point. APPLE-1003, ¶¶156-158. Therefore, a POSITA would have recognized that the term “behind” means later in time than the first time point. In Chen, the first part of the first message is “before” the first time point, whereas the second part of the second message is behind or after the first time point. APPLE-1003, ¶¶156-158.

[1.j]

Chen/3GPP renders [1.j] obvious. APPLE-1003, ¶¶159-160. As also discussed for claim [1h], Chen’s method discloses that, when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the default receiver parameter that is used for transmitting the **second message** (“**second radio signal**”) is used for the given multicarrier symbol. APPLE-1004, 15:65-16:3 (first part may be decoded in accordance with default receiver parameter); APPLE-[0155]; APPLE-1003, ¶¶159-160. For example, Chen discloses that “the default receiver parameter may be just the receiver parameter currently used by the receiving end device.” APPLE-1004, 11:29-45; APPLE-1013, [0128]; APPLE-1003, ¶¶159-160. As shown in FIG. 4 below, the reception of the **second message** occurs immediately before the reception of the first

message. Thus, the “currently used” receiver parameter in Chen is the receiver parameter used for the second message. APPLE-1003, ¶¶159-160.



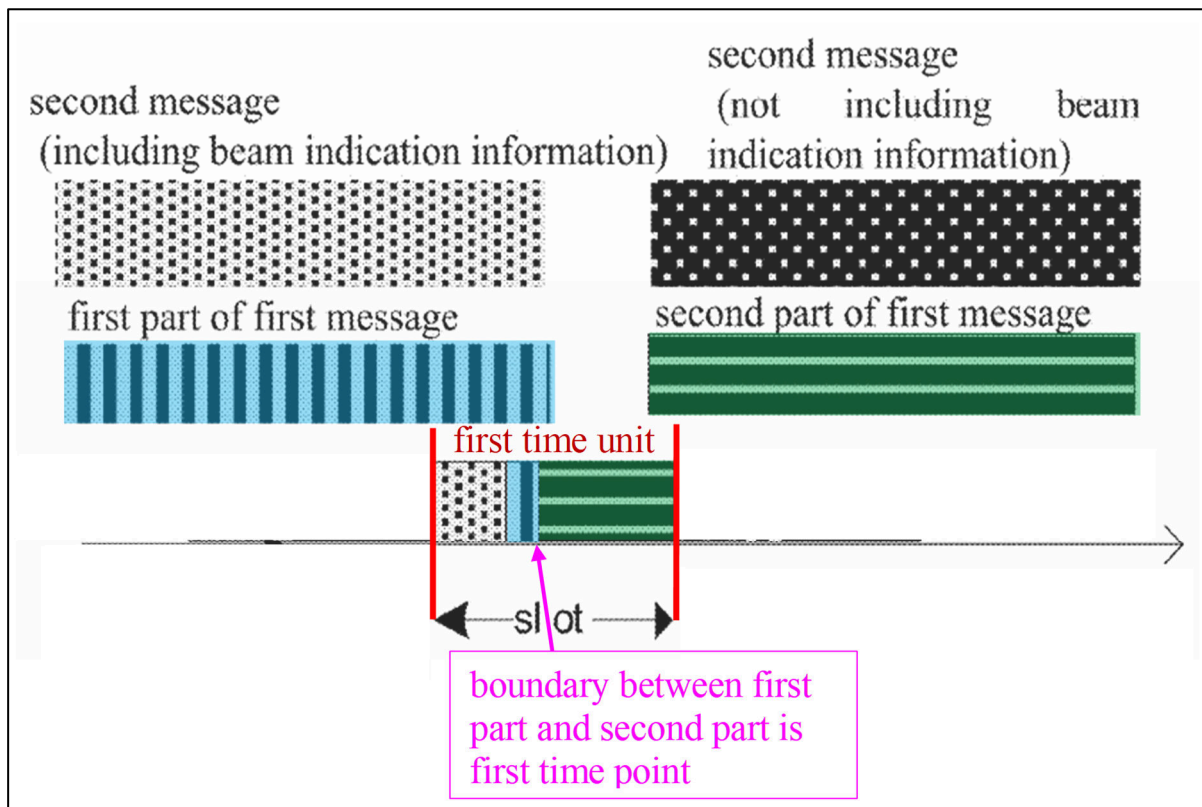
APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

APPLE-1003, ¶¶159-160.

Accordingly, in Chen, when the time-domain resource occupied by the given multicarrier symbol is before the first time point, the multi-antenna related receiving (e.g., the reception beam) for the given multicarrier symbol of the first message (“first radio signal”) is related to the multi-antenna related receiving for the **second message** (“**second radio signal**”). APPLE-1003, ¶¶159-160.

[1.k]⁹

Chen/3GPP renders [1.k] obvious. APPLE-1003, ¶¶161-162. As shown in annotated FIG. 4 below, the receiver parameter switching point (“**first time point**”) is one time point within the single slot (“**first time unit**”). *Id.*; see also APPLE-1004, 11:23-27 (“**at this time**, it is necessary for the receiving end device to **switch the receiver parameter**”); APPLE-1013, [0128].



APPLE-1004, FIG. 4 (annotated); APPLE-1013, FIG. 4.

Thus, Chen/3GPP renders claim 1 obvious. APPLE-1003, ¶¶161-162.

2. Claim 2

⁹ Limitation [1.l] is addressed above together with [1.e].

[2.a]

As discussed above, Chen/3GPP render claim 1 obvious. Further, Chen's UE receives "first information" from the base station that is used for determining the first time point. APPLE-1003, ¶¶163-166.

For example, as discussed above for claims [1h]-[1j], Chen discloses that the UE switches the receiver parameter (reception beam) to a target receiver parameter when the second message includes "parameter indication information."

Specifically, Chen discloses that a "reception beam indicated by the parameter indication information may be a receiver parameter different from the receiver parameter currently used by the receiving end device, and **at this time**, it is necessary for the receiving end device to **switch the receiver parameter**."

APPLE-1004, 11:23-27; APPLE-1013, [0128]. One specific example of "parameter indication information" disclosed by Chen is "beam indication information." APPLE-1004, FIG. 4; APPLE-1013, FIG. 4; APPLE-1003, ¶¶163-166.

Further, as discussed for claim [1g], Chen's control/scheduling message includes scheduling information and time/frequency information for the data message. APPLE-1003, ¶¶163-166.

The '081 Patent states that the claimed "first information" indicates "the first time point" either "explicitly" or "implicitly." APPLE-1001, 5:40-43. Thus, just

like the '081 Patent, a POSITA would have understood that Chen's parameter indication information (e.g., beam indication information), scheduling information, and time/frequency information constitutes the claimed "first information" used for determining the "first time point." APPLE-1004, 12:1-13, 2:7-17 (describing that the "reception beam may be flexibly indicated to the receiving end device in an explicit or implicit manner, so as to improve the system flexibility"); APPLE-1013, [0133], [0174]; APPLE-1003, ¶¶163-166.

[2.b]

Claim 2 includes an "or" between claim [2a] and [2b], so the above-discussed teachings of claim [2a] are sufficient to satisfy claim 2. *Brown*, 265 F.3d at 1351; APPLE-1003, ¶¶167-168.

Chen/3GPP renders [2.b] obvious. APPLE-1003, ¶¶167-168. 3GPP describes that the UE operating in transmission mode 10 receives PDSCH resource mapping parameters (third information) in the PDCCH (second radio signal) that the UE uses for "determining the PDSCH RE mapping ..., and for determining PDSCH antenna port quasi co-location." APPLE-1027 §7.1.9. A POSITA would have found it obvious to combine Chen's multi-antenna system with 3GPP's teachings of resource mapping parameters for determining antenna port quasi co-location to facilitate the reception of downlink messages using multiple antennas. APPLE-1003, ¶¶167-168; APPLE-1004, 1:22-41 (multi-antenna system); APPLE-

1013, [0002]. A POSITA would have recognized that the multi-antenna system of Chen would have operated in transmission mode 10. APPLE-1003, ¶¶167-168. A POSITA would have been motivated to turn to the 3GPP standard for implementation details pertaining to control message signaling for indicating antenna port quasi co-location. *Id.* A POSITA would have had a reasonable expectation of success applying the standardized techniques described in the 3GPP standard because the standard provides the required techniques for implementing LTE. *Id.*

3. Claim 3

[3]

Chen/3GPP renders Claim 3 obvious. APPLE-1003, ¶¶169-171. In Chen, “the parameter switching indication set may be acquired by the receiving end device, and then recommended to the transmitting end device.” APPLE-1004, 14:19-21, 12:25-28 (describing that “the receiving end device may at least transmit information about the recommended transmission beam, e.g., in the form of recommended RS resource, to the transmitting end device.”); APPLE-1013, [0144], [0135]. “The transmitting end device may use the parameter switching indication set recommended by the receiving end device” *Id.*, 14:21-30; APPLE-1013, [0144]. A POSITA would have found it obvious that the receiving device would then receive the parameter switching indication in a second message,

decode it, and implement it at the first time point for switching the beam for receiving the second part of the first message. APPLE-1003, ¶¶169-171.

Also, 3GPP describes radio resource control (RRC) information elements (IE) pertaining to PDSCH configuration. Specifically, 3GPP teaches the *PDSCH-RE-MappingQCL-ConfigId* IE “is used to identify a set of PDSCH parameters related to resource element mapping and quasi co-location, as configured by the IE *PDSCH-RE-MappingQCL-Config*.” APPLE-1028, §6.3.2. A POSITA would have recognized that the PDSCH parameters pertaining to resource element mapping and quasi co-location would have facilitated the time point when the UE would switch from the default beam to the indicated beam. APPLE-1003, ¶¶169-171.

A POSITA implementing Chen would have found it obvious to combine the teachings of 3GPP to report parameters related to downlink resource element mapping and quasi co-location to implement Chen’s multi-antenna beam switching techniques. APPLE-1003, ¶¶169-171. A POSITA would have had a reasonable expectation of success implementing the techniques taught by 3GPP because they were standardized and well-known techniques for implementing multi-antenna systems at that time. *Id.*

4. Claim 4

[4]

Claim 4 recites the same additional limitation as claim 3, except that claim 4 depends from claim 1 instead of claim 2. Thus, for at least the same reasons as claim 3, Chen/3GPP render claim 4 obvious. APPLE-1003, ¶172.

5. Claim 5

[5.pre]

As discussed for claim [1.pre], *supra*, Chen discloses a wireless communication system and methods of a UE in communication with a base station. APPLE-1004, 9:65-10:6, FIG. 1; APPLE-1013, [0118], FIG. 1. Likewise, Chen also discloses the corresponding system and methods performed by the base station. *See, e.g.*, APPLE-1004, 18:45-61, FIG. 7; APPLE-1013, [0118], [0279]-[0285]; APPLE-1003, ¶¶173-174.

For example, Chen discloses a method implemented in a base station that includes, among other things, “transmitting, by a transmitting end device, a second message associated with a first message to a receiving end device,” and “transmitting, by the transmitting end device, the first message to the receiving end device,” as shown in FIG. 7 below. APPLE-1004, 18:45-61, FIG. 7; APPLE-1013, [0177]-[0179].

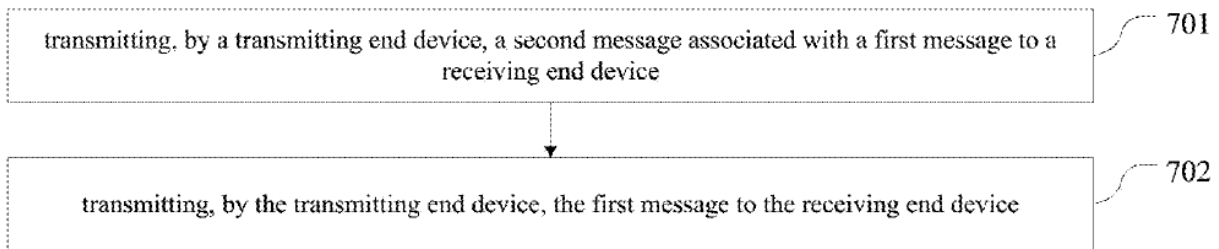


FIG. 7

APPLE-1004, FIG. 7; APPLE-1013, FIG. 7.

APPLE-1003, ¶¶173-174.

[5.a]

As discussed for claim [1.a], *supra*, Chen's UE receives a second message ("second radio signal") from the base station. APPLE-1004, 10:12-14, 13:25-29, 15:64-16:3, FIGS. 2, 4, 7; APPLE-1013, [0120], [0123], FIGS. 2, 4, 7. Thus, Chen also discloses the base station "transmitting a second radio signal." APPLE-1003, ¶175; *see also* APPLE-1004, 18:45-61, FIG. 7; APPLE-1013, [0177]-[0179], FIG. 7.

[5.b]

As discussed for claim [1.b], *supra*, Chen's UE receives a first message ("first radio signal") from the base station. APPLE-1004, 10:20-22, FIGS. 2, 4; APPLE-1013, FIGS. 2, 4, [0123], [0151], [0152]. Thus, Chen also discloses the

base station “transmitting a first radio signal.” APPLE-1003, ¶176; *see also* APPLE-1004, 18:45-61; APPLE-1013, [0177]-[0179].

[5.c]-[5.l]

Limitations [5.c]-[5.l] are identical to limitations [1c]-[1l] except for one instance where “for determining” instead recites “to determine.” Thus, as discussed for limitations [1.c]-[1.l], Chen discloses or Chen and 3GPP render obvious these limitations. APPLE-1003, ¶¶177-178.

Therefore, Chen/3GPP renders claim 5 obvious. APPLE-1003, ¶¶177-178.

6. Claim 6

[6.a]

As discussed above, Chen/3GPP render claim 5 obvious. As discussed for claim [2.a], *supra*, Chen describes the UE receiving (and by extension, the base station transmitting), first information, wherein the first information is used for determining the first time point. APPLE-1003, ¶¶179.

[6.b]

Claim 6 includes an “or” between claim [6.a] and [6.b], so the above-discussed teachings of claim [6.a] are sufficient to satisfy claim 6. *Brown*, 265 F.3d at 1351.

Supra, claim [2.b]. A POSITA reading the 3GPP standard would have recognized that the base station transmits information in PDCCH to the UE that the UE decodes for PDSCH reception. APPLE-1003, ¶¶180-181.

7. Claim 7

[7]

As discussed above, Chen/3GPP renders claim 6 obvious. As discussed for claim 3, Chen and 3GPP render obvious the UE transmitting to the base station, second information, wherein the second information is used for determining the first time point. Thus, Chen and 3GPP also render obvious the base station “receiving second information, wherein the second information is used for determining the first time point.” APPLE-1003, ¶182.

8. Claim 8

[8]

As discussed above, Chen and 3GPP render obvious claim 5. Claim 8 recites the same additional limitation as claim 7, except that claim 8 depends from claim 5 instead of claim 6. Thus, for at least the same reasons as claim 7, Chen and 3GPP render obvious claim 8. APPLE-1003, ¶183.

9. Claim 9

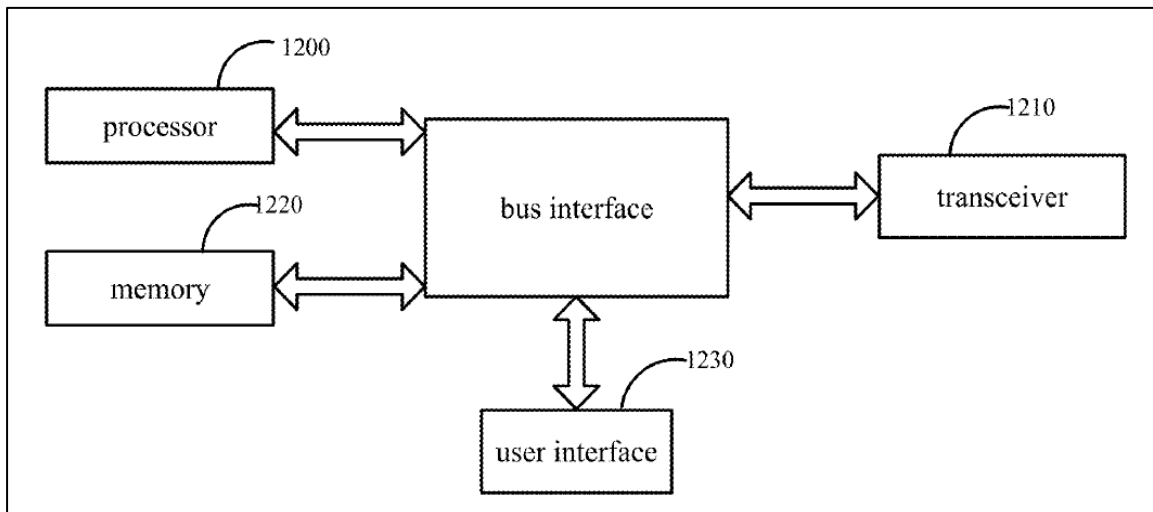
[9.pre]

As discussed for claim [1.pre], Chen/3GPP renders obvious a wireless communication system and methods implemented by a UE in communication with

a base station for switching beam parameters within a slot. APPLE-1004, 9:33-10:9, FIG. 1; APPLE-1013, [0118], FIG. 1; APPLE-1003, ¶184.

[9.a]

Chen/3GPP render [9.a] obvious. APPLE-1003, ¶185-187. As discussed for claim [1.a] and [1.b], Chen's UE receives a second message ("second radio signal") and a first message ("first radio signal") from a base station. As shown in FIG. 12 below, the UE "comprises a processor 1200, a transceiver 1210, memory 1220, a user interface 1230, and a bus interface." APPLE-1004, 23:33-46, FIG. 12; APPLE-1013, [0246]-[0252], FIG. 12.



APPLE-1004, FIG. 12; APPLE-1013, FIG. 12.

The transceiver 1210 includes "a plurality of elements, i.e., a transmitter and a receiver for communication with any other devices over a transmission medium." APPLE-1004, 23:53:57; APPLE-1013, [0252]. The UE can "receive through the

transceiver 1210 a second message associated with the first message.” APPLE-1004, 23:33-46; APPLE-1013, [0246]-[0251]. The “transceiver 1210 is configured to receive and transmit data under the control of the processor 1200,” including receiving the first and second messages. APPLE-1004, 20:5-15, 23:36-46, FIGS 8&12; APPLE-1013, [0246]-[0251]; APPLE-1003, ¶185-187.

[9.b]-[9.k]

Limitations [9.b]-[9.k] are identical to limitations [1.c]-[1.l] except for one instance where “for determining” recites “to determine.” Thus, as discussed for limitations [1.c]-[1.l], Chen discloses or Chen and 3GPP render obvious these limitations. APPLE-1003, ¶188.

10. Claim 10

[10.a]

As discussed above, Chen/3GPP renders [9] obvious. APPLE-1003, ¶189. As discussed for claim [2.a], Chen’s UE receives first information, the first information being used for determining the first time point. Thus, a POSITA would have understood that the transceiver 1210 and/or first receiving module 801 in Chen’s UE “receives first information, the first information being used for determining the first time point.” APPLE-1003, ¶189. Thus, Chen/3GPP render [10.a] obvious.

[10.b]-[10.c]

Claim 10 includes “or” between claim [10a], [10b], and [10c], so only one of the three limitations must be taught to satisfy claim 10. *Brown*, 265 F.3d at 1351.

Nonetheless, as discussed for claim 3, Chen’s UE transmits second information, the second information being used for determining the first time point. Thus, a POSITA would have understood that the transceiver 1210 and/or first receiving module 801 in Chen’s UE “transmits second information, the second information being used for determining the first time point.” APPLE-1003, ¶¶190-191. Thus, Chen/3GPP render [10.b] obvious.

11. Claim 11

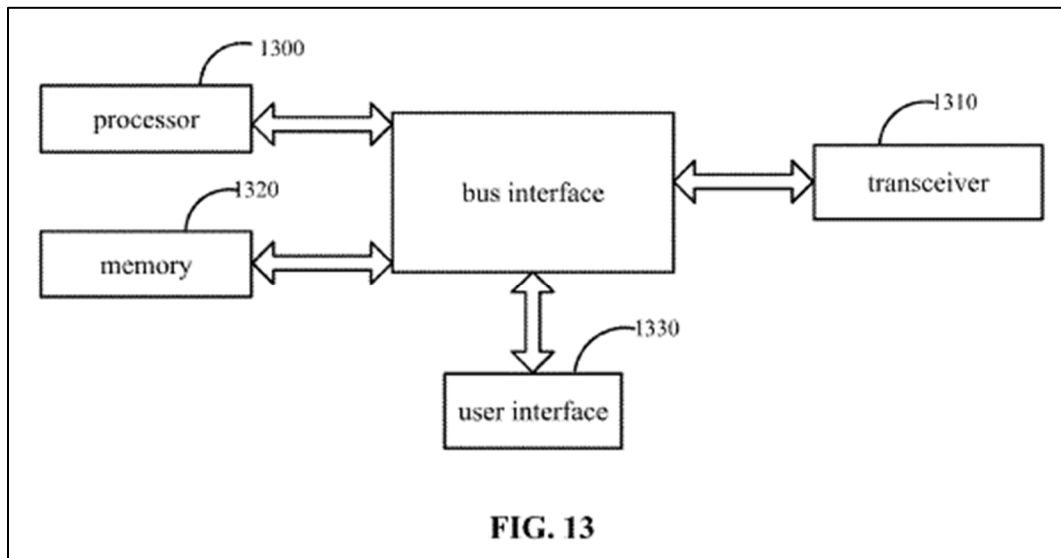
[11.pre]

As discussed for claim [5.pre], Chen discloses a wireless communication system in which a UE communicates with a base station. APPLE-1004, 9:33-10:9, FIG. 1; APPLE-1013, [0118], FIG. 1. Chen also discloses methods implemented by the base station in communication with the UE. APPLE-1004, 18:45-53, FIG. 7; APPLE-1013, [0177]-[0179], FIG. 7; APPLE-1003, ¶192. Chen’s base station includes “a processor 1300, a transceiver 1310, a memory 1320, a user interface 1330, and a bus interface.” APPLE-1004, 25:53-65; APPLE-1013, [0279]-[0284]. Thus, Chen/3GPP render [11.pre] obvious. APPLE-1003, ¶192.

[11.a]

As discussed for claim [5a] and [5b], Chen's base station transmits the second message ("second radio signal") and the first message ("first radio signal") to the UE. As discussed for [11pre], the base station includes a transceiver ("second transceiver module") for transmitting and receiving wireless signals.

APPLE-1003, ¶¶193-195. As shown in FIG. 13 below, the base station includes "a processor 1300, a transceiver 1310, a memory 1320, a user interface 1330, and a bus interface." APPLE-1004, 25:53-65; APPLE-1013, [0279]-[0284].



APPLE-1004, FIG. 13; APPLE-1013, FIG. 13.

The "transceiver 1310 may consist of a plurality of elements, i.e., a transmitter and a receiver for communication with any other devices over a transmission medium," and the transmitting end device "transmit[s] through the transceiver 1310 the first message to the receiving end device." APPLE-1004, 25:53-26:16; APPLE-1013,

[0279]-[0284]. “The transceiver 1310 is configured to receive and transmit data under the control of the processor 1300,” including transmitting the first and second messages. APPLE-1004, 22:4-13, 25:64-65, FIGS. 10&13; APPLE-1013, [0226]-[0239], [0279]-[0284]; APPLE-1003, ¶¶193-195.

[11.b]-[11.k]

Limitations [11.b]-[11.k] are identical to limitations [1.c]-[1.l] except for one instance where “for determining” instead recites “to determine.” Thus, as discussed for limitations [1.c]-[1.l], Chen discloses or Chen and 3GPP render obvious these limitations. APPLE-1003, ¶¶196-197.

Therefore, Chen/3GPP render claim 11 obvious. *Id.*

12. Claim 12

[12.a]

As discussed above, Chen/3GPP render obvious claim 11. As discussed for claim [6.a], Chen’s base station transmits first information, the first information being used for determining the first time point. Thus, a POSITA would have understood that the transceiver in Chen’s base station “transmits first information, the first information being used for determining the first time point.” APPLE-1003, ¶198. Thus, Chen/3GPP render [12.a] obvious. *Id.*

[12.b]-[12.c]

Claim 12 includes “or” between claim [12.a], [12.b], and [12.c], so only one of the three limitations must be taught to satisfy claim 12. *Brown*, 265 F.3d at 1351.

Nonetheless, as discussed for claim 7, in *Chen/3GPP*, *Chen*’s base station receives second information, the second information being used for determining the first time point. Thus, a POSITA would have understood that the transceiver in *Chen*’s base station “receives second information, the second information being used for determining the first time point.” *APPLE-1003*, ¶199-200. Thus, *Chen/3GPP* render [12.b]-[12.c] obvious. *Id.*

B. GROUND 1B – *Chen* in view of *Dahlman* renders claims 1-12 obvious

1. Claim 1

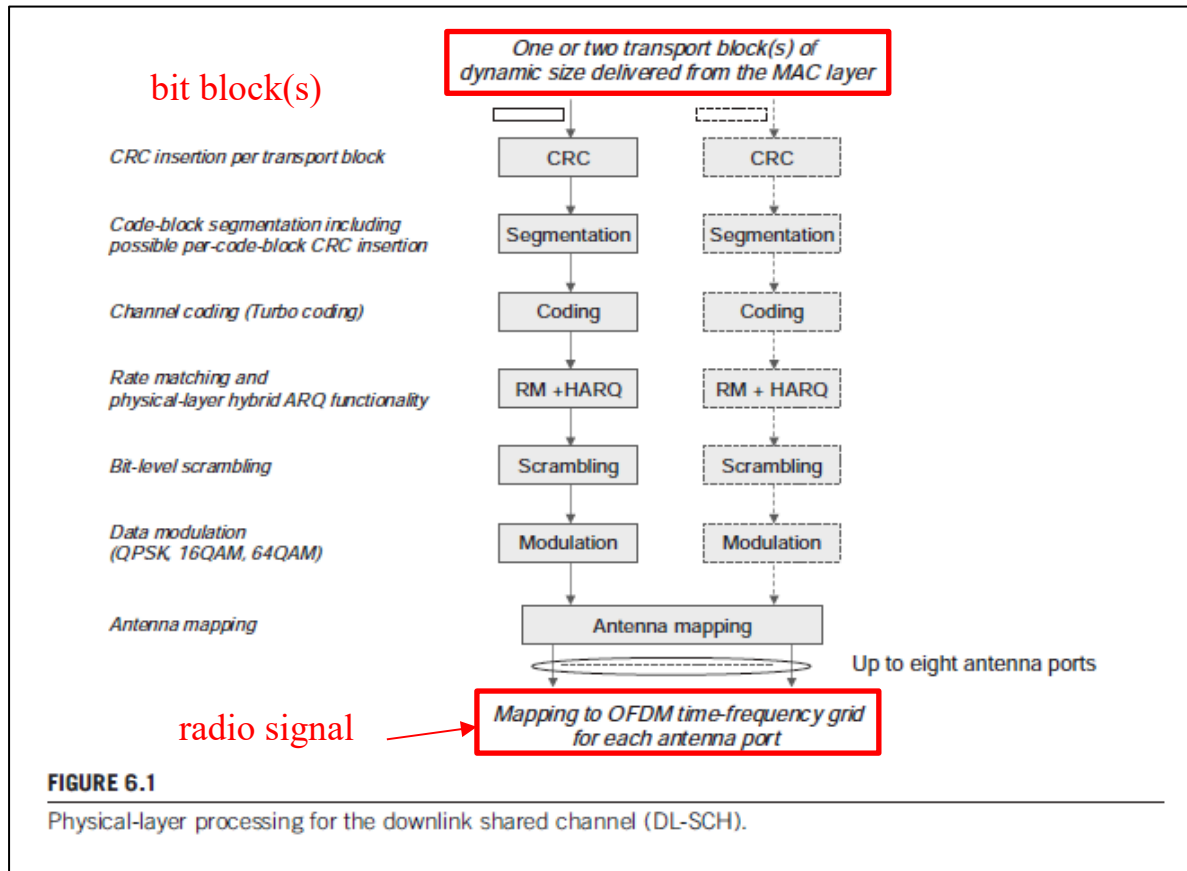
[1.pre]-[1.c]

The *Chen/Dahlman* combination (“*Chen/Dahlman*”) renders [1.pre]-[1.c] obvious for the same reasons described in §VII.A.1[1.pre]-[1.c], *supra*. *APPLE-1003*, ¶201.

[1.d]

See, supra, §VII.A.1[1.d] for *Chen*’s description of being compliant with LTE RAN technology; §III.D for overview of *Dahlman*. *APPLE-1003*, ¶¶202-203. *Chen/Dahlman* renders [1.d] obvious. For example, a transport block (first bit

block) is used according to Dahlman for generating the first message (first radio signal) of Chen. APPLE-1023, §6.1. The transport layer processing steps are shown in FIG. 6.1, reproduced below:



APPLE-1023, FIG. 6.1 (annotated)

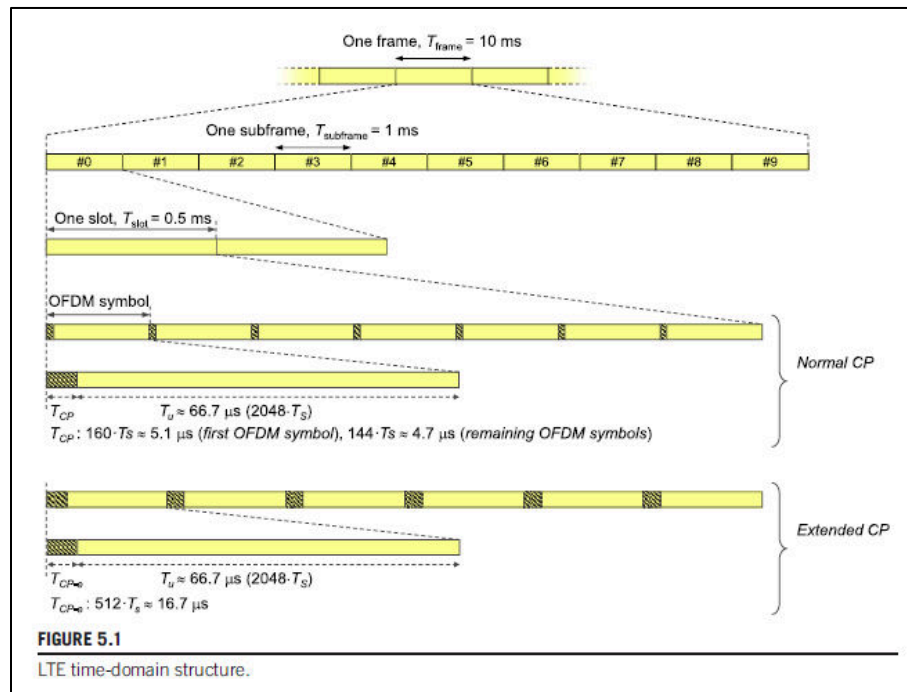
A POSITA would have recognized (or found it obvious) that a transport block is a bit block, in that a transport block is made up of a block of bits. APPLE-1003, ¶¶202-203. Transport blocks undergo bit-level processing, including code-block segmentation, cyclic redundancy check (CRC) insertion and bit-level scrambling. APPLE-1023, §6.1.1, FIG. 6.1. The transport blocks are “transmitted over the

radio interface.” APPLE-1023, §6.1.1. A POSITA would have recognized (or found it obvious) that transmissions over the radio interface were radio signals, such as the claimed first radio signal. APPLE-1003, ¶¶202-203. Thus, in the combination, the first message (first radio signal) of Chen is generated from a first bit block (transport block), that Dahlman describes as being a standard aspect of LTE. *Id.*

[1.e], [1.l]

See, supra, §III.D for overview of Dahlman; §VII.A.1[1.e] for Chen’s discussion of being compliant with and applicable to LTE. APPLE-1003, ¶¶204-205. Chen/Dahlman renders [1.e] and [1.l] obvious. The first message (first radio signal) of Chen comprises G multicarrier symbols, where G is a positive integer, in accordance with Dahlman. For example, the downlink transmission scheme that uses OFDM, and that there are 12 subcarriers (multi-carrier) for each of 6-7 (G) symbols in a slot. APPLE-1023, §§3.1.1, 5.1, FIG. 5.2; APPLE-1003, ¶¶204-205.

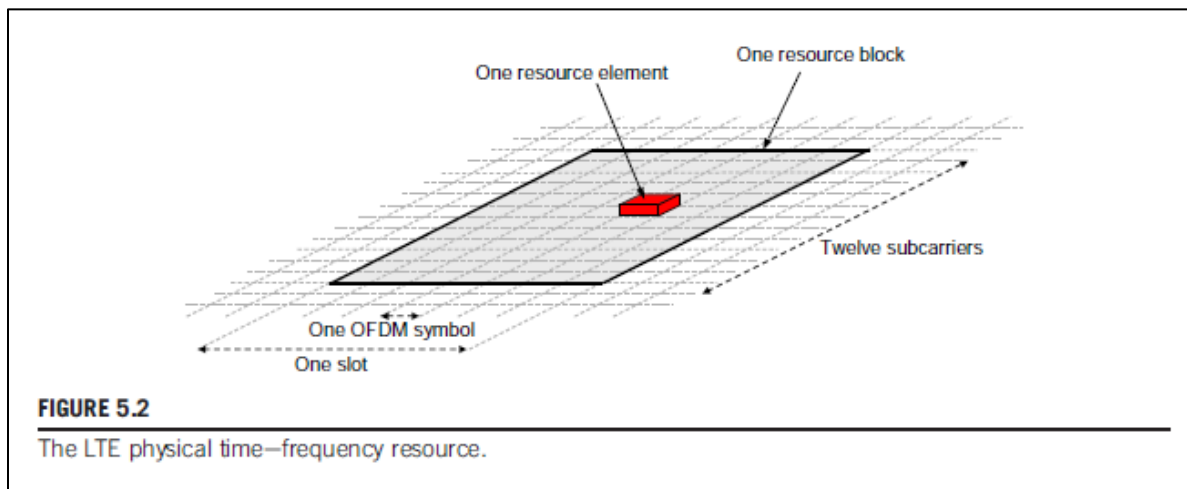
The time-domain structure in FIG. 5.1 and the physical transmission resource grid in FIG. 5.2 are reproduced below:



APPLE-1023, FIG. 5.1

Each slot consists of “a number of OFDM symbols including cyclic prefix.”

APPLE-1023, §5.1. Resource elements are grouped into resource blocks, as shown in FIG. 5.2:



APPLE-1023, FIG. 5.2

APPLE-1003, ¶¶204-206.

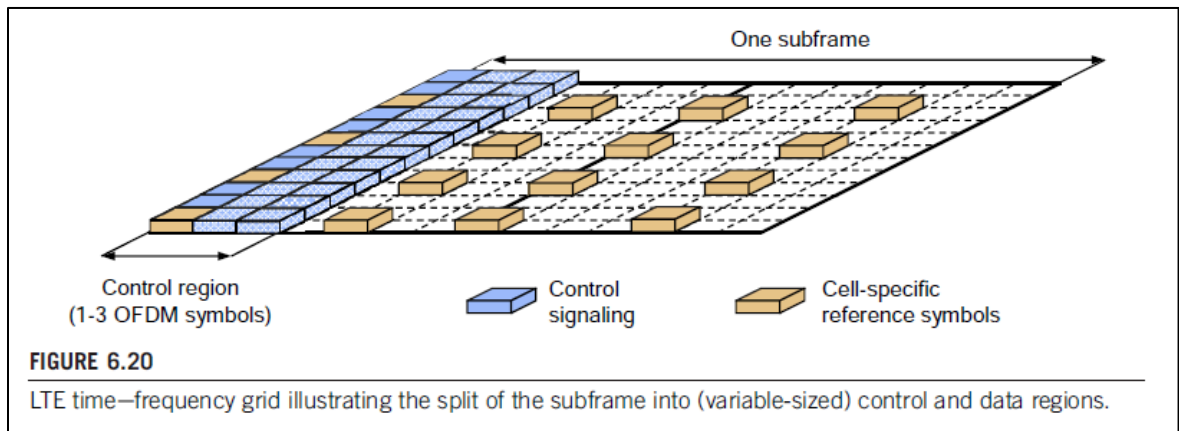
According to Dahlman, “each resource block consists of 12 consecutive subcarriers in the frequency domain and one 0.5 ms slot in the time domain. Each resource block thus consists of $7 \text{ [symbols]} \bullet 12 \text{ [subcarriers]} = 84$ resource elements in the case of a normal cyclic prefix and $6 \text{ [symbols]} \bullet 12 \text{ [subcarrier]} = 72$ resource elements in the case of an extended cyclic prefix.” APPLE-1023, §5.1 (where the number of symbols is either 6 or 7—an integer); APPLE-1003, ¶¶204-206.

[1.f]

See, supra, §VII.A.1[1.f]. APPLE-1003, ¶206.

[1.g]

See, supra, §VII.A.1[1.g]&[1.l] for Chen’s teaching of LTE applicability; §III.D for Dahlman’s teaching of DCI. APPLE-1003, ¶¶207-209. Chen/Dahlman renders [1.g] obvious. The second message (second radio signal) of Chen, which is a downlink control message, includes information that the UE uses to determine a time-domain resource (symbol) for each of the G multicarrier symbols, similar to Dahlman. For example, downlink subframes can include a control region occupying “an integer number of OFDM symbols, more specifically one, two, or three OFDM symbols,” as shown in FIG. 6.20:



APPLE-1023, FIG. 6.20

For an OFDM subframe in LTE, “each subframe can therefore be said to be divided into a control region followed by a data region, where the control region corresponds to the part of the subframe in which the L1/L2 control signaling is transmitted.” APPLE-1023, §6.4. “The reason for transmitting the control signaling at the beginning of the subframe is to allow for devices to decode downlink scheduling assignments as early as possible.” *Id.*; APPLE-1003, ¶¶207-209.

The PCFICH informs the device “about the size of the control region” in terms of OFDM symbols, thereby indicating where the data region starts. APPLE-1023, §§4.2.3.1, 6.4; *see also id.* §6.4.1. The PDCCH is “used for downlink scheduling assignments.” *Id.*; APPLE-1003, ¶¶207-209.

[1.h]-[1.k]

Chen/Dahlman renders [1.i]-[1.k] obvious for the same reasons described in

§§VII.A.1[1.i]-[1.k], *supra*. APPLE-1003, ¶210

2. Claim 2

[2.a]

See, supra, §VII.A.2[a]. APPLE-1003, ¶211.

[2.b]

Chen/Dahlman renders [2.b] obvious. APPLE-1003, ¶212. Per Dahlman, in LTE, the DCI includes downlink scheduling assignments that are decoded based on DCI format. APPLE-1023, §6.4.6. The DCI format provides multi-antenna information for receiving on the downlink. *Id.* Such information includes PDSCH mapping and quasi-colocation indicator. *Id.* A POSITA would have been motivated to include the DCI in the second message to indicate downlink scheduling assignments. APPLE-1003, ¶¶212. A POSITA would have had a reasonable expectation of success doing so because the DCI was a known control field for signaling resource assignments to the UE for reception of radio signals in the downlink. *Id.*

3. Claim 3

See, supra §VII.A.3 (describing how, in Chen, the receiving device transmits the parameter switching indication to the transmitter). APPLE-1003, ¶¶213-214.

In addition, the DCI includes PCFICH that includes the instantaneous number of symbols for the control region, which can map either to the claimed first

information or second information. APPLE-1023, §6.4. And the DCI includes the PDCCH that includes the downlink scheduling grant. *Id.* A POSITA would have been motivated to include the DCI in the second message to indicate the number of symbols for the control region. APPLE-1003, ¶¶213-214. A POSITA would have had a reasonable expectation of success doing so because the DCI was a known control field for signaling symbols assignments to the UE for reception of radio signals in the downlink. *Id.*

4. Claim 4

See, supra, §§VII.A.3, VII.B.3. APPLE-1003, ¶215.

5. Claim 5

[5.pre]-[5.c]

See, supra, §VII.A.5[5.pre]-[5.c]. APPLE-1003, ¶216.

[5.d]

See, supra, §VII.B.1[1.d]. APPLE-1003, ¶217.

[5.e]

See, supra, §VII.B.1[1.e]. APPLE-1003, ¶218.

[5.f]

See, supra, §VII.A.5[5.f]. APPLE-1003, ¶219.

[5.g], [5.l]

See, supra, §VII.B.1[1.g]&[1.l]. APPLE-1003, ¶220.

[5.h]-[5.k]

See, supra, §§VII.A.5[5.h]-[5.k]. APPLE-1003, ¶221

6. Claim 6

[6.a]-[6.b]

See, supra, §§VII.A.2, VII.B.2. APPLE-1003, ¶222.

7. Claim 7

[7]

See, supra, §§VII.A.3, VII.B.3. APPLE-1003, ¶223.

8. Claim 8

[8]

See, supra, §§VII.A.3-4, VII.B.3-4. APPLE-1003, ¶224.

9. Claim 9

[9.pre]-[9.a]

See, supra, §§VII.A.[9.pre]-[9.a]. APPLE-1003, ¶225.

[9.b]-[9.k]

Limitations [9.b]-[9.k] are identical to limitations [1.c]-[1.l] except for one instance where “for determining” recites “to determine.” As discussed for limitations [1.c]-[1.l], Chen discloses or Chen and Dahlman render obvious [9.b]-[9.k]. APPLE-1003, ¶226.

10. Claim 10

[10.a]-[10.c]

See, supra, §§VII.A.2-4 & 9, VII.B.2-4. APPLE-1003, ¶227.

11. Claim 11

[11.pre]-[11.a]

See, supra, §§VII.A.11[11.pre]-[11.a]. APPLE-1003, ¶228.

[11.b]-[11.k]

Limitations [11.b]-[11.k] are identical to limitations [1.c]-[1.l] except for one instance where “for determining” instead recites “to determine.” As discussed for [1.c]-[1.l], Chen discloses or Chen and Dahlman render obvious [11.b]-[11.k]. APPLE-1003, ¶229.

12. Claim 12

[12.a]-[12.c]

See, supra, §§VII.A.2-4&12, VII.B.2-4. APPLE-1003, ¶230.

VIII. TRIAL SHOULD BE INSTITUTED

Petitioner believes that discretionary denial is unwarranted, and yet, Petitioner intends to utilize the bifurcated briefing process contemplated by the March 26, 2025, Stewart Memorandum to rebut contentions if offered by Patent Owner to the contrary. *See, e.g.*, APPLE-1030; APPLE-1033; <https://uspto.cosocloud.com/p9xpz6s4jn75/> (Video).

IX. CONCLUSION AND FEES

The Challenged Claims are unpatentable. Petitioner authorizes charge of fees to Deposit Account 06-1050.

X. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

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

Apple Inc. is the petitioner and the real party-in-interest.

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

Petitioner is not aware of any disclaimers, reexamination certificates or petitions for inter partes review for the '081 Patent. The '081 Patent is the subject of a number of civil actions including: *Apex Beam Technologies LLC v. Apple Inc*, 6-24-cv-00223 (WDTX), filed April 29, 2024; *Samsung Electronics Co., Ltd. et al. v. Apex Beam Technologies LLC*, IPR2023-00599 (PTAB), filed February 28, 2023; *Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al*, 2-22-cv-00188 (EDTX), filed June 1, 2022; *Apex Beam Technologies LLC v. ZTE Corporation*, 2-22-cv-00031 (EDTX), filed February 1, 2022; *Apex Beam Technologies LLC v. OnePlus Technology (Shenzhen) Co., Ltd.*, 2-22-cv-00032 (EDTX), filed February 1, 2022; *Apex Beam Technologies LLC v. TCT Mobile International Limited et al*, 2-21-cv-00438 (EDTX), filed November 30, 2021.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup counsel
W. Karl Renner, Reg. No. 41,265 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR50095-0227IP1@fr.com	Rishi Gupta, Reg. No. 64,768 Jennifer J. Huang, Reg. No. 64,297 Fish & Richardson P.C. 60 South Sixth Street Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR50095-0227IP1@fr.com

D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR50095-0227IP1@fr.com.

Respectfully submitted,

Dated: April 28, 2025

/W. Karl Renner/
W. Karl Renner, Reg. No. 41,265
Rishi Gupta, Reg. No. 64,768
Jennifer J. Huang, Reg. No. 64,297
Fish & Richardson P.C.
60 South Sixth Street
Minneapolis, MN 55402
T: 202-783-5070
F: 877-769-7945

(Control No. IPR2025-00896)

Attorneys for Petitioner

CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,434 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: April 28, 2025

/W. Karl Renner/

W. Karl Renner, Reg. No. 41,265

Rishi Gupta, Reg. No. 64,768

Jennifer J. Huang, Reg. No. 64,297

Fish & Richardson P.C.

60 South Sixth Street

Minneapolis, MN 55402

T: 202-783-5070

F: 877-769-7945

(Control No. IPR2025-00896)

Attorneys for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on April 28, 2025, a complete and entire copy of this Petition for *Inter partes* Review, Power of Attorney, and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

Zhong Law, LLC
51 JFK Parkway
1st Floor West
Short Hills, NJ 07078
(908) 376-3104

/Crena Pacheco/

Crena Pacheco
Fish & Richardson P.C.
60 South Sixth Street
Minneapolis, MN 55402
pacheco@fr.com