

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Li et al.
U.S. Patent No.: 10,447,450 Attorney Docket No.: 00035-0021IP1
Issue Date: October 15 , 2019
Appl. Serial No.: 15/676,421
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Title: METHOD AND SYSTEM FOR MULTI-CARRIER PACKET
COMMUNICATION WITH REDUCED OVERHEAD

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 10,447,450 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

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EXHIBITS

Ex-1001	U.S. Patent 10,447,450 to Li et al. (“the ’450 patent”)
Ex-1002	Excerpts from the Prosecution History of the ’450 patent (“the Prosecution History”)
Ex-1003	Declaration of Dr. Zhi Ding
Ex-1004	Curriculum Vitae of Dr. Zhi Ding
Ex-1005	U.S. Patent Publication 2005/0157803 (“Kim”)
Ex-1006	RESERVED
Ex-1007	RESERVED
Ex-1008	IEEE 802.16-2004 Standard, entitled “IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems” (“IEEE802.16-2004”)
Ex-1009	Declaration of Mr. Gordon MacPherson for IEEE802.16-2004
Ex-1010	RESERVED
Ex-1011	Complaint, <i>Neo Wireless LLC., v. Dell Technologies Inc.</i> , 6:21-cv-0024, W.D. Tex., Jan. 12, 2021
Ex-1012	U.S. Patent 7,948,944 to Li et al. (“the ’944 patent”)
Ex-1013	U.S. Patent 8,693,430 to Li et al. (“the ’430 patent”)
Ex-1014	Stipulation by Petitioner
Ex-1015	Joint Proposed Scheduling Order, <i>Neo Wireless LLC., v. Dell Technologies Inc.</i> , 6:21-cv-0024, W.D. Tex., Aug. 6, 2021

Ex-1016 Defendants' Opposed Motion for Intra-District Transfer of Venue,
Neo Wireless LLC, v. Dell Technologies Inc., 6:21-cv- 0024, W.D.
Tex., May 8, 2021

Dell Inc. and Dell Technologies Inc. (collectively “Petitioner”) petition for *Inter Partes* Review (“IPR”) of claims 1-18 (“the Challenged Claims”) of U.S. Patent No. 10,447,450 (“the ’450 patent”).

I. REQUIREMENTS

A. Grounds for Standing

Petitioner certifies that the ’450 patent is available for IPR. Petitioner is not barred or estopped from requesting review. Petitioner was first served with a complaint of infringement of the ’450 patent less than one year prior to the filing of this Petition. Ex-1011.

B. Challenge and Relief Requested

Petitioner requests IPR and cancellation of the Challenged Claims on the grounds below. Dr. Ding provides supporting explanations in his Declaration cited throughout this petition. Ex-1003.

Ground	Claims	Basis
1	1-18	§103: Kim, IEEE802.16-2004

The ’450 patent issued from U.S. Application No. 15/676,421, filed August 14, 2017, and claims priority to U.S. Provisional Application No. 60/721,451, filed September 28, 2005. Accordingly, the earliest possible priority date of the ’450 patent is September 28, 2005 (the “Critical Date”). Petitioner does not concede that the Challenged Claims are entitled to the claimed priority, but applies prior art

before the alleged date. Ex-1003, 26. Applied references are prior art based on at least one of the bases listed below:

Reference	Date(s)	Basis
Kim	7/21/2005 1/21/2005	§102(a) §102(e)
IEEE802.16-2004	10/1/2004	§102(a)

Kim qualifies as prior art at least under 35 U.S.C §§ 102(a) and (e). Kim (Ex-1005) was published on July 21, 2005, more than 2 months before the Critical Date, and is therefore prior art at least under 35 U.S.C. § 102(a). Kim also was filed on January 21, 2005, more than 8 months before the Critical Date, and is therefore also prior art at least under 35 U.S.C. § 102(e).

IEEE802.16-2004 qualifies as prior art under 35 U.S.C § 102(a). Specifically, IEEE802.16-2004 (Ex-1008) is an IEEE Standard published on October 1, 2004, more than 11 months before the Critical Date. *See* Ex-1008, p.4 (“Published 1 October 2004”). This is confirmed by Mr. MacPherson, the “Director Board Governance & IP Operations of the Institute of Electrical and Electronics Engineers, Inc. (‘IEEE’),” the standards body that produced the IEEE802.16-2004 specification. In his declaration (Ex-1009), Mr. MacPherson confirms that the “October 1, 2004” date stated in IEEE802.16-2004 is the date of its publication. Accordingly, IEEE802.16-2004 is prior art at least under 35 U.S.C. § 102(a).

II. THE '450 PATENT

A. Brief Description

The '450 patent relates to a “multi-carrier wireless communication network” based on the **IEEE 802.16**¹ wireless communication standard (“WiMAX”). Ex-1001, Abstract; 1:41-49. The '450 patent describes a wireless network in which a **base station** (which provides wireless coverage for a geographic cell) communicates with a **mobile station** (which “may be **fixed** or may **roam**”). Ex-1001, 3:35-42. The claims of the '450 patent are directed to “downlink (DL)” communication directed from the base station to the mobile station. Ex-1001, 3:52-54, claims 1-18.

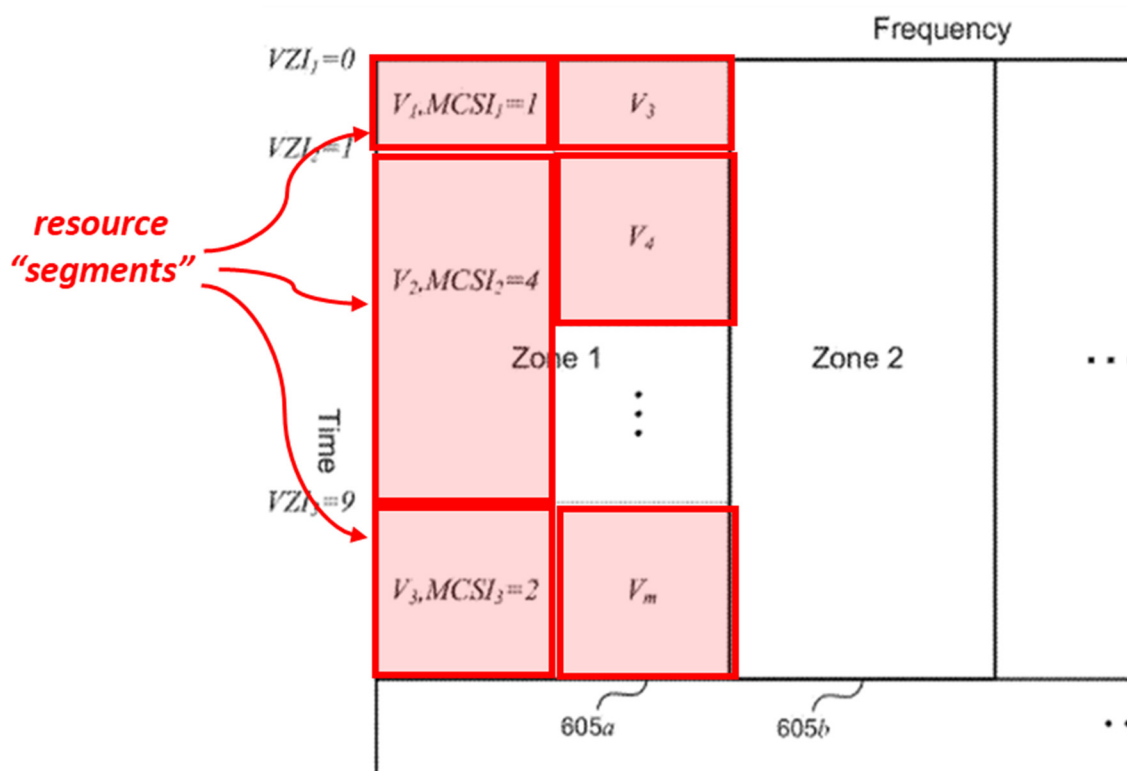
The '450 patent describes a communication signaling framework based on the IEEE 802.16 standard using physical **resources** in both “frequency and time domains.” Ex-1001, 4:16-18. In the time domain, the signal utilizes a “**frame** structure” in which “[e]ach frame consists of a number of **time slots**, and each time slot is comprised of one or more OFDM **symbols**.” Ex-1001, 4:63-66, claim 1. In the frequency domain, a signal is made up of multiple “**subcarriers**.” Ex-1001, 4:29-31, 4:57-59.

Building on this signaling framework, the '450 patent describes “an

¹ Bold represents emphasis added by Petitioner, unless otherwise specified.

Orthogonal Frequency Division Multiple Access (**OFDMA**) system” as specified in the IEEE 802.16 standard. Ex-1001, 3:6-8. The ’450 patent explains that, “in a typical wireless system based on the IEEE 802.16 standard (‘WiMAX’), multiple packet streams are established for each mobile device” to provide “simultaneously supported communications” between a single base station and a single mobile station (*i.e.*, reflecting the term “multiple access” in “OFDMA”). Ex-1001, 5:30-37. To provide simultaneous communication, the ’450 patent explains that the IEEE 802.16 standard specifies different information “may be spread throughout the available time-frequency resource.” Ex-1001, 5:39-31, Ex-1003, 37.

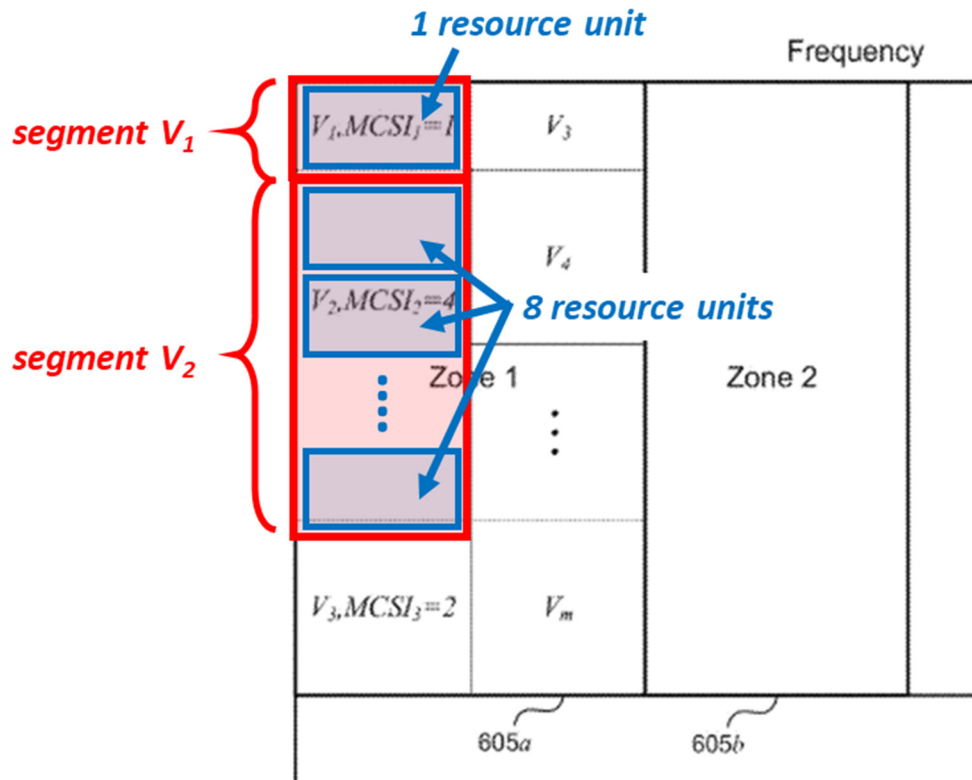
Reflecting this well-known concept of multi-access communication in OFDMA, the ’450 patent allocates different “**segments**” of time-frequency resources for transmissions of different packet streams. Ex-1001, 6:12-21, Fig. 6 (below, annotated); Ex-1003, 56.



Ex-1001, Fig. 6 (annotated)

The location of each resource segment is identified by a “**starting time-frequency coordinate**,” where the starting “time coordinate” has a granularity of “one or multiple OFDM symbols” and the starting “frequency coordinate” has a granularity of “one or multiple subcarriers.” Ex-1001, 5:57-63.

The ’450 patent describes that each resource segment is allocated in multiples of a basic “**resource unit**.” Ex-1001, 6:45-52. The ’450 patent refers to this as utilizing “modular resources” whereby each segment is “simply an integer multiple of the basic unit.” Ex-1001, 6:45-52. As an example, in Figure 6 (below, annotated), segment “ V_1 ” includes “one basic resource unit” and segment “ V_2 ” includes “eight basic resource units.” Ex-1001, 7:20-24; Ex-1003, 58.



Ex-1001, Fig. 6 (annotated)

The '450 patent specification proposes various allegedly novel features to improve over the prior art by “minimizing the control overhead” required to identify the locations of different resource segments. Ex-1001, Abstract, 5:45-6:2, 7:28-30; Ex-1003, 59. Specifically, the '450 patent specification proposed “**grouping** applications of a similar type together within a **zone**” (each zone consisting of a group of segments) and identifying the location of a segment “relative to the starting point of the **zone**” using the “basic resource units as the granularity of a location offset.” Ex-1001, Abstract, 5:45-62, 7:28-30; Ex-1003, 59. Although earlier patents in the family of the '450 patent included these

features,² over time Patent Owner removed them from the claims pursued in the '450 patent family. Ex-1003, 59. As a result, none of the allegedly novel features are recited in the claims of the '450 patent. Ex-1003, 59.

Instead, the claims of the '450 patent merely recite features of OFDMA systems that were well-known in prior art IEEE 802.16 technology. Ex-1003, 60. For example, the Background Section of the '450 patent acknowledges that various features of claim 1 were known, such as a mobile station being assigned a “16-bit **connection ID** (CID).” Ex-1001, 1:51-55; Ex-1003, 60. The Background Section of the '450 patent also recognized that, in the prior art IEEE 802.16 standard, “resource allocation is **identified** in the **time domain** scale with a **start** symbol **offset** (8 bits)” and “in the **frequency domain** scale with a **start** logical subchannel **offset** (6 bits) and a **number** of allocated subchannels (6 bits).” Ex-1001, 1:61-66. With the acknowledged similarity between the '450 patent claims and the prior art IEEE 802.16 standard, it is unsurprising to find all claimed features of the '450 patent in prior 802.16 or WiMAX publications. *Id.* As demonstrated below, Kim and IEEE802.16-2004 teach all of the claimed features

² See Ex-1012 (US 7,948,944), claim 1 (“allocating a **zone** in the time-frequency resource, wherein: the zone is designated for a **type of application**”); Ex-1013 (US 8,693,430), claim 1 (“the **zone** is designated for carrying packets of **the class**”).

of the '450 patent, rendering the Challenged Claims obvious. *Id.*

B. Prosecution History

During prosecution of the '450 patent, the Examiner did not issue any rejections based on prior art, and instead only issued a double patenting rejection which Patent Owner overcame by submitting a terminal disclaimer for allowance. The Examiner did not provide any reasons for allowance. During prosecution, the Examiner did not consider or substantively apply Kim or IEEE802.16-2004, which in combination render the Challenged Claims obvious. Ex-1003, 61.

C. Claim Construction

Based on the evidence below, striking similarities between the prior art's description of the claimed elements and that found within the '450 Patent specification, and the well-established principle that "claim terms need only be construed to the extent necessary to resolve the controversy," no formal claim constructions are necessary in this proceeding. *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011).

D. Level of Ordinary Skill

A person of ordinary skill in the art as of the Critical Date of the '450 patent ("POSITA") would have had at least a Bachelor's degree in an academic area emphasizing electrical engineering, computer engineering, or a similar discipline, and at least two years of experience in the field working with, teaching, or

researching wireless communication networks. Ex-1003, 32. Superior education could compensate for a deficiency in work experience, and vice-versa. *Id.*

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE³

A. Kim and IEEE802.16-2004 Render Obvious Claims 1-18⁴

All of the features claimed in the '450 patent were well-known in prior art IEEE 802.16 technology and were specifically disclosed in numerous references prior to the Critical Date. Ex-1003, 62. An example of such a reference, Kim, is discussed below. *Id.* Kim utilizes the same IEEE 802.16-based OFDMA signaling framework as the '450 patent, namely time-domain **frames** each composed of multiple **slots** including multiple OFDM **symbols**, and frequency-domain **subcarriers**. *Id.* Based on this signaling framework, Kim discloses allocating channel resources (the claimed “*segments*” of the '450 patent) in integer multiples of a minimum allocation unit (the claimed “*resource unit*”). *Id.*

³ Petitioner understands that challenges for failure to meet §112 cannot be brought in this forum. Petitioner is not waiving any arguments under §112 or arguments regarding claim scope.

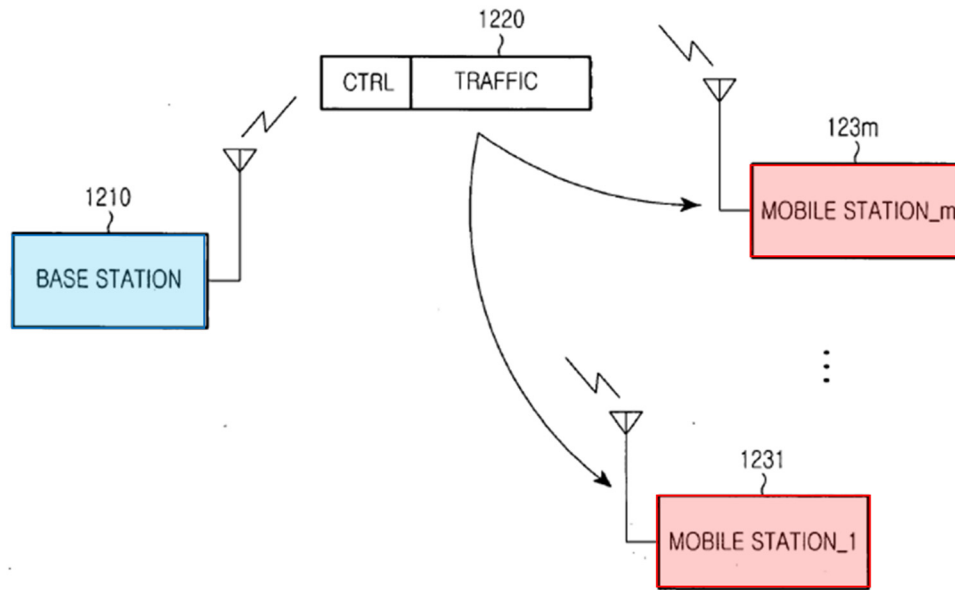
⁴ General descriptions provided for the references and combinations discussed in Section III.A are incorporated into each subsection addressing/applying those references, as are the discussions of combinations.

IEEE802.16-2004 (the technical standard that is foundational to both the '450 patent and Kim) supplements Kim by providing further details of other claim features of the '450 patent, including: (i) “*assigning an **identifier** to a mobile station*” (claim feature [1.1], *infra*) and (ii) “*the segment having a **starting time-frequency coordinate***” (claim feature [1.3], *infra*). Ex-1003, 63.

1. Kim

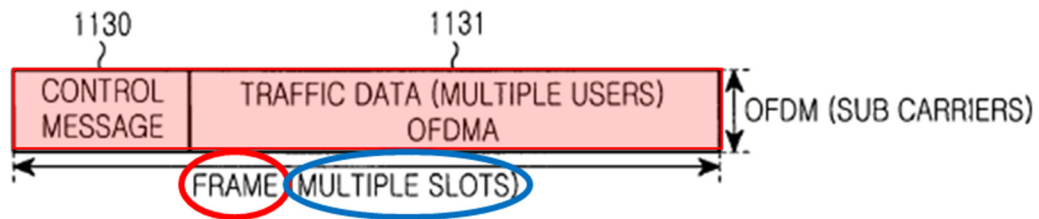
Kim is titled “[m]odulating and coding apparatus and method in a high-rate wireless data communication system.” Ex-1005, Cover. Like the '450 patent, Kim describes a wireless communication system based on the **IEEE 802.16 standard** that uses Orthogonal Frequency Division Multiple Access (**OFDMA**) technology for **downlink** communication from a base station to a mobile station. Ex-1005, Abstract, [0006], [0007], Fig. 12; Ex-1003, 64.

An example of Kim’s wireless network is shown in Figure 12, which includes a **base station** 1210 that communicates with **mobile stations** 1231, ..., 123m. Ex-1005, Fig. 12, [0085]; Ex-1003, 65.



Ex-1005, Fig. 12 (annotated)

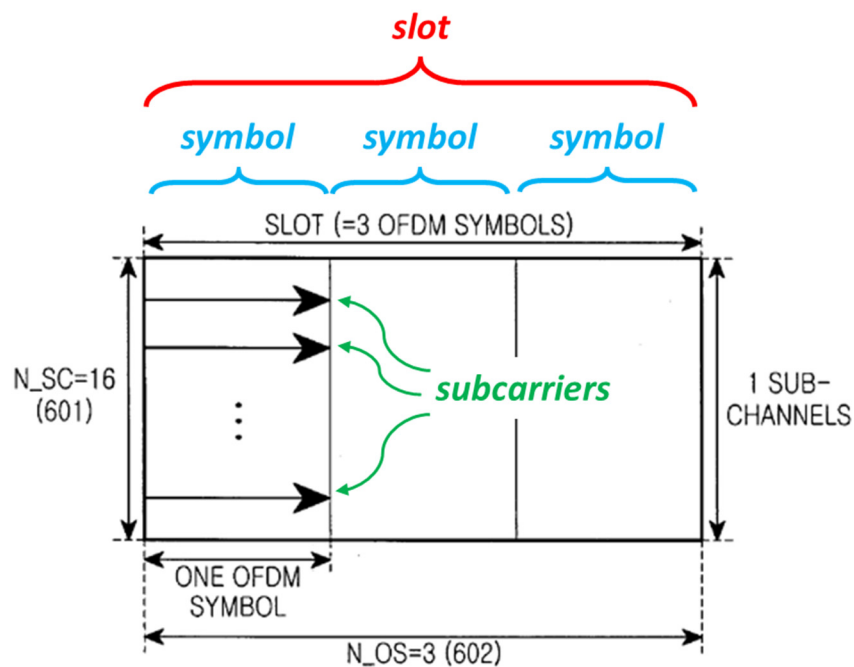
The base station transmits data in a “**frame**” (e.g., frame 1220 in Fig. 12), with each frame consisting of “multiple **slots**.” Ex-1005, Figs. 11 (below, annotated) and 12, [0085]; Ex-1003, 66.



Ex-1005, Fig. 11 (annotated)

In the time domain, “one slot comprises one or more OFDM **symbols**.” Ex-1005, [0014]; Ex-1003, 67. Kim provides examples in which “one slot comprises three OFDM symbols” (e.g., in Figs. 2, 3, 6), and more generally discloses a parameter that defines the “number of OFDM symbols allocated per slot,”

expressed as “N_OS.” Ex-1005, [0057]; *Id.* In the frequency domain, the frequency bandwidth is divided into “**subcarriers**,” where a subcarrier “refers to an orthogonal carrier used in OFDM.” *Id.*; Ex-1005, [0014], Fig. 6. Kim’s Figure 6 (below, annotated) shows an example of a slot which includes 3 symbols in time, and each symbol includes 16 subcarriers in frequency. *Id.*

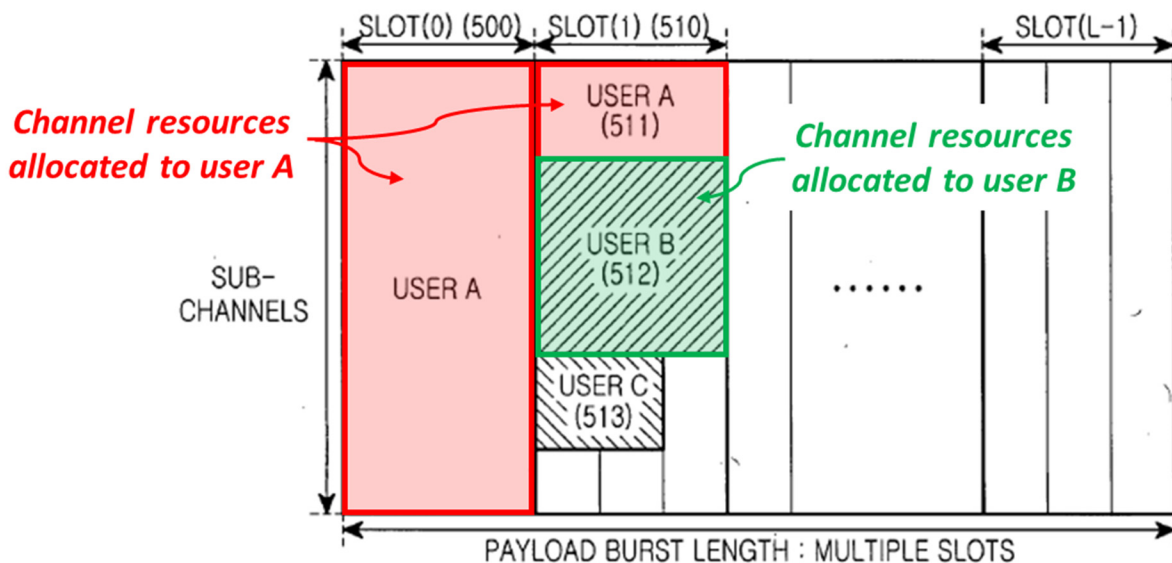


Ex-1005, Fig. 6 (annotated)

Kim further discloses a resource allocation scheme in which “channel resources are allocated to multiple users.” Ex-1005, [0013]; Ex-1003, 68. Kim explains that “the amount of **channel resources** allocated to one user is determined based on the number of **subchannels** ... and the number of **slots**” (where a “subchannel” refers to a set of subcarriers). Ex-1005, [0011], [0052]–[0054],

[0058], Figs. 5, 7, 8. Each “**channel resource**” in Kim’s network is composed of a single “**subchannel**” in frequency spanning a single “**slot**” in time. Ex-1005, [0053], [0058].

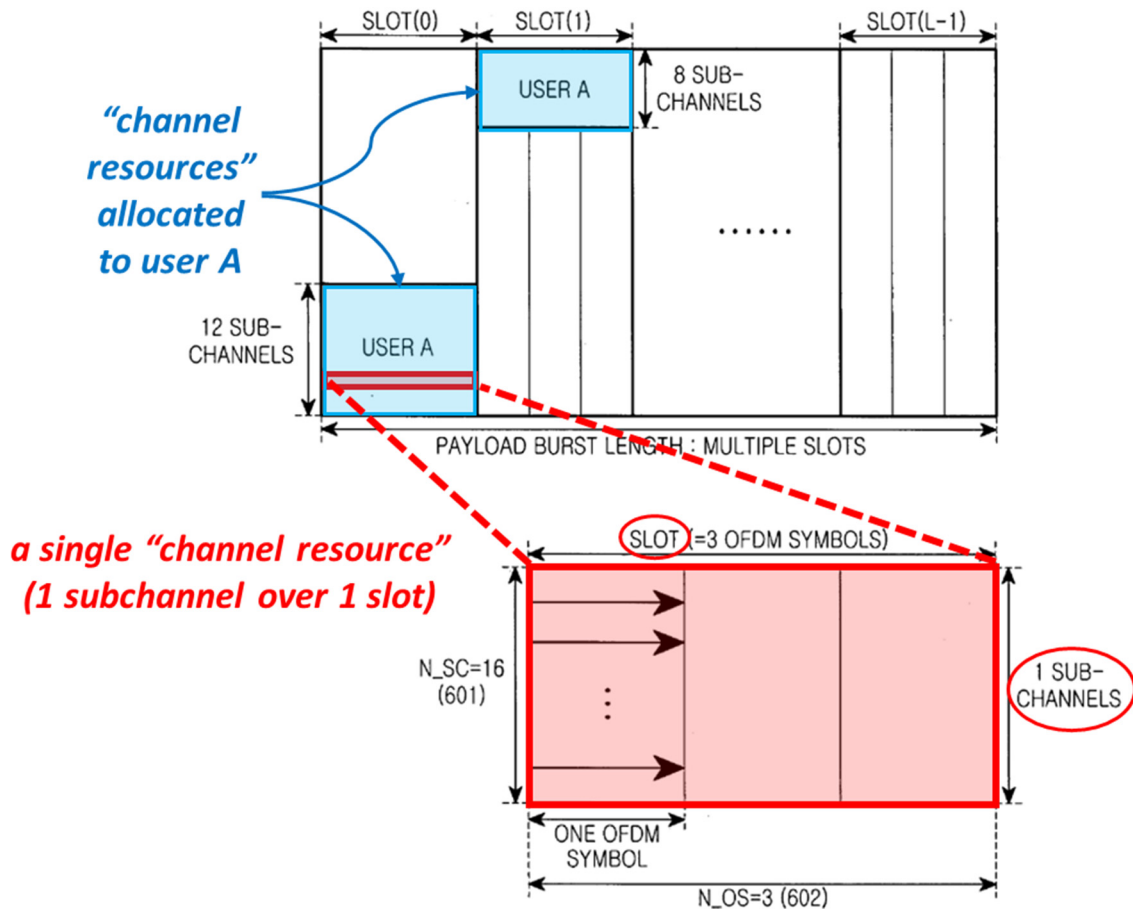
One embodiment of Kim’s resource allocation is shown in Figure 5 (below), in which “user A is allocated all of the subchannels of a first slot SLOT(0) 500 and occupies some subcarriers of a second slot SLOT(1)” and where “user B occupies some other subcarriers of the second slot SLOT(1) 510.” Ex-1005, [0058]; Ex-1003, 69.



Ex-1005, Fig. 5 (annotated)

Another example is shown in Figure 7 (below, annotated to illustrate an individual “channel resource” with Figure 6), where user A is allocated 12 subchannels in the first slot (SLOT 0) and 8 subchannels in the second slot (SLOT

1). Ex-1003, 70.



Ex-1005, Figs. 7 and 6 (annotated)

In Kim's system, data is transmitted over one or more of these channel resources using an adaptive coding and modulation scheme corresponding to a Modulation order Product code Rate (MPR), which depends on the number of subchannels allocated to a user's data in a slot. Ex-1005, [0061]-[0067]; Ex-1003, 71. Kim's network uses "a modulation scheme and a code rate based on a block size" where "the block has a different **number of subchannels for each slot**" and thus "provides **various block sizes for error correction codes.**" Ex-1005, [0053],

[0054]; *Id.* Kim also discloses “symbol **repetition** & puncturing” which “performs symbol repeating and puncturing on the FEC-encoded data.” Ex-1005, [0010], [0069]; *Id.* Kim’s network uses “symbol puncturing and symbol **repetition** to match a code rate,” thereby providing the final Modulation order Product code Rate (MPR) of the encoding scheme. *Id.*; Ex-1005, [0067].

The contents of each frame in Kim’s network include a control message (“CTRL”) and user data (“TRAFFIC”). Ex-1005, Figs. 11, 12, [0085]; Ex-1003, 72. The CTRL part of Kim’s frame includes various control information which allows a mobile station to correctly locate and recover user data from the TRAFFIC portion of the frame. *Id.*; Ex-1005, [0072], [0075], [0076], [0082], [0085]. The “TRAFFIC” portion of Kim’s frame includes user data for “multiple users,” as provided by OFDMA technology in which multiple “user data is multiplexed every transmission frame.” *Id.*; Ex-1005, [0014], [0075].

When a base station transmits a frame , the “mobile station first detects the CTRL part from the frame 1220 to determine whether its **own data** has been transmitted” in the frame and “determine whether a signal transmitted by a base station is a signal transmitted to the mobile station itself.” Ex-1005, [0085], [0072]; Ex-1003, 73. The CTRL part of the frame also “includes **location information** in a frame where user data is multiplexed every transmission frame” and information regarding “the **number of subchannels**” and a “subchannel

index” of the user data. *Id.*; Ex-1005, [0075], [0081]. The mobile station is thus able to “determine whether the data heading therefor has been received by detecting the control message” and “acquire data information” and “perform data demodulation and decoding” of the user data. *Id.*; Ex-1005, [0076], [0082].

2. IEEE802.16-2004

IEEE802.16-2004 is a wireless communication standard that “specifies the air interface, including the medium access control layer and multiple physical layer specifications, of fixed [broadband wireless access, BWA] systems... It consolidates IEEE Std 802.16, IEEE Std 802.16a, and IEEE Std 802.16c, retaining all modes and major features without adding modes.” Ex-1008, 37; Ex-1003, 74. In particular, IEEE802.16-2004 discloses a physical layer (PHY) “WirelessMAN-OFDMA PHY” specification which is “based on OFDM modulation.” *Id.*; Ex-1008, 529, §8.4.

IEEE802.16-2004 specifies a standard for a “**base station (BS)**” communicating with a “**subscriber station (SS)**.” Ex-1008, Title, 43 (definition 3.5), 47 (definition 3.56); Ex-1003, 75. The signaling structure consists of time domain “OFDMA **symbol[s]**” and frequency domain “**subcarriers.**” *Id.*; Ex-1008, 530 (§§8.4.2.1, 8.4.2.2).

Resource allocation in IEEE802.16-2004 is based on a “**minimum possible**

data allocation unit” which consists of “one **slot**” in time (each slot consisting of multiple OFDMA symbols⁵) and “one **subchannel**” in frequency (each subchannel being a “subset” of subcarriers). Ex-1008, 532 (§8.4.3.1), 530 (§8.4.2.2); Ex-1003, 76. Based on this “minimum possible data allocation unit,” IEEE802.16-2004 specifies a “**data region**” as a “two-dimensional allocation of a group of contiguous subchannels, in a group of contiguous OFDMA symbols.” *Id.*; Ex-1008, 532 (§8.4.3.1), Fig. 215 (below).

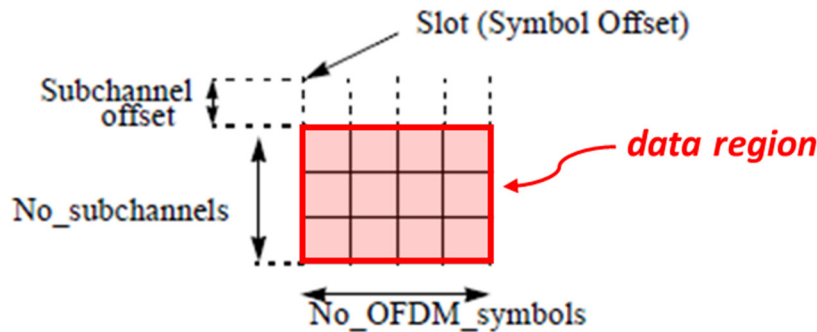


Figure 215—Example of the data region which defines the OFDMA allocation

Ex-1008, Figure 215 (annotated)

IEEE802.16-2004 provides an example of allocating a “data region” using a “minimum possible data allocation unit” consisting of one subchannel (in frequency) and one slot (in time) in Figure 216 (below, annotated). Ex-1003, 77.

⁵ For example, each slot consists of “two OFDMA symbols” in the mode of “partial usage of subchannels” (PUSC). Ex-1008, 532 (§8.4.3.1); Ex-1003, 76.

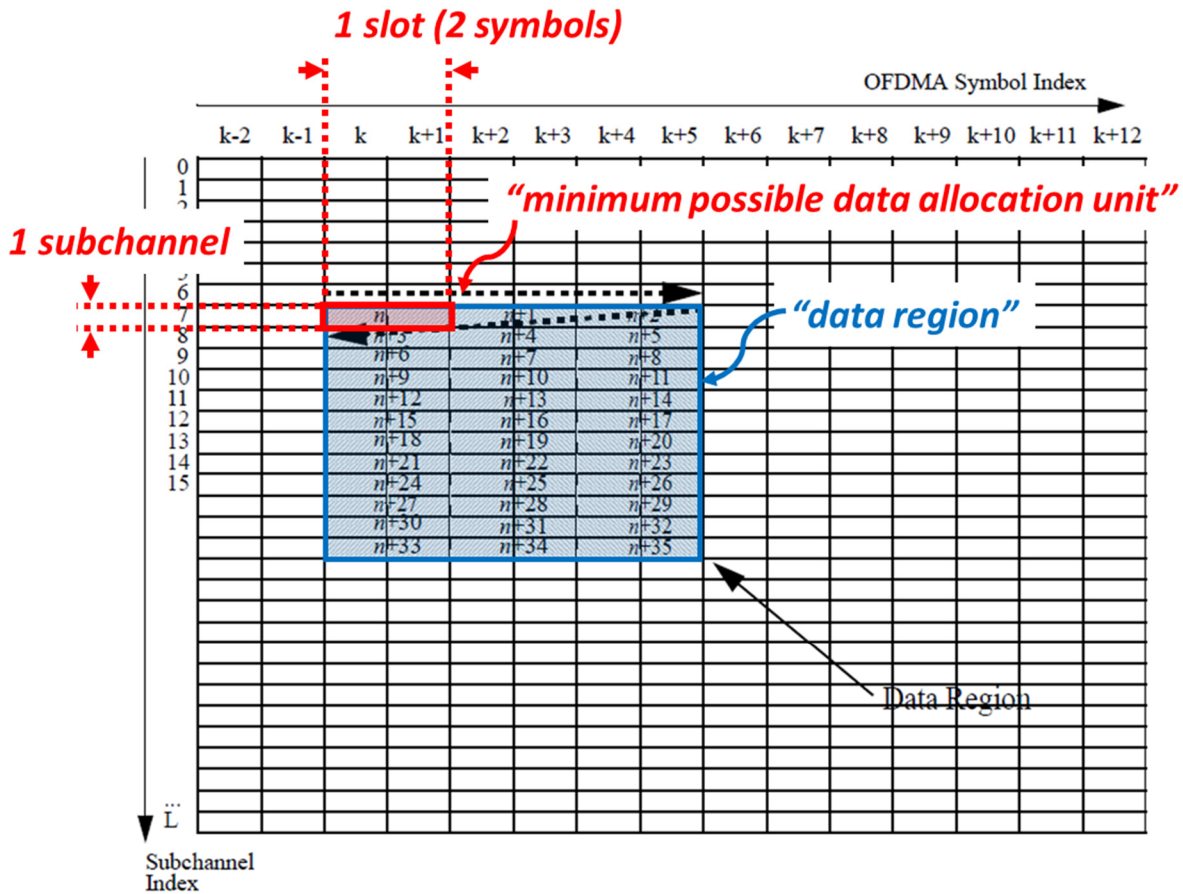


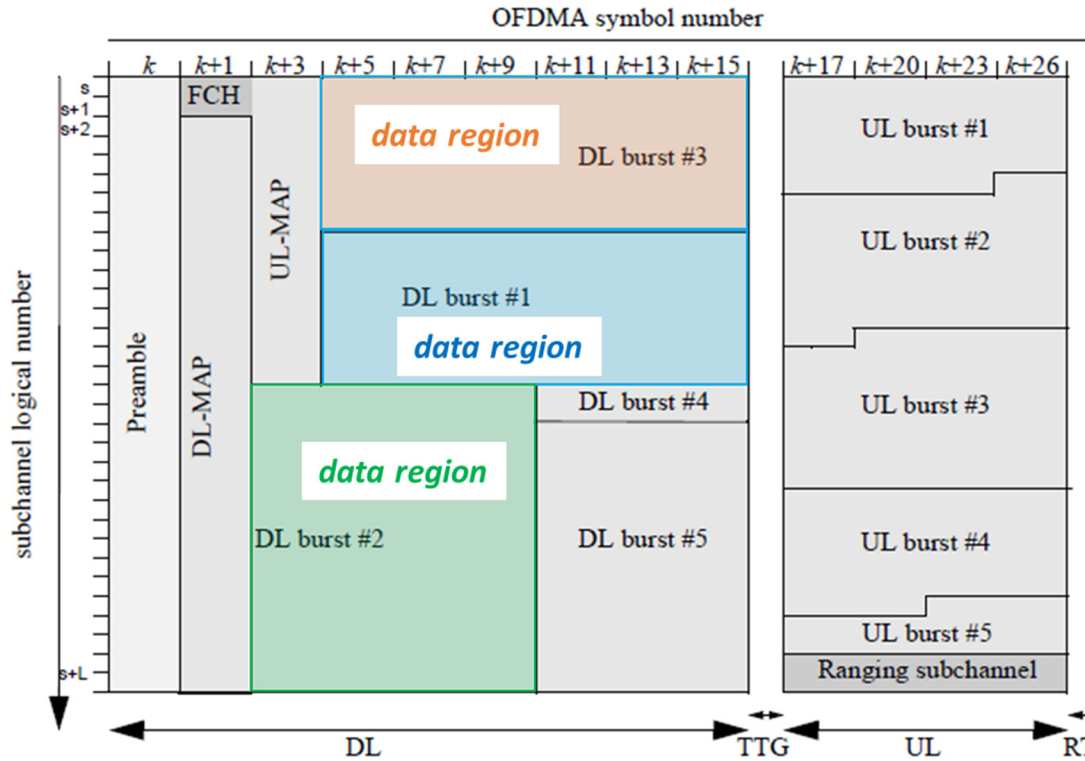
Figure 216—Example of mapping OFDMA slots to subchannels and symbols in the downlink (in PUSC mode)

Ex-1008, Figure 216 (annotated)

IEEE802.16-2004 specifies that “data shall be processed ... and shall be mapped to an OFDMA Data Region.” Ex-1008, 533 (§8.4.3.4, first paragraph); Ex-1003, 78. Each “data region” is allocated for transmission of a “burst” of information for a particular subscriber station. *Id.*; Ex-1008, 533 (§8.4.3.4, first paragraph, subsection 8.4.9.2.3.5.6 “Modulation order of DL traffic **burst**”).

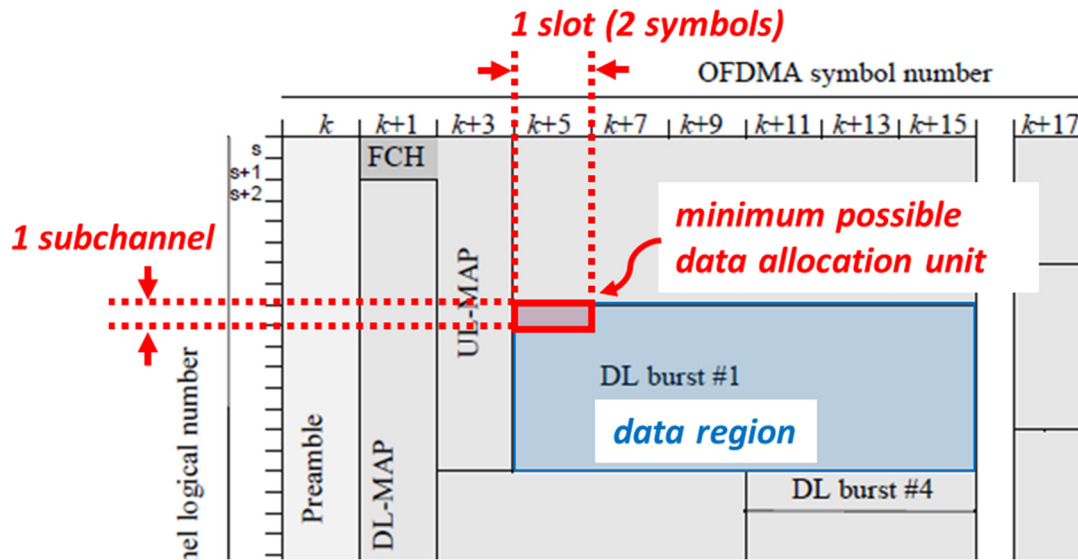
IEEE802.16-2004 provides an example of allocating resources to different down-

link “bursts” (“DL bursts”) in a frame. Ex-1008, Fig. 218 (below, annotated to illustrate a single “minimum possible data allocation unit” within a data region).⁶



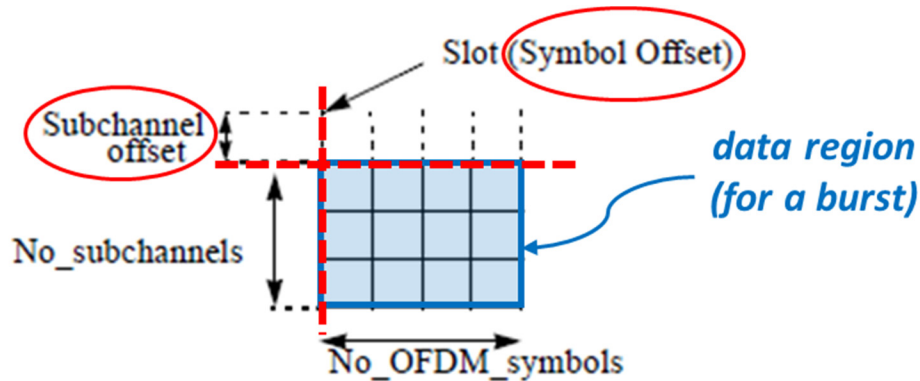
Ex-1008, Figure 218 (annotated)

⁶ In Figure 218, the time axis shows increments of 2 OFDMA symbols (e.g., “ $k+5$ ” is followed by “ $k+7$ ”) and therefore shows increments in units of slots (each consisting of 2 OFDMA symbols for IEEE802.16-2004’s PUSC mode).



Ex-1008, Figure 218 (annotated)

IEEE802.16-2004 specifies that the location of each data region (allocated for a “burst” of information) is identified in time by a “**symbol offset**” (or, alternatively, a “slot” offset) and in frequency by a “**subchannel offset**,” shown in Figure 215 (below, annotated). Ex-1008, 558 (end of §8.4.5.3); Ex-1003, 79.



Ex-1008, Figure 215 (annotated)

IEEE802.16-2004 specifies a “**frame structure**,” shown in Figure 218 (below, annotated). Ex-1008, page 535 (§8.4.4); Ex-1003, 80. Each frame includes

(in addition to data regions allocated to various “bursts”) a “DL-MAP” message located in the beginning part of the frame. *Id.*; Ex-1008, Table 275, Figure 218 (below, annotated).

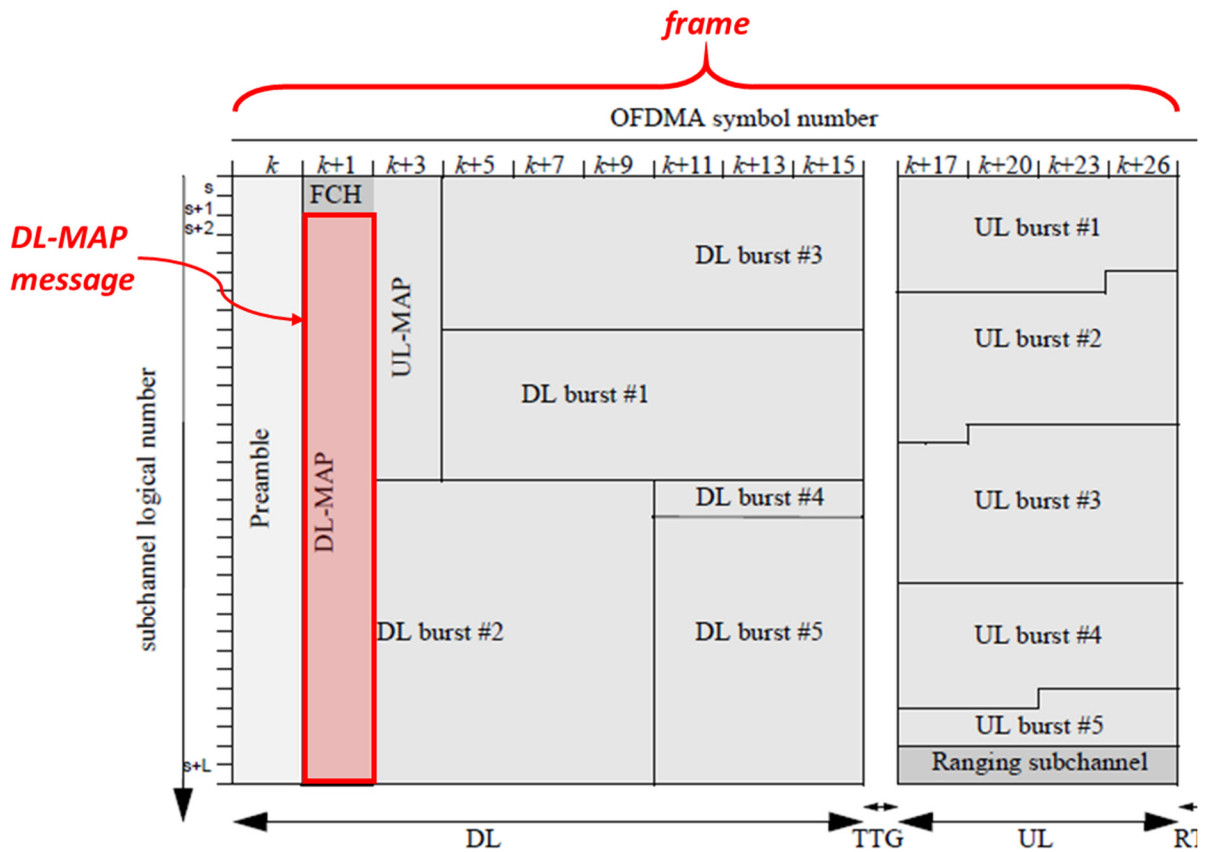


Figure 218—Time plan - one TDD time frame (with only mandatory

Ex-1008, Figure 218 (annotated)

This DL-MAP message includes information that “defines a two-dimensional allocation pattern” of each burst, and information regarding the

assignment of a “connection identifier (CID).”⁷ Ex-1008, 557 (§8.4.5.3), 43 (definition 3.13), Table 275, Figure 218; Ex-1003, 81. As shown in Table 275 (below, annotated), the DL-MAP message includes the time-domain “OFDMA **Symbol offset**” of a burst (indicating the “offset of the OFDMA symbol in which the burst starts”), the frequency-domain “**Subchannel offset**” of a burst (indicating the “lowest index OFDMA subchannel used for carrying the burst”), and the “**No. Subchannels**” in a burst (indicating the “**number of subchannels** with subsequent indexes, used to carry the burst”). *Id.*; Ex-1008, 558, Table 275. In addition, the DL-MAP message includes the “**connection identifier (CID)**.” Ex-1008, Table 275.

⁷ This is consistent with the Background Section of the '450 patent, which acknowledges that, in the IEEE 802.16 standard, “[s]pecial scheduling messages, DL-MAP ... , are utilized to broadcast the scheduling decisions to the mobile stations” and “a 16 bits connection ID (CID) ... is included in the MAP message to identify the mobile station” Ex-1001, 1:47-55; Ex-1003, 81.

Table 275—OFDMA **DL-MAP** IE format

Syntax	Size	Notes
DL-MAP_IE() {		
DIUC	4 bits	
if (DIUC == 15) {		
Extended DIUC dependent IE	<i>variable</i>	See subclauses following 8.4.5.3.1
} else {		
if (INC_CID == 1) {		The DL-MAP starts with INC_CID = 0. INC_CID is toggled between 0 and 1 by the CID-SWITCH_IE() (8.4.5.3.7)
N_CID	8 bits	Number of CIDs assigned for this IE
for (n=0; n< N_CID; n++) {		
CID	16 bits	
}		
}		
OFDMA Symbol offset	8 bits	
Subchannel offset	6 bits	
Boosting	3 bits	000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;
No. OFDMA Symbols	7 bits	
No. Subchannels	6 bits	
Repetition Coding Indication	2 bits	0b00 – No repetition coding 0b01 – Repetition coding of 2 used 0b10 – Repetition coding of 4 used 0b11– Repetition coding of 6 used

Ex-1008, Table 275 (annotated)

3. The Kim-IEEE802.16-2004 Combination

As discussed in §III.A.1, Kim describes an “**IEEE 802.16a** system” that “uses Orthogonal Frequency Division Multiple Access (OFDMA).” Ex-1005, Abstract, [0006], [0007]; Ex-1003, 82. A POSITA would have understood that IEEE802.16-2004 is an updated version of the IEEE 802.16a standard, and “consolidates IEEE Std 802.16, IEEE Std 802.16a, and IEEE Std 802.16c, retaining all modes and major features without adding modes.” *Id.*; Ex-1008, 37. Therefore, a POSITA would have understood that the teachings of IEEE802.16-2004 were directly applicable to Kim. *Id.* Furthermore, a POSITA would have understood that incorporating the teachings of IEEE802.16-2004 into Kim’s network would have involved use of a known technique (e.g., the known techniques specified in the IEEE 802.16 standard) to known devices (e.g., Kim’s network based on the IEEE 802.16 standard), ready for improvement to yield predictable results. *Id.*

A POSITA would have implemented the network of Kim by utilizing at least the following details specified in IEEE802.16-2004 (a combination hereinafter referred to as “Kim-IEEE802.16-2004”): **(a)** a POSITA would have utilized IEEE802.16-2004’s “connection ID (**CID**)” to assign **identifiers** to Kim’s mobile stations, and **(b)** a POSITA would have utilized IEEE802.16-2004’s “**symbol offset**” and “**subchannel offset**” to implement Kim’s “**location information**”

which identifies the location of Kim's channel resources. Ex-1003, 83.

(a) A POSITA Would Have Utilized IEEE802.16-2004's "CID" as Identifiers for Kim's Mobile Stations

As discussed in §III.A.1, when Kim's base station transmits a frame, "each mobile station first detects the CTRL part from the frame 1220 to determine whether its own data has been transmitted" and thus "determine whether a signal transmitted by a base station is a signal transmitted to the mobile station itself." Ex-1005, [0072], [0085], Figs. 11, 12; Ex-1003, 84.

Although Kim does not provide details of how a mobile station is able to utilize the "CTRL part" of a frame to "determine whether its own data has been transmitted," a POSITA would have understood that such details are provided in the IEEE 802.16-2004 standard. Ex-1003, 85.

As discussed in §§III.A.2, IEEE802.16-2004 specifies that each frame includes a "DL-MAP" message in the beginning part of each frame. Ex-1008, Table 275, Figure 218; Ex-1003, 86. The DL-MAP includes a "connection identifier (CID)" as a "16-bit value that identifies a connection to equivalent peers in the MAC of the base station (BS) and subscriber station (SS)." Ex-1008, 43 (definition 3.13), Table 275, Figure 218. IEEE802.16-2004 further specifies that "each SS [subscriber station] joining the IEEE Std 802.16 system shall request a dedicated CID" and "[t]he SS's Basic CID ... is the first static CID the BS assigns

to an SS during initial ranging.” Ex-1008, 56 (§5.1.2.4, last paragraph), 309 (last paragraph, §7.2.1).

Consistent with Kim, IEEE802.16-2004 explains the CID is utilized for the purpose of determining whether data in a frame is intended for a particular station: “[t]he SSs check the CIDs in the received PDUs [protocol data units] and retain only those PDUs addressed to them.” Ex-1008, 67 (§6.1, first paragraph); 69, §6.3.1.1 (“[t]he CID can be considered a connection identifier ... since it serves as a pointer to destination and context information”); Ex-1003, 87.

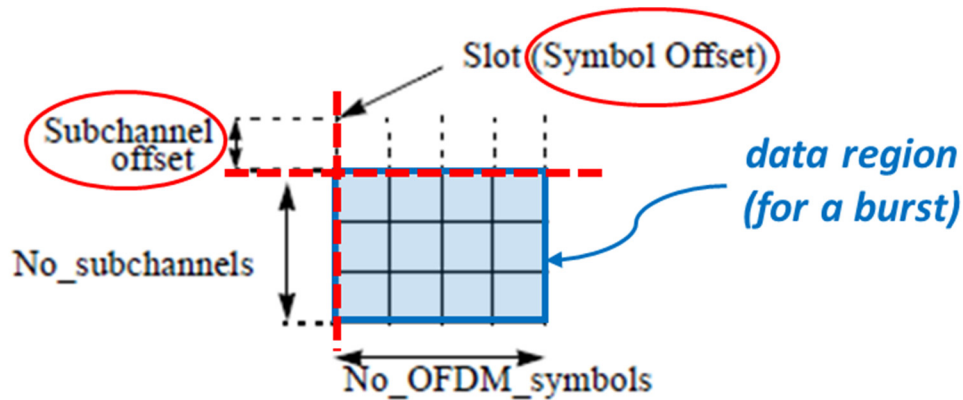
Therefore, a POSITA would have found it obvious to implement Kim’s feature of a mobile station detecting the “CTRL part” of each frame to determine “whether its own data has been transmitted” using the “connection ID (CID)” indicated in the “DL-MAP” message at the beginning of each frame, as specified in IEEE802.16-2004. Ex-1003, 88. Thus, a POSITA would have understood that the “CID” specified in IEEE802.16-2004 would be transmitted, by a base station to a mobile station, as part of Kim’s “CTRL part” in each frame. *Id.*

(b) A POSITA Would Have Utilized IEEE802.16-2004’s “Symbol Offset” and “Subchannel Offset” to Indicate the Location of Kim’s Channel Resources

As discussed in §§III.A.1, Kim explains that a “mobile station should correctly receive information” regarding “channel resources allocated to each user.”

Ex-1005, [0072]; Ex-1003, 89. Specifically, Kim's "control message" (i.e., the CTRL part at the beginning of each frame) is "transmitted from a base station to a mobile station" and "includes **location information** in a frame where user data is multiplexed every transmission frame." *Id.*; Ex-1005, [0073], [0075], [0085], FIGS. 11, 12. When Kim's mobile station receives the control message, it "detects **location information** in a multiplexed frame of data," allowing the mobile station to decode the "user data" from the frame. Ex-1005, [0081]-[0082].

Although Kim does not provide details of how the "location information" indicates "where user data is multiplexed every transmission frame," a POSITA would have understood that such details are provided in IEEE 802.16-2004. Ex-1003, 90. As discussed in §III.A.2, IEEE802.16-2004 specifies that the "DL-MAP" message (in the beginning of each frame) includes information regarding an "OFDMA **Symbol offset**" and a "[s]ubchannel offset." which identify the location of a "data region" (allocated for a "burst" of information) within the frame. Ex-1008, 558 (end of §8.4.5.3), Figure 215 (below, annotated); Ex-1003, 90.



Ex-1008, Figure 215 (annotated)

A POSITA would have understood that IEEE802.16-2004’s “OFDMA **Symbol offset**” and “[s]ubchannel offset” (for locating a “data region” allocated to a “burst”) are appropriate for implementing Kim’s “**location information**” of “user data” within a frame. Ex-1003, 91. For example, a POSITA would have understood that Kim’s “**channel resources**” assigned to a “user” are analogous to IEEE802.16-2004’s “**data region**” assigned to a “burst” of information, as illustrated in Diagram A, below. Ex-1005, [0011], [0052]–[0054], [0058], Figs. 5, 7, 8; Ex-1008, Figs. 215, 216, §8.4.3.1; Ex-1003, 93.

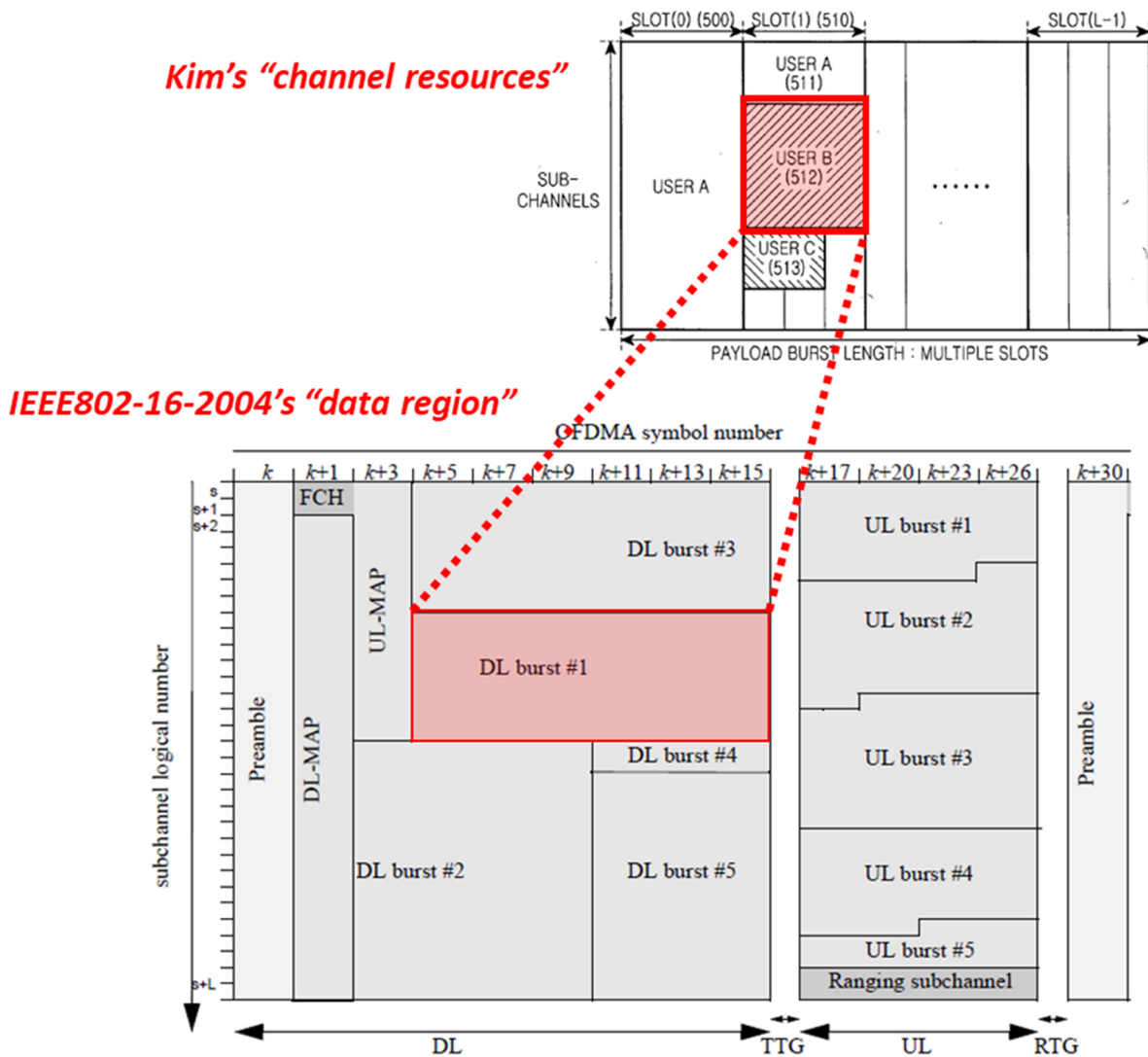


Diagram A

As shown in Diagram A, a POSITA would have understood that Kim's per-user resource allocation is analogous to IEEE802.16-2004's per-burst resource allocation. Ex-1003, 94. This is evidenced, for example, by the similar techniques in which both Kim and IEEE802.16-2004 determine the transmission scheme for Kim's per-user resources and IEEE802.16-2004's burst. *Id.* Both Kim and

IEEE802.16-2004 disclose a “Modulation order Product code Rate (MPR)” as a technique to calculate the “modulation scheme” and “code rate” for transmission over a resource. Ex-1005, [0029], [0046], [0061], [0062], [0067], Equation (4); Ex-1008, 641 (§8.4.9.2.3.5.6), Equation (128); *Id.* Kim discloses that the MPR is calculated “for each multiaccess **user** according to the **number of subchannels**...allocated to each multiaccess **user**, the number of slots...and an EP size allocated to each multiaccess user.” *Id.*; Ex-1005, [0067]. Kim discloses specific equations for calculating the MPR which depend on “the **number of subchannels** allocated to a *k*th **slot**” for a “particular **user**.” Ex-1005, Equation (5), [0063]; *Id.* Consistent with Kim, IEEE802.16-2004 discloses similar equations for calculating the MPR for a “DL traffic **burst**” depending on the “number of allocated subchannels” in the **burst**. *Id.*; Ex-1008, 641 (§8.4.9.2.3.5.6), Equation (128).

Thus, a POSITA would have understood that Kim’s per-user resource allocation is analogous to IEEE802.16-2004’s per-burst resource allocation, and would have found it obvious to utilize IEEE802.16-2004’s “OFDMA **Symbol offset**” and “[s]**ubchannel offset**” (which identifies the location of a “data region” allocated to a “burst”) to implement Kim’s “**location information**” (which identifies the location of “user data” within a frame). Ex-1003, 94.

Specifically, in order to implement Kim’s feature that a mobile station

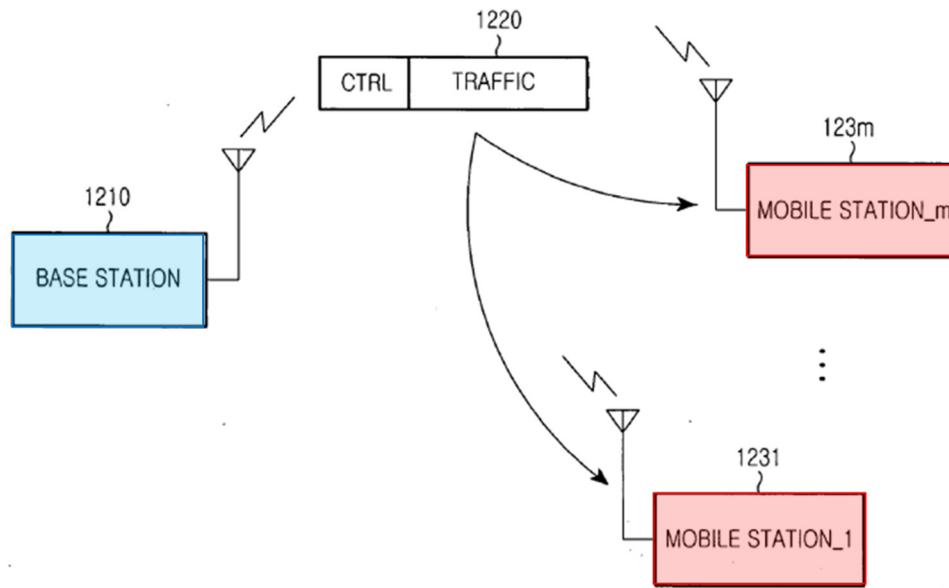
should “detect **location information** in a multiplexed frame of data transmitted to each mobile station,” a POSITA would have understood that Kim’s mobile station would utilize the “OFDMA **symbol offset**” and the “**subchannel offset**” (as specified in IEEE802.16-2004) as part of Kim’s “location information” to identify the resource location of user data within a frame, and thereby achieve Kim’s goal that a mobile station should “correctly receive information on channel resources allocated to each user.” Ex-1005, [0080], [0081]; Ex-1003, 92.

Thus, in the Kim-IEEE802.16-2004 network, the location of a user’s data within a frame is identified by (i) an OFDMA symbol specified by IEEE802.16-2004’s “OFDMA **symbol offset**” in time, and (ii) a subchannel specified by IEEE802.16-2004’s “**subchannel offset**” in frequency. Ex-1003, 95.

4. Claim 1

[1.P1] An operating method for a wireless network comprising at least a base station and a mobile station,

To the extent the preamble is deemed limiting, the Kim-IEEE802.16-2004 network renders it obvious. Ex-1003, 96. Kim discloses “wireless data communication networks” and an “operation between a base station and mobile stations.” Ex-1005, [0005], [0084], [0086], FIG. 12 (below, annotated).



Ex-1005, Fig. 12 (annotated)

This is consistent with IEEE802.16-2004, which is directed to “fixed broadband wireless access systems” that include a “base station (BS)” communicating with a “subscriber station (SS).” Ex-1008, Title, 43 (definition 3.5), 47 (definition 3.56); Ex-1003, 97.

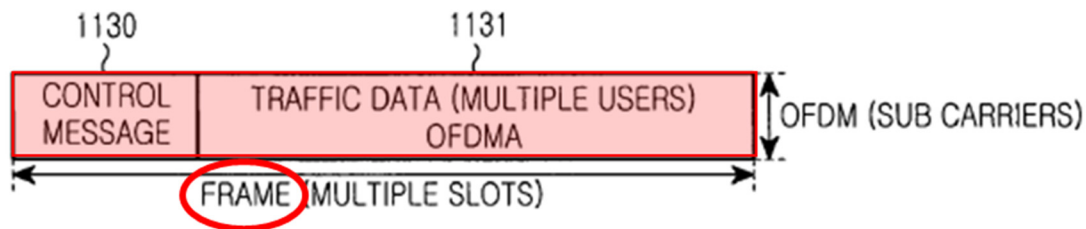
To the extent Patent Owner argues that the Kim-IEEE802.16-2004 network does not disclose a “*mobile*” station because the IEEE 802.16-2004 standard is specified for “**fixed** broadband wireless access systems” and because Kim explains that the IEEE 802.16a standard (the predecessor to IEEE 802.16-2004) “does not guarantee the mobility of a mobile station,” a POSITA would have understood that the ’450 patent itself describes its “mobile devices” as devices which **may be** “**fixed** or may roam.” Ex-1001, 3:40-42; Ex-1003, 98. Therefore, a POSITA

would have understood that Kim-IEEE802.16-2004 discloses a fixed wireless implementation of a “mobile station” which is consistent with the description of the ’450 patent. *Id.*

Thus, the Kim-IEEE802.16-2004 network implements an “*operating method for a wireless network comprising at least a base station and a mobile station.*” Ex-1003, 99.

[1.P2] the wireless network employing a frame structure of multiple frames for transmission,

As discussed in §§III.A.1 and III.A.3, Kim’s base station transmits “user data in a **frame**” such that “user data is multiplexed **every** transmission **frame**.” Ex-1005, [0014], [0075], Fig. 11 (below, annotated); Ex-1003, 100.



Ex-1005, Fig. 11 (annotated)

IEEE802.16-2004 provides additional details of a “frame structure,” shown in Figure 218 (below, annotated). Ex-1008, page 535 (§8.4.4); Ex-1003, 101.

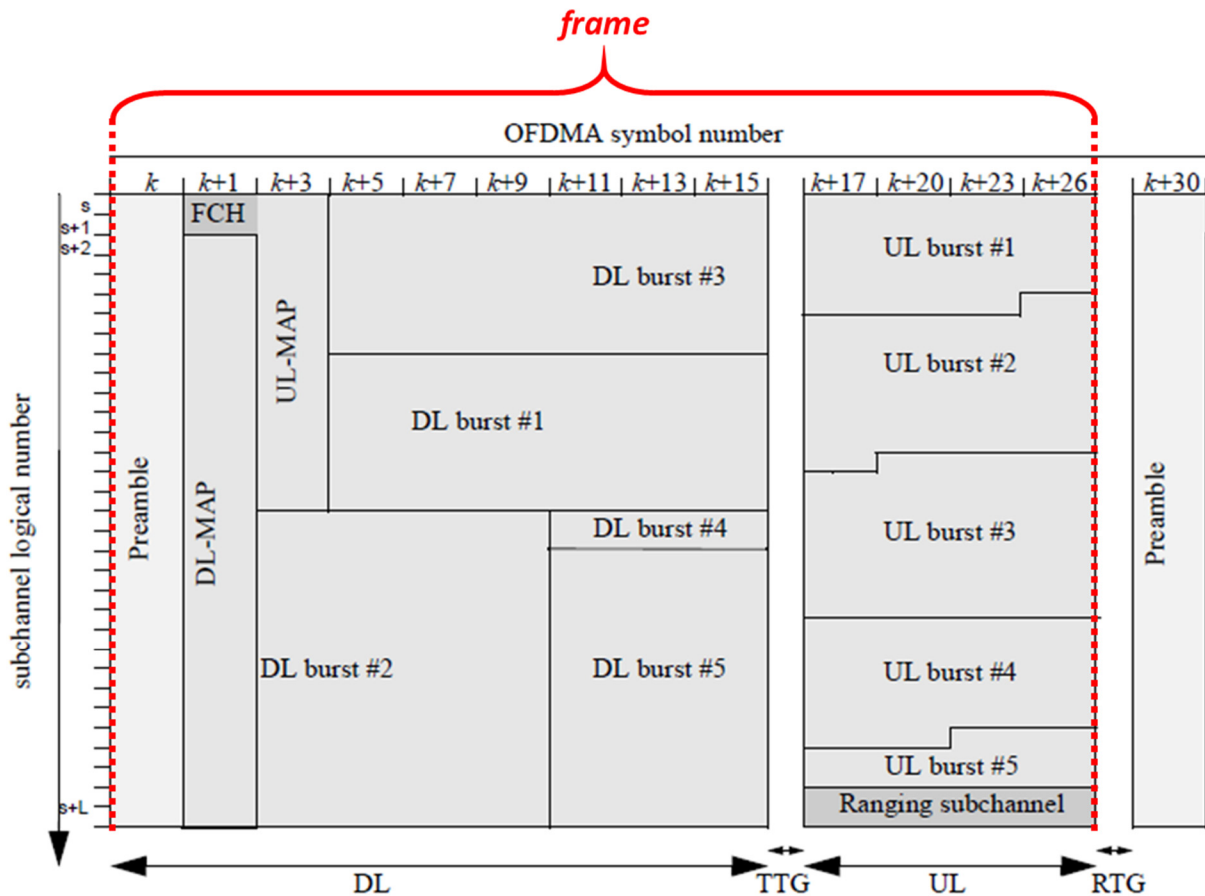


Figure 218—Time plan - one TDD time frame (with only mandatory zone)

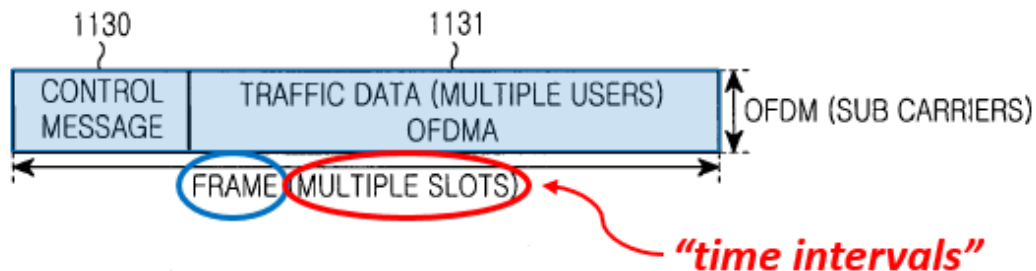
Ex-1008, Figure 218 (annotated)

Thus, the Kim-IEEE802.16-2004 network employs “*a frame structure of multiple frames for transmission.*” Ex-1003, 102.

[1.P3] each frame comprising a plurality of time intervals,

As discussed in §III.A.3, in the Kim-IEEE802.16-2004 network, each frame consists of multiple **time slots** (the claimed “*plurality of time intervals*”). Ex-1005, Figure 11 (below, annotated); Ex-1003, 103. Kim discloses that each

“**SLOT** refers to a transmission duration” which is “used to transmit user data in a frame.” Ex-1005, [0014].



Ex-1005, Fig. 11 (annotated)

Consistent with Kim, IEEE802.16-2004 provides further details of an “OFDMA **slot**” consisting of “two OFDMA symbols” in the mode of “partial usage of subchannels” (PUSC), shown in Figures 216 and 218 (below, annotated). Ex-1008, 532 (§8.4.3.1); Ex-1003, 104.

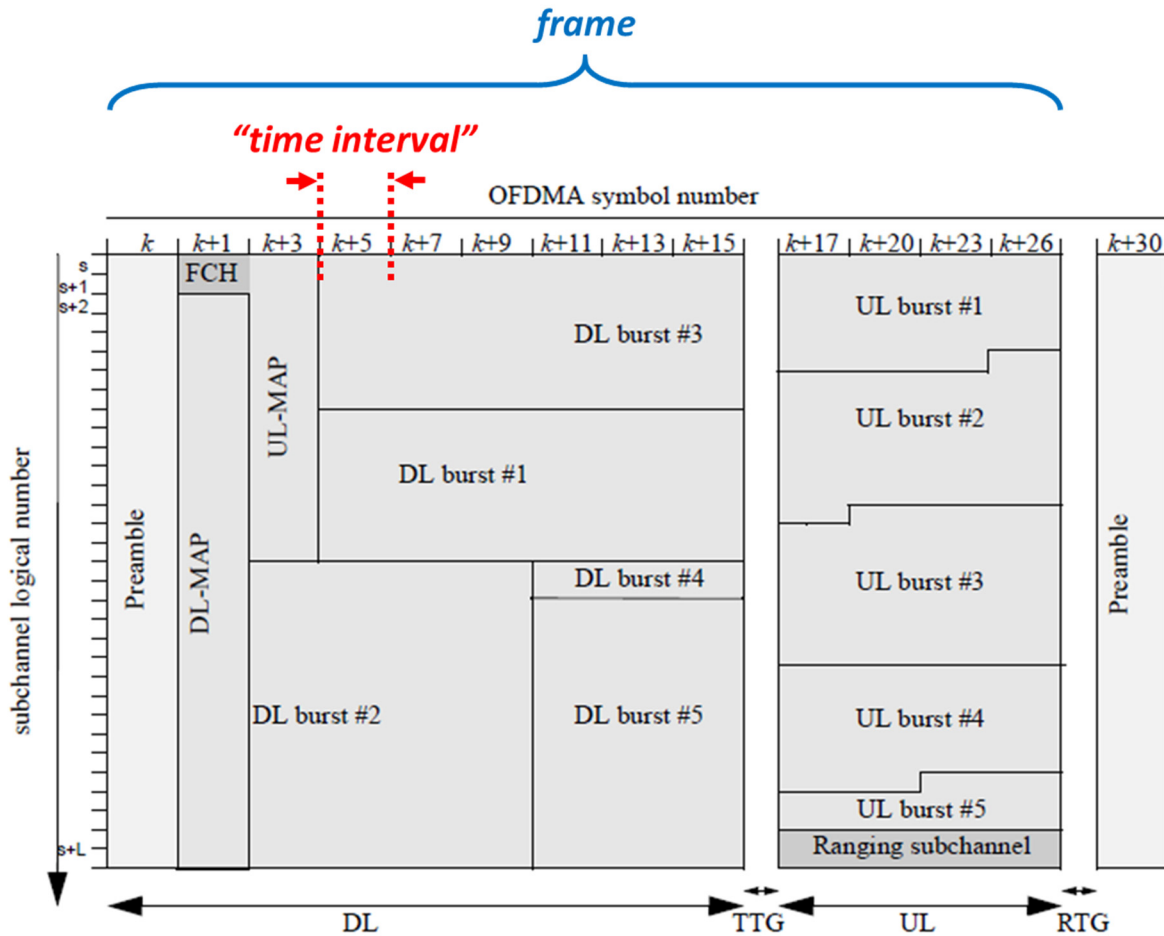


Figure 218—Time plan - one TDD time frame (with only mandatory zone)

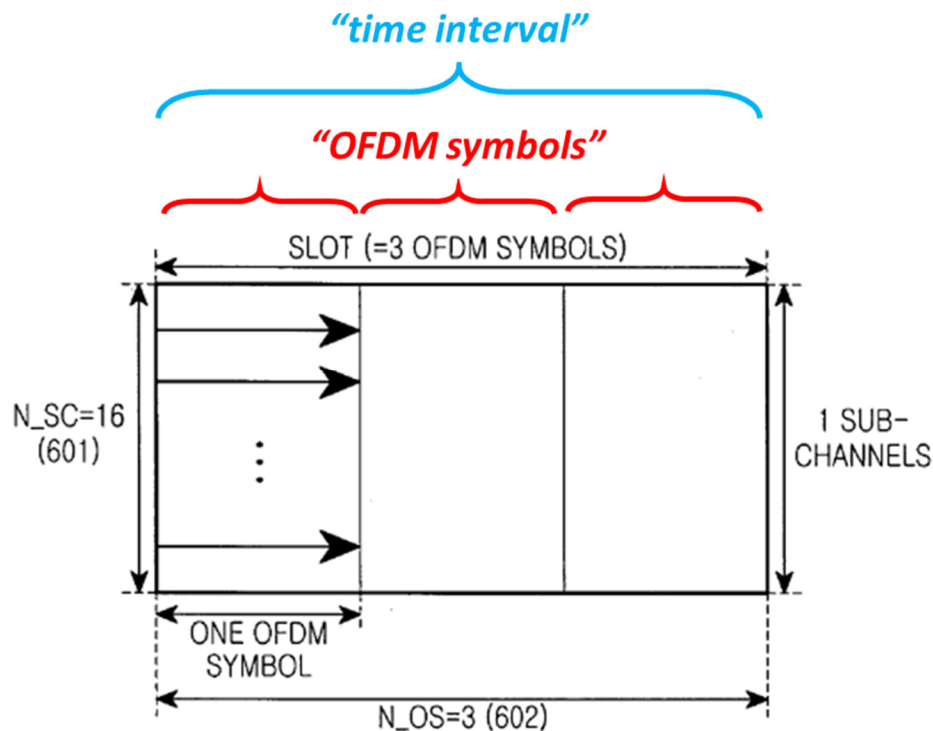
Ex-1008, Figure 218 (annotated)

Thus, the Kim-IEEE802.16-2004 network renders obvious “*each frame comprising a plurality of time intervals.*” Ex-1003, 105.

Such a system is consistent with the ’450 patent, which discloses that a “frame consists of a number of **time slots.**” Ex-1001, 4:64-65, FIG. 3; Ex-1003, 106.

[1.P4] each time interval comprising a plurality of orthogonal frequency division multiplexing (OFDM) symbols, and

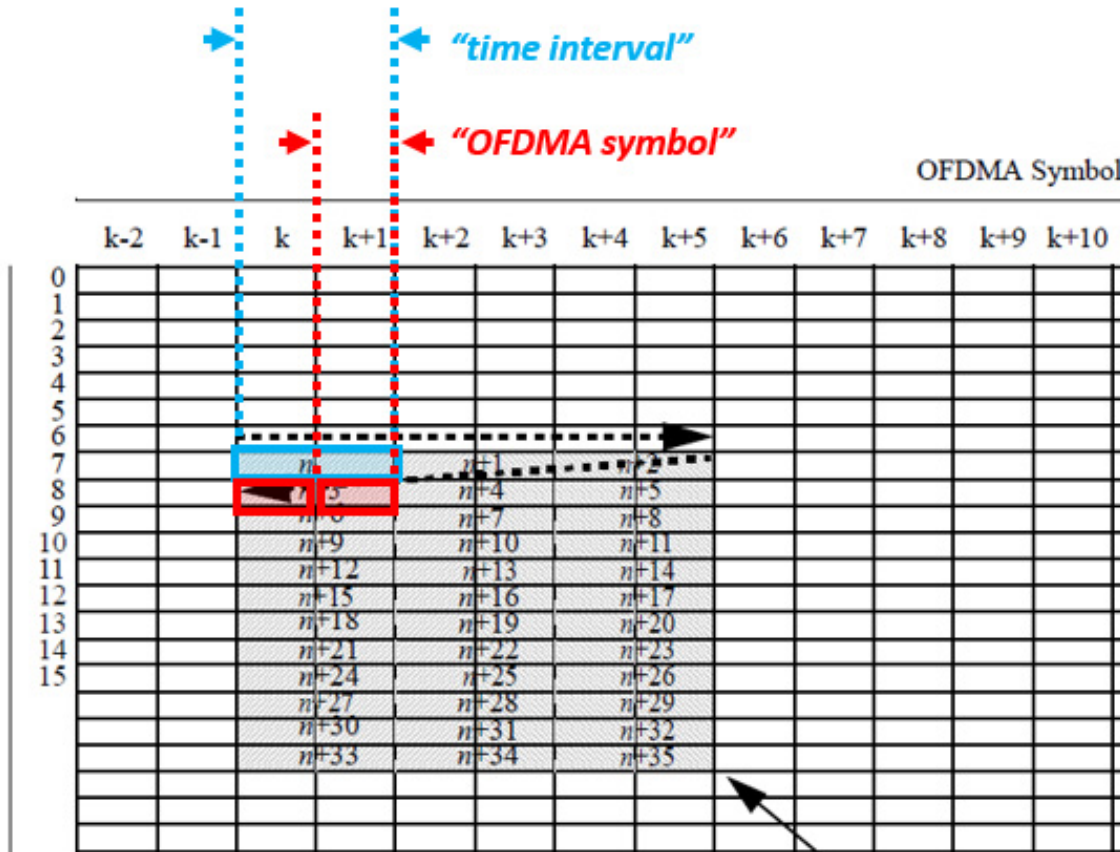
As discussed in §III.A.3, Kim discloses that “one **slot** comprises one or more **OFDM symbols**.” Ex-1005, [0014]; Ex-1003, 107. Kim provides an example of a **slot** with “three OFDM symbols” (e.g., Fig. 6, below, annotated), but more generally discloses a **variable** “number of **OFDM symbols** allocated per **slot**” as a **variable** “N_OS.” Ex-1005, [0057]; Ex-1003, 107.



Ex-1005, Fig. 6 (annotated)

IEEE802.16-2004 further specifies that in “OFDMA” mode (which is “based on OFDM modulation,” Ex-1008, 529, §8.4.1, first paragraph), “[e]ach **slot** shall span...two **OFDMA symbols**” for partial usage of subchannels (PUSC), as

shown in Figures 216 and 218 (below, annotated). Ex-1008, 532 (§8.4.3.1), 533 (§8.4.3.4); Ex-1003, 108.



Ex-1008, Figure 216 (annotated)

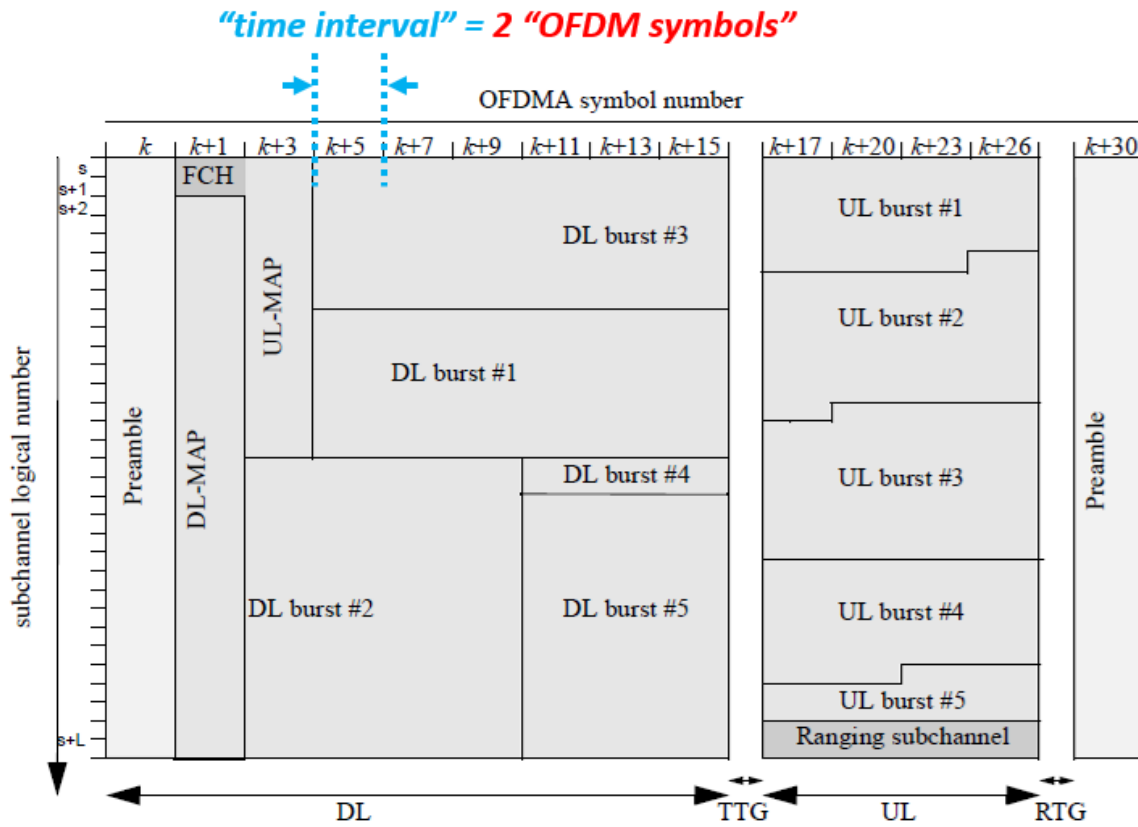


Figure 218—Time plan - one TDD time frame (with only mandatory zone)

Ex-1008, Figure 218 (annotated)

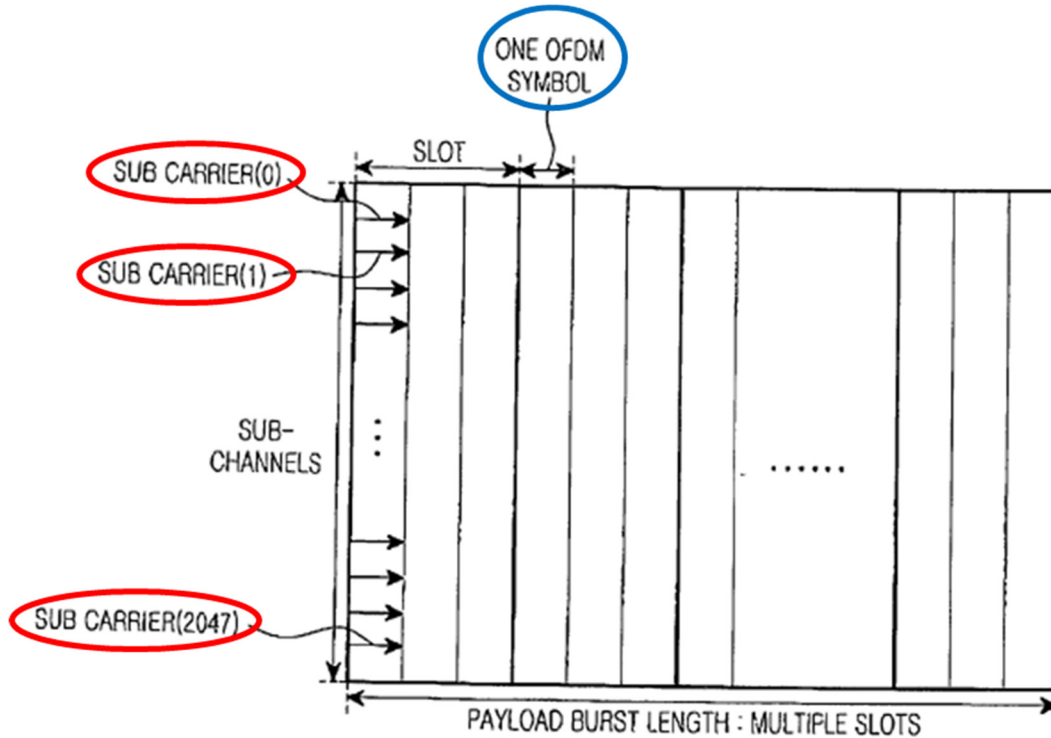
Thus, the Kim-IEEE802.16-2004 network renders obvious “*each time interval comprising a plurality of orthogonal frequency division multiplexing (OFDM) symbols.*” Ex-1003, 109.

This is consistent with the '450 patent, which discloses that “each time slot is comprised of one or more OFDM symbols.” Ex-1001, 4:65-66; Ex-1003, 110.

[1.P5] each OFDM symbol containing a plurality of frequency subcarriers, the method comprising:

As discussed in §III.A.3, Kim discloses a “**number of subcarriers** allocated

per subchannel and **OFDM symbol**” (Fig. 2, below, annotated). Ex-1005, [0014], [0056], [0060]; Ex-1003, 111.



Ex-1005, Fig. 2 (annotated)

Consistent with Kim, IEEE802.16-2004 specifies an OFDMA **symbol** “is made up of **subcarriers**” and defines a parameter “number of used subcarriers” (“N_{used}”) to “characterize the OFDMA symbol.” Ex-1008, 530 (§8.4.2.2); 531 (§8.4.2.3); Ex-1003, 112.

Therefore, the Kim-IEEE802.16-2004 network performs transmission using OFDM symbols, with “*each OFDM symbol containing a plurality of frequency subcarriers.*” Ex-1003, 113.

[1.1] assigning an identifier to the mobile station;

Prior art knowledge of “***assigning an identifier to the mobile station***” is acknowledged in the Background of the ’450 patent itself, which acknowledges that the IEEE 802.16 standard specifies a 16-bit “connection ID (**CID**)...to identify the mobile station.” Ex-1001, 1:51-55; Ex-1003, 114. Therefore, a POSITA would have understood that assignment of an identifier was part of a POSITA’s general knowledge, as evidenced by the Background of the ’450 patent, and would have understood that assignment of an identifier was an obvious solution and design choice based on this general knowledge. Ex-1003, 114.

Such prior art knowledge is further evidenced in Kim and IEEE802.16-2004. As discussed in §III.A.3(a), the Kim-IEEE802.16-2004 network assigns a connection identifier (CID) to each of Kim’s mobile stations. Ex-1005, [0072], [0085]; Ex-1008, Table 275, Figure 218, 43 (definition 3.13); Ex-1003, 115. The CID would be included in Kim’s “control message” (“CTRL” part) of a frame, so as to implement Kim’s feature that “each mobile station first detects the CTRL part from the frame 1220 to determine whether its own data has been transmitted.” Ex-1005, [0085]; Ex-1003, 115.

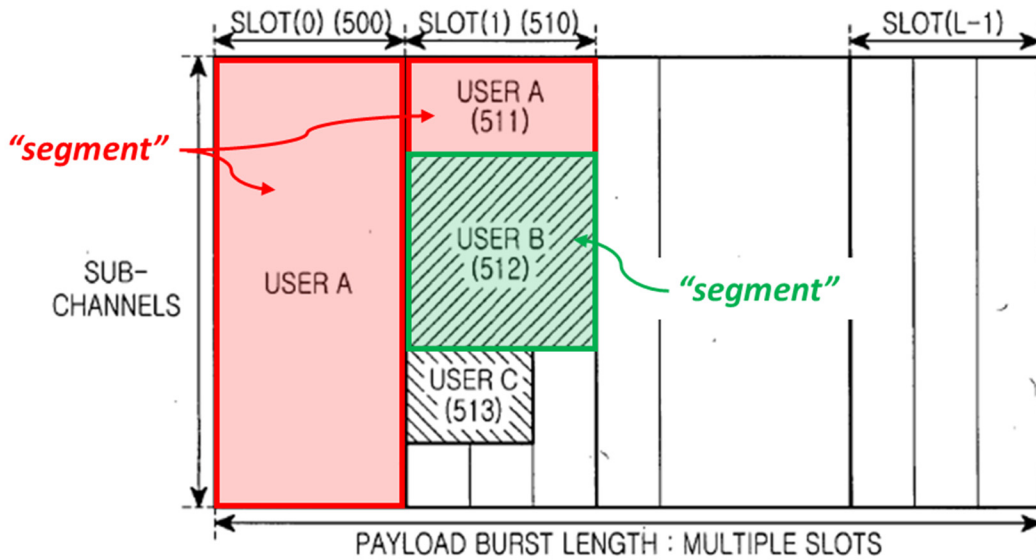
Thus, a POSITA would have understood that the Kim-IEEE802.16-2004 network assigns a connection ID (**CID**) (the claimed “***identifier***”) to each of Kim’s mobile stations. Ex-1003, 116.

[1.2] transmitting a signal containing information from the base station to the mobile station over a segment of time-frequency resource,

As discussed in §III.A.1, Kim discloses that information for the user is transmitted over “channel resources” consisting of multiple subchannels in frequency (e.g., a *frequency resource*) and one or more slots in time (e.g., a *time resource*).

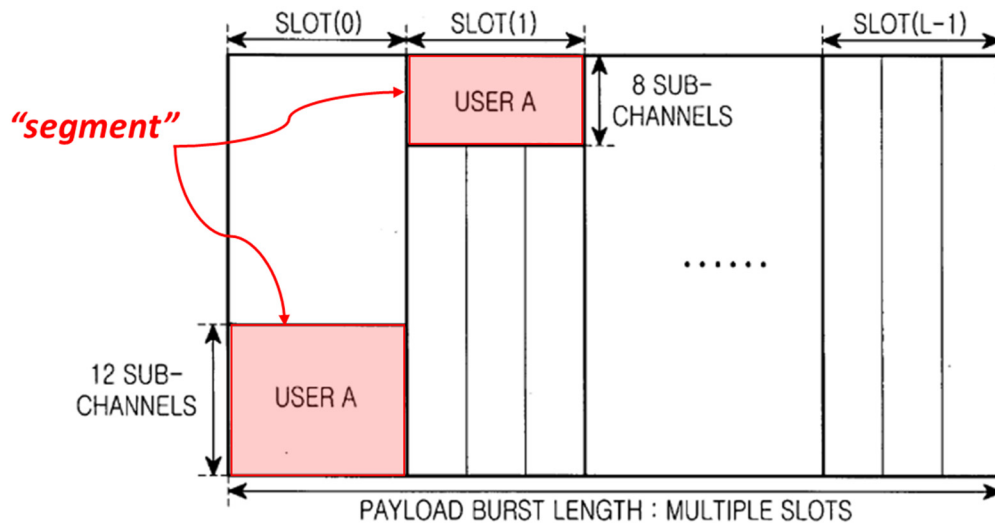
Ex-1005, [0058], Fig. 5; Ex-1003, 118. The multiple subchannels in frequency and one or more slots in time collectively comprise a “*time-frequency resource*.” *Id.*

Kim provides an example, in FIG. 5, in which “user A is allocated all of the subchannels of a first slot SLOT(0) 500 and occupies some subcarriers of a second slot SLOT(1)” and “user B occupies some other subcarriers of the second slot SLOT(1) 510.” Ex-1005, [0058], Fig. 5 (below, annotated); Ex-1003, 119. Each group of resources (the claimed “*segment*”) is allocated for transmission of a particular user’s information, from the base station to the mobile station. Ex-1005, [0061]-[0067]; *Id.*



Ex-1005, Fig. 5 (annotated)

Another example is shown in Figure 7 (below, annotated), where user A is allocated 12 subchannels in the first slot (SLOT 0) and 8 subchannels in the second slot (SLOT 1). Ex-1005, Fig. 7 (below, annotated); Ex-1003, 120.



Ex-1005, Fig. 7 (annotated)

With these assignments in both time (e.g., x-axis time slots) and frequency

(e.g., y-axis subcarriers), Kim discloses that user A and user B are allocated “channel resources” (the claimed “*segment of time-frequency resource*”) consisting of multiple subchannels in frequency and one or more slots in time, over which information is transmitted to the user. Ex-1003, 121.

Thus, a POSITA would have understood that the Kim-IEEE802.16-2004 network transmits “*a signal containing information from the base station to the mobile station over a segment of time-frequency resource.*” Ex-1003, 122.

[1.3] the segment having a starting time-frequency coordinate and

Prior art knowledge of transmission of a “*starting time-frequency coordinate*” for resource allocation is acknowledged in the Background Section of the ’450 patent itself, which explains that, according to the existing IEEE 802.16 standard, “resource allocation is identified in the time domain scale with a **start symbol offset** (8 bits)...and in the frequency domain scale with a **start logical subchannel offset** (6 bits).” Ex-1001, 1:60-66; Ex-1003, 123. Therefore, a POSITA would have understood prior art knowledge of transmission of a resource allocation that is identified in time by a **start symbol offset**, and is identified in frequency by a **start logical subchannel offset** (collectively, the claimed “*starting time-frequency coordinate*”). *Id.* Indeed, a POSITA would have found transmission of a resource allocation using a starting time-frequency coordinate as

being part of a POSITA's general knowledge, as evidenced by the Background of the '450 patent, and would have found transmission of a starting time-frequency coordinate to have been an obvious solution and design choice based on this general knowledge. Ex-1003, 123.

Such prior art knowledge is further evidenced in Kim and IEEE802.16-2004. Ex-1003, 124. As discussed in §III.A.3(b), in the Kim-IEEE802.16-2004 network, the location of a user's data within Kim's frame is identified by (i) an OFDMA symbol in time specified by IEEE802.16-2004's "OFDMA **symbol offset**," and (ii) a subchannel in frequency specified by IEEE802.16-2004's "**subchannel offset**" (collectively, the claimed "*starting time-frequency coordinate*"). *Id.*

Specifically, as discussed in §§III.A.1 and III.A.3(b), Kim discloses "**location information**" included in a "control message" "**transmitted from** a base station to a mobile station," which specifies a location "**in a frame** where user data is multiplexed every transmission frame." Ex-1005, [0073], [0075]; Ex-1003, 125. Upon receiving this control message, Kim's mobile station "**detects location information** in a multiplexed frame of data" to recover the "user data" from the frame. Ex-1005, [0081]-[0082].

As discussed in §§III.A.2 and III.A.3(b), IEEE802.16-2004 specifies the location of a "data region" (for transmitting a "burst" of information) by an "OFDMA **Symbol offset**" and a "**[s]ubchannel offset**." Ex-1008, 558 (end of

§8.4.5.3), Figures 215, 218 (below, annotated); Ex-1003, 126. The “OFDMA Symbol offset” is “[t]he offset of the OFDMA symbol in which the burst starts, measured in OFDMA symbols from beginning of the downlink frame” and the “[s]ubchannel offset” is “[t]he lowest index OFDMA subchannel used for carrying the burst, starting from subchannel 0.” Ex-1008, 558 (end of §8.4.5.3).

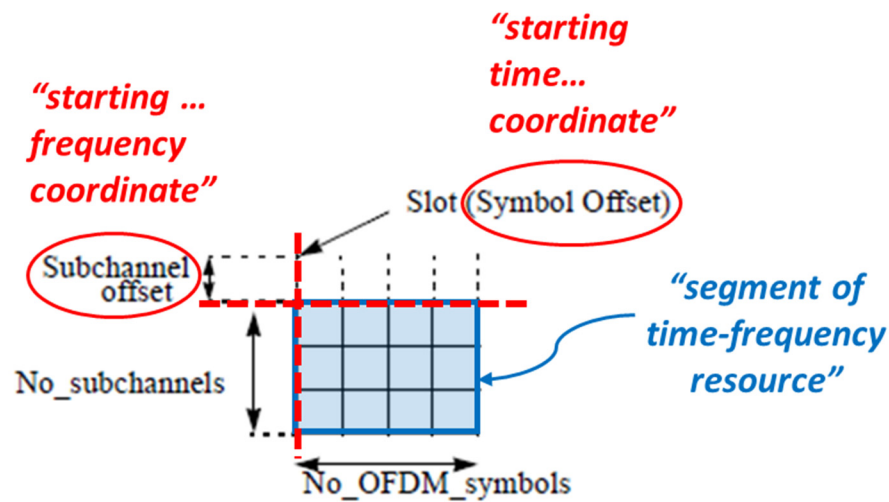


Figure 215—Example of the data region which defines the OFDMA allocation

Ex-1008, Figure 215 (annotated)

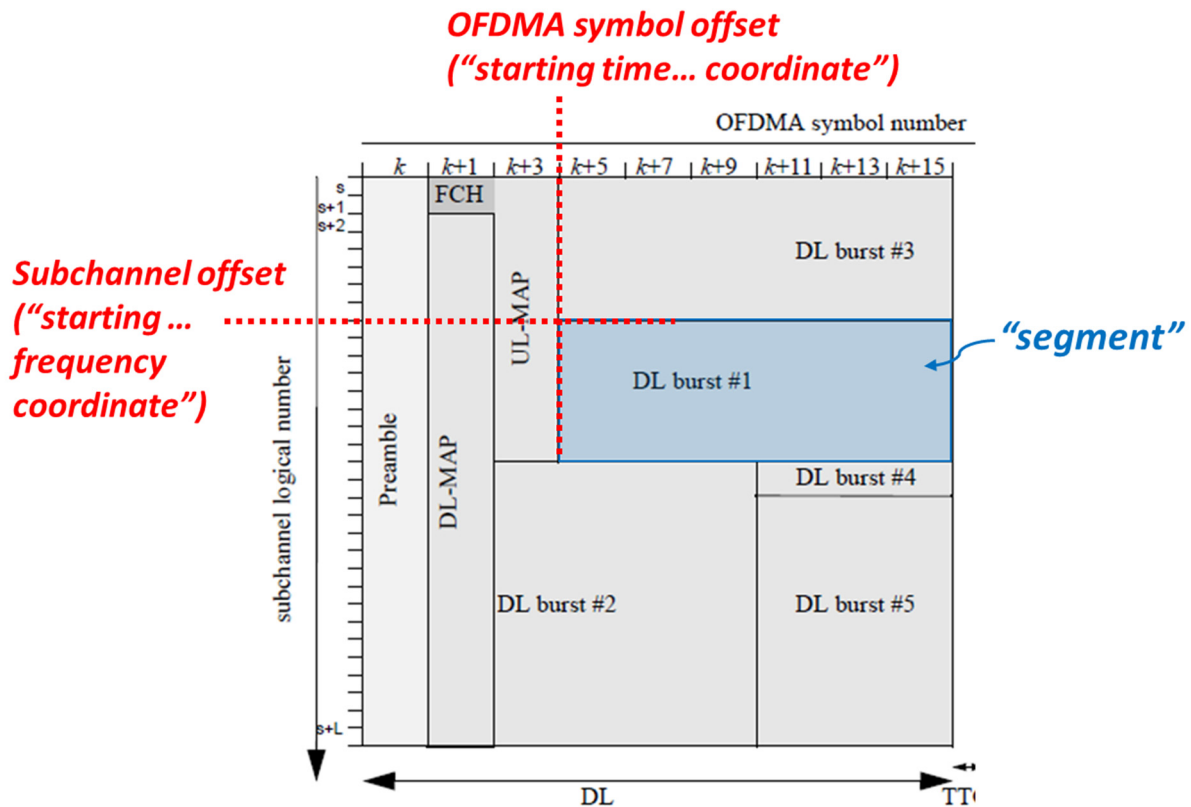


Figure 218—Time plan - one TDD time frame

Ex-1008, Figure 218 (annotated)

In the Kim-IEEE802.16-2004 network, a data region (the claimed “*segment*”) allocated to a “burst” of information for Kim’s user data is transmitted with (i) a “*starting time ... coordinate*” which is an OFDMA symbol specified by IEEE802.16-2004’s “OFDMA symbol offset,” and (ii) a “*starting ... frequency coordinate*” which is a subchannel specified by IEEE802.16-2004’s “subchannel offset” (collectively, the claimed “*starting time-frequency coordinate*”). Ex-1003, 127.

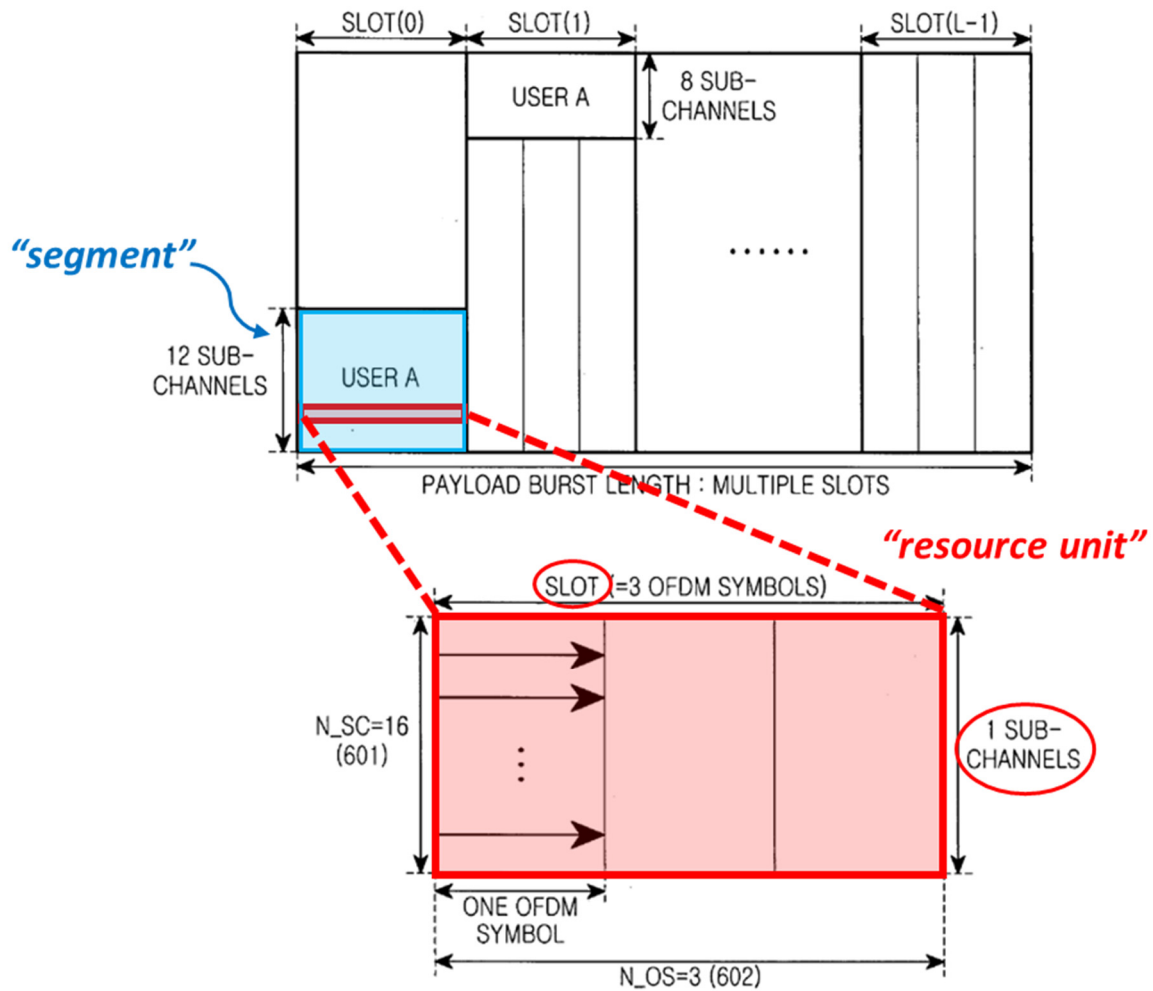
Thus, a POSITA would have understood that, in the Kim-IEEE802.16-2004

network, a resource segment is transmitted with a “*starting time-frequency coordinate*.” Ex-1003, 128.

[1.4] the segment comprising N time-frequency resource units within a time interval,

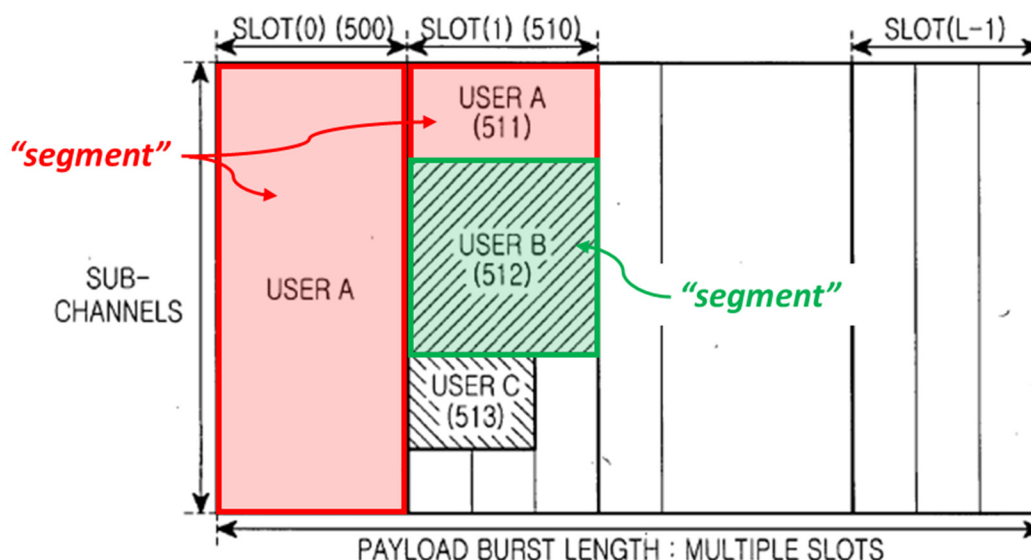
In the Kim-IEEE802.16-2004 network, a resource *segment* includes multiple resource units, each resource unit defined by a single subchannel (in frequency) and a single slot (in time). Ex-1003, 129

As discussed in §III.A.3(b), the Kim-IEEE802.16-2004 network allocates resources in multiples of a “subchannel” in frequency and a “slot” in time, which Kim refers to as a “channel resource” and which IEEE802.16-2004 refers to as a “**minimum possible data allocation unit**” (the claimed “*resource unit*”). Ex-1005, [0011], [0053], [0054], [0058], Figs. 5, 7, 8; Ex-1008, 532 (§8.4.3.1), 530 (§8.4.2.2); Ex-1003, 130. An example resource allocation is shown in Kim’s Figures 6 and 7 (below, annotated, showing a resource unit of one slot in time and one sub-channel in frequency). Ex-1003, 130.



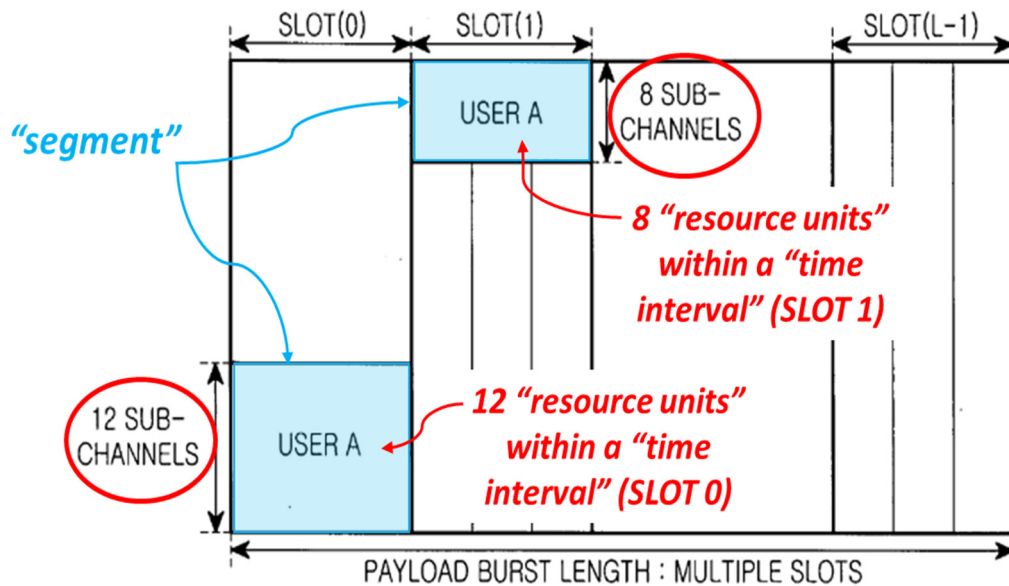
Ex-1005, Figs. 6 and 7 (annotated)

In Figure 5 (below, annotated), Kim shows an example where “user A” is allocated “a different number of subchannels for each slot” (in SLOT(0) and SLOT(1)) and user B “has the same number of subchannels for every slot.” Ex-1005, [0062]; Ex.1003, 131.



Ex-1005, Fig. 5 (annotated)

In Figure 7 (below, annotated), Kim shows an example where “user A transmits an OFDM symbol through **12** subchannels in a first slot SLOT(0) and an OFDM symbol through **8** subchannels in a second slot SLOT(1).” Ex-1005, [0063]; Ex-1003, 132.



Ex-1005, Fig. 7 (annotated)

Therefore, because Kim discloses allocating resources (the claimed “*segment*”) that include an integer number (“*N*”) of subchannels per slot (the claimed “*resource units*”), a POSITA would have understood that the Kim-IEEE802.16-2004 network allocates a resource segment “*comprising N time-frequency resource units within a time interval.*” *Id.*

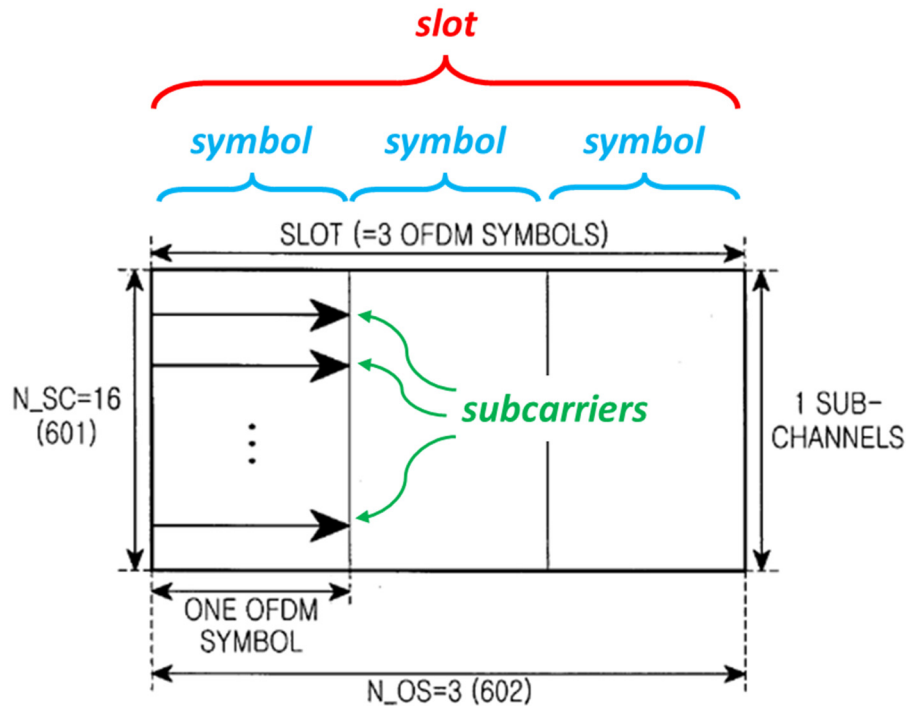
This is consistent with the ’450 patent itself. Ex-1003, 134. In particular, neither the language of claim feature [1.4] of the ’450 patent nor the written description of the ’450 patent requires that the claimed “segment” must consist of **only** “*N time-frequency resource units within a time interval.*” *Id.* Instead, claim feature [1.4] uses the open-ended claim language “*comprising N time-frequency resource units within a time interval.*” *Id.* As explained above, this is disclosed at

least by Kim's allocation of a resource segment to user A (in Figure 7) which comprises "12 subchannels in a first slot SLOT(0)" (an example of the claimed "*N time-frequency resource units within a time interval*") and "8 subchannels in a second slot SLOT(1)" (another example of the claimed "*N time-frequency resource units within a time interval*"). *Id.*; Ex-1005, [0063], Fig. 7.

[1.5] each unit containing a set of frequency subcarriers in a group of OFDM symbols,

As discussed for [1.4], the Kim-IEEE802.16-2004 network allocates resources using a "minimum possible data allocation unit" (the claimed "*unit*") defined by "one subchannel" in frequency and a "slot" in time. Ex-1005, [0058]; Ex-1008, 532, §8.4.3.1; Ex-1003, 135.

Further, as discussed in §§III.A.1 and III.A.2, both Kim and IEEE802.16-2004 disclose that each "**subchannel**" includes a set of **subcarriers**. Ex-1003, 136. For example, Kim discloses an example of a subchannel containing a set of **16 subcarriers** within a group of "**3 OFDM symbols**." Ex-1005, [0060], Fig. 6 (below, annotated).



Ex-1005, Fig. 6 (annotated)

Also, IEEE802.16-2004 specifies that “subcarriers are divided into **subsets** of **subcarriers**, each subset is termed a subchannel.” Ex-1008, 530 (§8.4.2.2); Ex-1003, 137.

Furthermore, as discussed in §§III.A.1 and III.A.2, both Kim and IEEE802.16-2004 disclose that each time **slot** consists of a group of **OFDM symbols**. Ex-1005, [0014]; Ex-1008, 532 (§8.4.3.1); Ex-1003, 138.

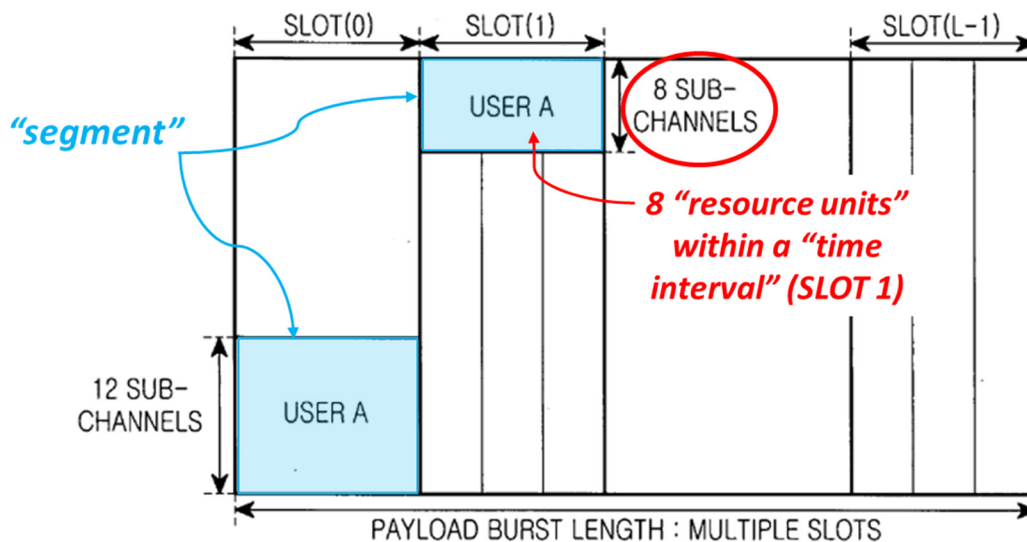
Therefore, in disclosing a subchannel which contains multiple subcarriers and a slot which contains multiple OFDM symbols (the frequency-domain subchannel and time-domain slot forming the claimed “*resource unit*”), the Kim-

IEEE802.16-2004 network allocates a resource unit which contains “*a set of frequency subcarriers*” in “*a group of OFDM symbols*.” Ex-1003, 139.

[1.6] where $N=2, 4, \text{ or } 8$; and

As discussed for [1.4], the Kim-IEEE802.16-2004 network allocates resources based on multiples (the claimed “ N ”) of a “channel resource” which is a “minimum possible data allocation unit” (the claimed “*resource unit*”) within a single time slot (the claimed “*time interval*”). Ex-1003, 140.

Kim provides an example in which “a user A transmits ... an OFDM symbol through **8 subchannels** in a second slot SLOT(1)” such that “the **number NSCH,1 of subchannels** in the second slot SLOT(1) is **8**.” Ex-1005, [0063], Fig. 7 (below, annotated); Ex-1003, 141.



Ex-1005, Figure 7 (annotated)

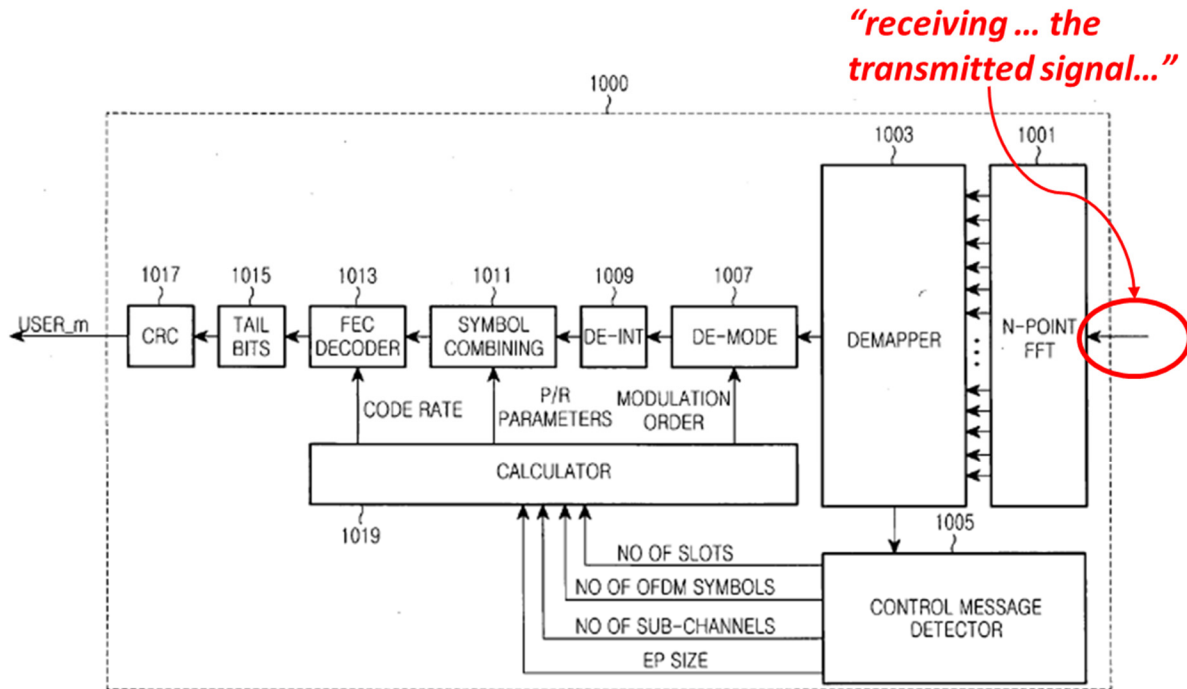
Therefore, because the Kim-IEEE802.16-2004 network discloses allocating **8** subchannels within a time slot (the claimed “*resource units*” within a “*time interval*”), and because claim feature [1.6] uses the alternative language “where $N=2, 4, \text{ or } 8$,” a POSITA would have understood that the Kim-IEEE802.16-2004 network allocates a resource segment comprising N time-frequency resource units within a time interval, “*where $N=2, 4, \text{ or } 8$.*” Ex-1003, 142.

Moreover, a POSITA would have found that allocating 2, 4, or 8 subchannels to a user would have been obvious as a mere **design choice**. Ex-1003, 144. Kim explains that “the **number** of ... **subchannels** allocated to each user or mobile station is **variable** according to a **channel condition** and the **amount of data**.” Ex-1005, [0019]; *Id.* Therefore, a POSITA would have understood that, for a relatively low amount of data, it would have been obvious to allocate 2 subchannels, and to allocate 4 and 8 subchannels for twice and quadruple the amount of data. Ex-1003, 144. Kim’s variable assignment of subchannels is consistent with IEEE802.16-2004, which provides that “a transmitter may be assigned **one or more subchannels**” per slot. Ex-1008, 530 (§8.4.2.2), 533 (§8.4.3.4). Therefore, a POSITA would have found it obvious, and a matter of mere design choice, that the Kim-IEEE802.16-2004 network allocates a resource *segment* which includes a “variable” number of N *resource units*, where N can be “one or more,” such as **2, 4, or 8**. *Id.*

[1.7] receiving by the mobile station the transmitted signal; and

Kim discloses operations performed by a “**receiver**” of a mobile station, wherein “FFT 1001 in the receiver detects” a frame in “a **received RF signal**.”

Ex-1005, [0071]-[0073], [0078]-0083], Fig. 10 (below); Ex-1004, 145.



Ex-1005, Figure 10 (annotated)

Kim explains that “[e]ach **mobile station**, or **receiver**, should first determine whether a **signal transmitted** by a base station is a signal transmitted to the mobile station itself” and “[t]he mobile station performs demodulation and decoding only on the **signal transmitted** to the mobile station itself, thereby restoring its user data.” Ex-1005, [0072]; Ex-1003, 146.

Therefore, the Kim-IEEE802.16-2004 network implements transmission of

signals from a base station to a mobile station which involves “*receiving by the mobile station the transmitted signal.*” Ex-1003, 147.

[1.8] recovering by the mobile station the information from the received signal based on the starting time-frequency coordinate and N in conjunction with the identifier assigned to the mobile station.

As discussed in §§III.A.3(a) and (b), when a mobile station in the Kim-IEEE802.16-2004 network receives a frame, a “control message” in the DL-MAP part of the frame allows the mobile station to determine whether user data in the frame is intended for the mobile station and, if so, to recover that user data with knowledge of the location and size (number of subchannels) of the resource allocated for the user data. *Id.*

- (i) ***“recovering by the mobile station the information from the received signal based on the starting time-frequency coordinate...”***

As discussed for [1.3] and in §III.A.3(b), the control message in the DL-MAP includes an “OFDMA symbol offset” and “subchannel offset” (collectively, the claimed “*starting time-frequency coordinate*”) for resources assigned to a user. Ex-1008, 558 (end of §8.4.5.3), Table 275. Ex-1003, 149. The Kim-IEEE802.16-2004 network utilizes the “OFDMA Symbol offset” and “subchannel offset” (as specified in IEEE802.16-2004) to implement Kim’s “location information” which (as Kim explains) identifies the location of “user data” multiplexed in a frame. Ex-1005, [0073], [0075], [0081]-[0082]; Ex-1008, 558 (end of §8.4.5.3), Table 275;

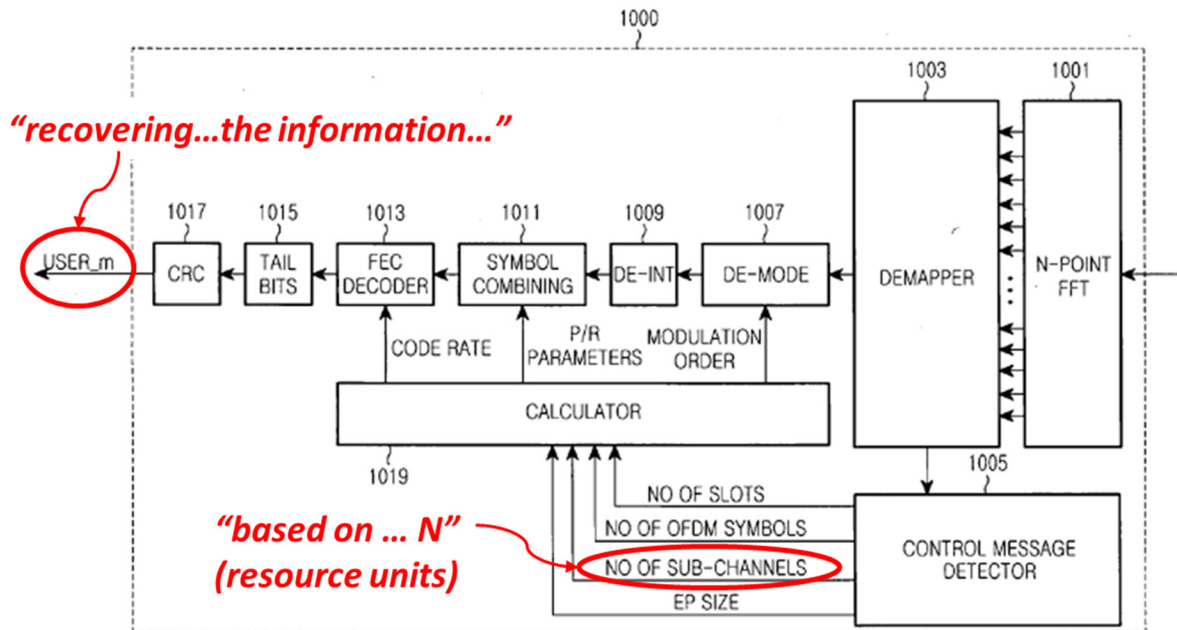
Ex-1003, 149. As disclosed in Kim, upon receiving the “control message,” mobile station “detects **location information** in a multiplexed frame of data” which allows the mobile station to **decode** the “**user data**” from the frame. Ex-1005, [0081]-[0082]. Thus, in the Kim-IEEE802.16-2004 combination, the mobile station uses the starting time-frequency coordinate (e.g., the “OFDMA Symbol offset” and “subchannel offset” as specified in IEEE802.16-2004) to locate information within the frame and start the process of recovering the information from the received signal. Ex-1003, 149.

(ii) “... *and N*...”

As discussed in §III.A.1, Kim discloses that the “control message” in each frame also indicates “the **number of subchannels**” allocated for the user data. Ex-1005, [0075], [0081]; Ex-1003, 150. Using this information, Kim’s mobile station can “perform data demodulation and decoding” of the user data. Ex-1005, [0076], [0082]. This is consistent with IEEE802.16-2004, which specifies that the “DL-MAP” message in each frame includes the parameter “**No. Subchannels**” which indicates the “**number of subchannels** with subsequent indexes, used to carry the burst.” Ex-1008, 558, Table 275; Ex-1003, 150.

Kim discloses that “control message detector 1005...detects...the **number of subchannels**...from the control message 1130.” Ex-1005, [0081], [0082], Fig. 10; Ex-1003, 151. Based on the detected **number of subchannels**, Kim’s receiver

performs various operations, including demodulation and decoding, to recover the user data (“USER_m”), as shown in Figure 10 (below, annotated). *Id.*



Ex-1005, Figure 10 (annotated)

Specifically, Kim’s “calculator 1019 detects a modulation order, a code rate, an MPR value, and a puncturing/repetition parameter,” based on the detected **number of subchannels**, referred to in Kim as “ $N_{SCH,k}$ ” which “denotes the number of subchannels allocated to a kth slot” (in addition to other parameters, such as “the number of slots” referred to in Kim as “ N_{slot} ” over which the number of subchannels per slot are added; “the number of modulation symbols allocated to channel resource comprised of one slot and one subchannel referred to in Kim at “ N_{MS} ,”; and the “EP size” which is the “encoder packet” size). Ex-1005, [0018], [0058], [0063], [0081], Equation (5), Fig. 10; Ex-1003, 152.

Then, “demodulator 1007 demodulates the input traffic data according to the modulation order received from the calculator 1019” and “FEC decoder 1013 decodes the input traffic symbols according to the code rate received from the calculator 1019.” Ex-1005, [0082]; Ex-1003, 153. As a result, the receiver 1000 of Kim’s mobile station “**outputs the decoded information as user data.**” *Id.*

With this background, in the Kim-IEEE802.16-2004 combination, the mobile station recovers the information from the signal using both the *starting time-frequency coordinate* (e.g., the “OFDMA Symbol offset” and “subchannel offset” (as specified in IEEE802.16-2004)) *and* *N* (e.g., the number of sub-channels (as specified by Kim)). Ex-1003, 154. As discussed for claim feature [1.8](i), the Kim-IEEE802.16-2004 mobile station uses the starting time-frequency coordinate (e.g., the “OFDMA Symbol offset” and “subchannel offset” (as specified in IEEE802.16-2004)) to locate the start of the user data within the frame. *Id.* Then, the Kim-IEEE802.16-2004 mobile station uses *N* (e.g., the number of sub-channels (as specified by Kim)) to determine the full extent of the user data that begins at the starting time-frequency coordinate. *Id.* Finally, with the start and full extent of the user data known, the Kim-IEEE802.16-2004 mobile station is able to perform decoding operations to recover the information in the received signal. *Id.*

(iii) “*...in conjunction with the identifier assigned to the mobile station*”

As discussed for [1.1] and in §III.A.3(a), the “control message” in the DL-MAP part of each frame also includes a “connection ID (**CID**)” (the claimed “*identifier*”) assigned to the mobile station. Ex-1003, 155. Recovery of information in the Kim-IEEE802.16-2004 network occurs in conjunction with the identifier in at least two ways. First, in the Kim-IEEE802.16-2004 network, recovery of information occurs in conjunction with the identifier because the identifier is used to determine whether data received in a frame is intended for the mobile station. Second, in the Kim-IEEE802.16-2004 network, recovery of information also occurs in conjunction with the identifier because decryption of the data (using a security association identifier, which is equal to the identifier) is required for recovering information.⁸

⁸ For purposes of this proceeding and consistent with Patent Owner’s infringement allegations, Petitioner contends that this limitation is met by use of the identifier to determine that data received in a frame is intended for the mobile station (i.e., the first way) or use of the identifier to interpret (e.g., decrypt) data received in a frame (i.e., the second way). In co-pending litigation, Petitioner may argue that this limitation should be limited to only the second way the Kim-IEEE802.16-2004 net-

As to the first way the Kim-IEEE802.16-2004 network renders obvious this limitation, as discussed for claim features [1.1], [1.3] and in §§III.A.3(a) and (b), *supra*, Kim explains that “each mobile station first **detects the CTRL part** from the frame 1220 to **determine whether its own data** has been transmitted, and **decodes its own data** ... if its own data has been transmitted.” Ex-1005, [0083]. The ability to determine “whether its own data has been transmitted” is provided by the “CID” (as specified by IEEE802.16-2004), which would allow Kim’s mobile station to **determine whether data** received in a frame is **intended** for the mobile station, as disclosed in Kim. Ex-1005, [0072] (“[t]he mobile station **performs demodulation and decoding** only on the **signal** transmitted to the mobile station itself, thereby **restoring its user data**.”). Indeed, IEEE802.16-2004 explains that the “**CID**” is utilized to determine whether data in a frame is intended for a particular station. Ex-1008, 67 (§6.1, first paragraph, “[t]he SSs check the CIDs in the received PDUs and retain only those PDUs addressed to them.”).

IEEE802.16-2004 specifies that the CID is part of the “**MAC PDU header**”

work renders obvious this limitation (e.g., use of the identifier to interpret (e.g., decrypt) data received in a frame). Because the prior art renders obvious both options, the construction is not in controversy here and Petitioner advances an interpretation that covers both options in this proceeding.

which is received by a subscriber station (SS) in its DL burst. Ex-1008, 733 (§11.13.2, first paragraph); 71 (Figure 18); 72 (Figure 19); 73 (Table 5); Ex-1003, 156. As Dr. Ding explains, a POSITA would have found it obvious that the CID in the MAC PDU header would have been used by the SS to determine that the MAC PDU payload information is indeed destined for the SS. *Id.* In this way, the Kim-IEEE802.16-2004 network transmits (in the header of the MAC PDU in the DL burst) the **CID** which is used by the SS to **recover** the information contained within the MAC PDU payload, in conjunction with the location information of the DL burst. *Id.*

In addition, as to the second way the Kim-IEEE802.16-2004 network renders obvious this limitation, IEEE802.16-2004 specifies the **CID** also serves as a “security association identifier” (SAID)” which is an “identifier shared between the base station (BS) and subscriber station [SS] that uniquely **identifies** a **security association** (SA)” of the subscriber. Ex-1008, 46 (definition 3.48), 308 (§ 7.1.3, fourth paragraph, “[t]he SAID of any SS’s Primary SA shall be **equal to** the Basic **CID** of that SS”); Ex-1003, 157. The SAID (i.e., the CID) is necessary for a station to identify the security association (SA) in order to **recover** the MAC PDU payload because “**encryption** is always applied to the MAC PDU payload.” Ex-1008, 307 (§7.1.1), 308 (§7.1.3). In this regard, because the SAID equates to the CID and is used to decrypt the received information, the recovery of the received

information occurs in conjunction with the CID. Ex-1003, 157.

Because a determination that data received in a frame is intended for the mobile station (using the CID) is a prerequisite for the mobile station to begin recovering information from the frame, and/or because decryption of the data (using the SAID, which is equal to the CID) is required for recovering that information, a POSITA would have understood that the recovery of information from a received signal in the Kim-IEEE802.16-2004 combination occurs “*in conjunction with the identifier assigned to the mobile station the mobile station.*” Ex-1003, 158. Specifically, the Kim-IEEE802.16-2004 network demodulates, decodes, and outputs data from a received signal by using the “OFDMA symbol offset” and “subchannel offset” of a resource allocated to user data (the claimed “*the starting time-frequency coordinate*” of a “*segment*”), and the “number of subchannels” allocated to the user data (the claimed “*N*”), in conjunction with the **CID** (the claimed “*identifier assigned to the mobile station*”). *Id.* Therefore, a POSITA would have understood that the mobile station in the Kim-IEEE802.16-2004 network recovers “*the information from the received signal based on the starting time-frequency coordinate and N in conjunction with the identifier assigned to the mobile station.*” *Id.*

5. Claims 2-6

[2.0] The method of claim 1, wherein the starting time-frequency coordinate indicates a starting OFDM symbol of the segment of time-frequency resource.

Prior art knowledge of a “**starting OFDM symbol**” for resource allocation is acknowledged in the Background Section of the ’450 patent itself, which explains that according to the existing IEEE 802.16 standard, “resource allocation is identified in the **time domain** scale with a **start symbol offset** (8 bits).” Ex-1001, 1:60-66; Ex-1003, 159. Therefore, a POSITA would have understood prior art knowledge that a resource allocation is identified in time by a **start symbol offset** (the claimed “**starting OFDM symbol**”). Ex-1003, 159. Indeed, a POSITA would have found resource allocation using a starting OFDM symbol as being part of a POSITA’s general knowledge, as evidenced by the Background of the ’450 patent, and would have found use of a starting OFDM symbol to have been an obvious solution and design choice based on this general knowledge. *Id.*

Such prior art knowledge is further evidenced in Kim and IEEE802.16-2004. As discussed for [1.3], the Kim-IEEE802.16-2004 network identifies the location of a “data region” (the claimed “**segment**”) allocated to a “burst” of information for Kim’s “user data” by using a “**starting time-frequency coordinate**” in which the “**starting time ... coordinate**” is an OFDMA symbol specified by IEEE802.16-2004’s “**OFDMA symbol offset**.” Ex-1008, 558 (end of §8.4.5.3), Figures 215,

218; Ex-1005, [0073], [0075], [0081]-[0082]; Ex-1003, 160. This is “[t]he offset of the **OFDMA symbol** in which the **burst starts**, measured in OFDMA symbols from beginning of the downlink frame.” Ex-1008, 558 (end of §8.4.5.3); *Id.*

Therefore, a POSITA would have understood that “*the starting time-frequency coordinate*” in the Kim-IEEE802.16-2004 network “*indicates a starting OFDM symbol of the segment of time-frequency resource.*” Ex-1003, 161.

[3.0] The method of claim 1, wherein the starting time-frequency coordinate indicates a starting subcarrier of the segment of time-frequency resource.

As discussed for [4.0], *infra*, the Background Section of the ’450 patent acknowledges that the prior art IEEE 802.16 standard specifies “resource allocation is identified ... in the **frequency domain** scale with a **start logical subchannel offset** (6 bits).” Ex-1001, 1:60-66; Ex-1003, 162. The ’450 patent further explains that “**subcarriers** can be arranged into **groups** called **subchannels**.” Ex-1001, 4:57-59; Ex-1003, 162. Therefore, a POSITA would have understood prior art knowledge that a resource allocation is identified in frequency by a starting group of subcarriers. Ex-1003, 162. Indeed, resource allocation using a starting subcarrier would have been part of a POSITA’s general knowledge, as evidenced by the Background of the ’450 patent, and a POSITA would have found use of a starting subcarrier an obvious solution and design choice based on this general knowledge. *Id.*

Such prior art knowledge is further evidenced in Kim and IEEE802.16-2004. As discussed for [1.3], the Kim-IEEE802.16-2004 network identifies the location of a “data region” (the claimed “*segment*”) allocated to a “burst” of information for Kim’s “user data” by using a “*starting time-frequency coordinate*” in which the “*starting ... frequency coordinate*” is a subchannel specified by IEEE802.16-2004’s “**subchannel offset**.” Ex-1008, 558 (end of §8.4.5.3), Figures 215, 218; Ex-1005, [0073], [0075], [0081]-[0082]; Ex-1003, 163. IEEE802.16-2004 specifies the “[s]ubchannel offset” is “[t]he **lowest index OFDMA subchannel** used for carrying the **burst**, starting from subchannel 0.” Ex-1008, 558 (end of §8.4.5.3); *Id.* Further, as discussed for [3.0], each **subchannel** of the Kim-IEEE802.16-2004 network consists of **multiple subcarriers**. Ex-1005, [0060], Fig. 6 (showing a subchannel containing 16 subcarriers); Ex-1008, 530 (§8.4.2.2, describing that “subcarriers are divided into **subsets** of **subcarriers**, each subset is termed a **subchannel**”); Ex-1003, 163.

Therefore, as discussed for [4.0], *infra*, because each resource *segment* of the Kim-IEEE802.16-2004 network has “*a starting time-frequency coordinate*” which indicates a starting subchannel, and because each subchannel consists of multiple subcarriers, a POSITA would have understood that, in the Kim-IEEE802.16-2004 network, “*the starting time-frequency coordinate indicates a starting group of subcarriers of the segment of time-frequency resource.*” Ex-

1003, 164.

Moreover, IEEE802.16-2004 specifies that the **subcarriers** in each subchannel are indexed by a “**subcarrier index**” for that particular subchannel. Ex-1008, 602 (§8.4.6.1.2.2.2, defining the parameter “*subcarrier(n,s)*” as the “**subcarrier index of subcarrier *n* in subchannel *s*.**”); Ex-1003, 165. Therefore, because subcarriers in each subchannel are **indexed** in the subchannel, a POSITA would have understood that each subchannel has a **starting subcarrier** (e.g., the subcarrier with a **starting subcarrier index** in the subchannel). *Id.*

Thus, a POSITA would have understood that each resource *segment* of the Kim-IEEE802.16-2004 network has “*a starting time-frequency coordinate*” which “*indicates a starting subcarrier of the segment of time-frequency resource*” (namely, the subcarrier with the starting “subcarrier index” in the subchannel specified by the “subchannel offset” of IEEE802.16-2004). Ex-1003, 166.

[4.0] The method of claim 1, wherein the starting time-frequency coordinate indicates a starting group of subcarriers of the segment of time-frequency resource.

As discussed for [3.0], prior art knowledge of a “**starting group of subcarriers**” for resource allocation is acknowledged in the Background Section of the ’450 patent itself, which explains that according to the existing IEEE 802.16 standard,

“resource allocation is identified ... in the frequency domain scale with a **start logical subchannel offset** (6 bits).” Ex-1001, 1:60-66; Ex-1003, 167. The ’450 patent further explains that “**subcarriers** can be arranged into **groups** called **subchannels**.” Ex-1001, 4:57-59; *Id.* Therefore, a POSITA would have understood as part of their prior art knowledge that a resource allocation is identified in frequency by **a starting group of subcarriers**. Ex-1003, 167. Indeed, a POSITA would have understood resource allocation using a starting group of subcarriers as being part of a POSITA’s general knowledge, as evidenced by the Background of the ’450 patent, and would have found use of a starting group of subcarriers to have been an obvious solution and design choice based on this general knowledge. *Id.*

Such prior art knowledge is further evidenced in Kim and IEEE802.16-2004. As discussed for [1.3] and [3.0], the Kim-IEEE802.16-2004 network identifies the location of a “data region” (the claimed “*segment*”) allocated to a “burst” of information for Kim’s “user data” by using a “*starting time-frequency coordinate*” in which the “*starting ... frequency coordinate*” is a subchannel specified by IEEE802.16-2004’s “**subchannel offset**.” Ex-1008, 558 (end of §8.4.5.3), Figures 215, 218; Ex-1005, [0073], [0075], [0081]-[0082]; Ex-1003, 168. IEEE802.16-2004 specifies the “[s]ubchannel offset” is “[t]he **lowest index OFDMA subchannel** used for carrying the **burst**, starting from subchannel 0.” Ex-1008, 558 (end of §8.4.5.3). Further, as discussed for [3.0], each **subchannel** of the

Kim-IEEE802.16-2004 network consists of **multiple subcarriers**. Ex-1005, [0060], Fig. 6 (a subchannel containing 16 subcarriers); Ex-1008, 530 (§8.4.2.2, “subcarriers are divided into **subsets of subcarriers**, each subset is termed a **subchannel**”); Ex-1003, 168.

Therefore, because each resource *segment* of the Kim-IEEE802.16-2004 network has “*a starting time-frequency coordinate*” which indicates a starting subchannel, and because each subchannel consists of multiple subcarriers, a POSITA would have understood that, in the Kim-IEEE802.16-2004 network, “*the starting time-frequency coordinate indicates a starting group of subcarriers of the segment of time-frequency resource.*” Ex-1003, 169.

[5.0] The method of claim 1, wherein modular coding is applied to the time-frequency resource units in the segment of time-frequency resource.

As discussed for [1.4], the Kim-IEEE802.16-2004 network allocates *resource units*, where each resource unit is defined by a single subchannel (in frequency) and a single slot (in time). Ex-1003, 170. In addition, as detailed below, the Kim-IEEE802.16-2004 network applies **modular coding** to the resource units because the Kim-IEEE802.16-2004 network implements modulation and coding schemes that utilize **integer multiples** of a basic **resource unit**. *Id.*

Kim describes a system that determines “a modulation scheme and a code rate **based on a block size**” that “provides **various block sizes** for error

correction codes.” Ex-1005, [0053], [0054]; Ex-1003, 171. Each “**block** has a different **number of subchannels for each slot**” (i.e., the block has a different number of the claimed “*resource units*”). Ex-1005, [0062].

The “**code rate**” of Kim’s error correction code depends on the “number of subchannels for each slot” (i.e., the number of “*resource units*”). Ex-1005, [0062]; Ex-1003, 172. To determine the code rate, a user first “calculates an **MPR** [Modulation order Product code Rate] for each multiaccess user **according to the number of subchannels** (or subcarriers) allocated to each multiaccess user, the **number of slots** (or OFDM symbols) and an EP [encoding packet] size allocated to each multiaccess user.” Ex-1005, [0067], [0029]; Ex-1003, 172. As a result, Kim explains that “when the block has a **different number of subchannels for each slot**” then “the **MPR should be modified** as shown in Equation (5).” Ex-1005, [0062]. Then, “based on the MPR” each user determines a “modulation order” (MO) and, “[o]nce a modulation order is determined in this process, a **code rate R** of an **error correction code** is determined as a ratio of the MPR to the modulation order (MO).” Ex-1005, [0067]. Having determined the modulation order (MO) and code rate (R), Kim describes that an “**FEC encoder 905 encodes user data** at a code rate having a value determined by the modulation order and code rate.” Ex-1005, [0069]. Kim’s coding is applied from a table of “modulation orders and code rates” which are “pre-calculated for all possible combinations” of

MPRs. Ex-1005, [0070]; *Id.*

Therefore, Kim describes a ***modular coding*** scheme that “provides various block sizes for error correction codes,” where the “**code rate**” of Kim’s error correction code depends on the “**number of subchannels** for each slot” (i.e., the number of the claimed “***resource units***”). Ex-1005, [0062]; Ex-1003, 173.

Similarly, IEEE802.16-2004 discloses the same concept of an “MPR” which is calculated based on the **number of subchannels** allocated to a “burst.” Ex-1008. §8.4.9.2.3.5.6 “Modulation order of DL traffic burst”); Ex-1003, 174. IEEE802.16-2004 discloses examples of “FEC Code types” which specify different modulation schemes (e.g., QPSK, QAM, QPSK) and coding schemes (e.g., Convolutional Code “CC” or Block Turbo Code “BTC” or Convolutional Turbo Code “CTC”). Ex-1008, Table 363 (below, annotated), *Id.*

Table 363—DCD burst profile encodings—WirelessMAN-OFDMA

Name	Type (1 byte)	Length	Value (variable length)
FEC Code type	150	1	0 = QPSK (CC) 1/2 14 = QPSK (CTC) 3/4 1 = QPSK (CC) 3/4 15 = 16-QAM (CTC) 1/2 2 = 16-QAM (CC) 1/2 16 = 16-QAM (CTC) 3/4 3 = 16-QAM (CC) 3/4 17 = 64-QAM (CTC) 2/3 4 = 64-QAM (CC) 2/3 18 = 64-QAM (CTC) 3/4 5 = 64-QAM (CC) 3/4 19 = 64-QAM (CTC) 5/6 6 = QPSK (BTC) 1/2 20 = QPSK (ZT CC) 1/2 7 = QPSK (BTC) 3/4 or 2/3 21 = QPSK (ZT CC) 3/4 8 = 16-QAM (BTC) 3/5 22 = 16-QAM (ZT CC) 1/2 9 = 16-QAM (BTC) 4/5 23 = 16-QAM (ZT CC) 3/4 10 = 64-QAM (BTC) 2/3 or 5/8 24 = 64-QAM (ZT CC) 2/3 11 = 64-QAM (BTC) 5/6 or 4/5 25 = 64-QAM (ZT CC) 3/4 12 = QPSK (CTC) 1/2 26..255 = <i>Reserved</i> 13 = QPSK (CTC) 2/3
DIUC Mandatory exit threshold	151	1	0–63.75 dB CINR at or below where this DIUC can no longer be used and where this change to a more robust DIUC is required, in 0.25 dB units. See Figure 81.
DIUC Minimum entry threshold	152	1	0–63.75 dB The minimum CINR required to start using this DIUC when changing from a more robust DIUC is required, in 0.25 dB units. See Figure 81.

Ex-1008, Table 363 (annotated)

Therefore, IEEE802.16-2004 specifies, consistent with Kim, that the “**encoding** block size shall **depend** on the **number of subchannels** allocated” (i.e., the number of the claimed “*resource units*”). Ex-1008, 589 (§8.4.9.2, 2nd paragraph); Ex-1003, 175. Furthermore, IEEE802.16-2004 describes a “subchannel concatenation rule” in which “concatenation of a number of subchannels” can be performed “in order to make larger blocks of coding.” Ex-1008, 589 (§8.4.9.2, 2nd and 3rd paragraphs); Ex-1003, 175.

Therefore, because the Kim-IEEE802.16-2004 network implements modulation and coding schemes that utilize an integer **multiple** of **subchannels** per slot (i.e., integer multiples of the claimed “*resource unit*”), a POSITA would have understood that, in the Kim-IEEE802.16-2004 network, “*modular coding is applied to the time-frequency resource units in the segment of time-frequency resource.*” Ex-1003, 176.

This is consistent with the ’450 patent. Ex-1003, 177. Although the ’450 patent specification does not use the term “*modular coding*,” the ’450 patent describes modulation and coding schemes that utilize “**modular resources.**” Ex-1001, 6:45-62. In particular, the ’450 patent describes different modulation and coding schemes (MCSs) using integer multiples of a basic “resource unit.” Ex-1001, 6:31-34, Table 1 (showing four different modulation and coding schemes, indexed by MCSI numbers 1 through 4, using different integer multiples of a basic resource unit), 6:45-55.

[6.0] The method of claim 5, wherein a repetition coding is further applied to the time-frequence [sic] resource units.

The ’450 patent acknowledges, in its Background Section, that the IEEE 802.16 standard specifies “2 bits are used to indicate the coding **repetition.**” Ex-1001, 2:6-7; Ex-1003, 178. Therefore, a POSITA would have understood prior art knowledge of “*repetition coding.*” Ex-1003, 178. Indeed, a POSITA would have

understood repetition coding as being part of a POSITA's general knowledge, as evidenced by the Background of the '450 patent, and would have found use of repetition coding to have been an obvious solution and design choice based on this general knowledge. *Id.*

Such prior art knowledge is further evidenced in Kim and IEEE802.16-2004. Ex-1003, 179. As discussed for [5.0], the Kim-IEEE802.16-2004 network applies FEC coding to multiples of a resource unit (the claimed “**modular coding**”). In addition, the Kim-IEEE802.16-2004 network further applies **repetition coding** to the encoded data. Ex-1005, [0010], [0069], [0070]; Ex-1003, 179. For example, Kim discloses a “symbol **repetition** & puncturing part” which “performs symbol **repeating** and puncturing on the FEC-encoded data.” *Id.* Kim explains that “a puncturing/**repetition** parameter” is determined according to “the modulation order and code rate” (which is determined based on the number of subchannels, i.e., the number of “**resource units**,” as discussed for [5.0]), and then “symbol **repetition**” is performed based on the puncturing/repetition parameter. Ex-1005, [0069], FIG. 9 (below, showing encoding by a transmitter); Ex-1003, 179.

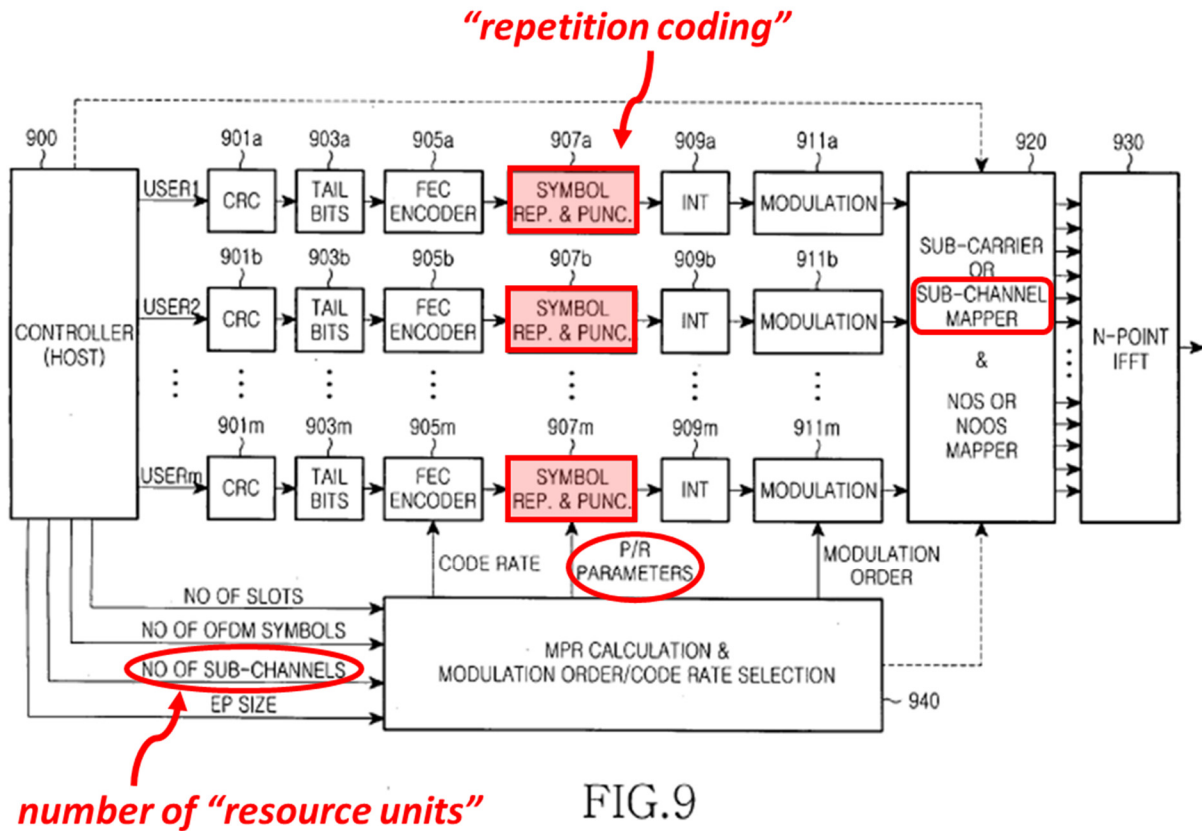


FIG. 9

Ex-1005, Fig. 9 (annotated)

Kim explains that the “symbol **repetition**” then determines the final code rate of the encoding scheme. Ex-1003, 180. For example, Kim explains that, “[i]f a 2-times symbol **repetition** parameter is delivered and a code rate is $\frac{1}{3}$, the final code rate becomes $\frac{1}{6}$.” Ex-1005, [0070]; Ex-1003, 180.

In addition, IEEE802.16-2004 specifies “**repetition coding**” is indicated by a “**repetition coding indication**” carried in the DL-MAP message, which “[i]ndicates the **repetition code** used **inside** the allocated **burst**” (e.g., repetition coding of 2, 4, or 6). Ex-1008, 558, lines 16-17, Table 275 (below, annotated); Ex-

1003, 181.

Table 275—OFDMA DL-MAP_IE format

Syntax	Size	Notes
DL-MAP_IE() {		
DIUC	4 bits	
if (DIUC == 15) {		
Extended DIUC dependent IE	<i>variable</i>	See subclauses following 8.4.5.3.1
} else {		
if (INC_CID == 1) {		The DL-MAP starts with INC_CID = 0. INC_CID is toggled between 0 and 1 by the CID-SWITCH_IE() (8.4.5.3.7)
N_CID	8 bits	Number of CIDs assigned for this IE
for (n=0; n< N_CID; n++) {		
CID	16 bits	
}		
}		
OFDMA Symbol offset	8 bits	
Subchannel offset	6 bits	
Boosting	3 bits	000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB;
No. OFDMA Symbols	7 bits	
No. Subchannels	6 bits	
<u>Repetition Coding Indication</u>	<u>2 bits</u>	<u>0b00 – No repetition coding</u> <u>0b01 – Repetition coding of 2 used</u> <u>0b10 – Repetition coding of 4 used</u> <u>0b11– Repetition coding of 6 used</u>

Ex-1008, Table 275 (annotated)

Therefore, because the Kim-IEEE802.16-2004 network applies repetition coding to a number of subchannels per slot (i.e., the claimed “*resource units*”), a POSITA would have understood that, in the Kim-IEEE802.16-2004 network, “*a repetition coding is further applied to the time-frequency [sic] resource units.*” Ex-1003, 182.

6. Claim 7

[7.P1] A mobile device in a wireless packet system

See [1.P1]. In addition, Kim’s system is designed to transmit “**packet** data” by implementing “a **packet** transmission service.” Ex-1005, Abstract, [0017].

[7.P2] using a frame structure of multiple frames for transmission,

See [1.P2].

[7.P3] each frame comprising a plurality of time intervals,

See [1.P3].

[7.P4] each time interval comprising a plurality of orthogonal frequency division multiplexing (OFDM) symbols, and

See [1.P4].

[7.P5] each OFDM symbol containing a plurality of frequency subcarriers, the mobile device configured to:

See [1.P5].

[7.1] receive an identifier from a base station in a cell in which the mobile device is operating; and

See [1.1]. For example, as discussed for [1.1] and § III.A.3(a), the Kim-

IEEE802.16-2004 mobile station **receives**, from a base station, a “DL-MAP” message (as specified in IEEE802.16-2004) in the “CTRL part” (control message) of Kim’s frame, which includes a “**connection identifier (CID)**.” Ex-1005, Abstract, [0017]; Ex-1008, Table 275, Figure 218, 43 (definition 3.13); Ex-1003, 188.

In addition, IEEE802.16-2004 discloses a typical scenario of “base station” in a “**cell**” that includes “configuration of the **base station** sectors.” Ex-1008, 851, Figure B.6 (below, annotated); Ex-1003, 189. As Dr. Ding explains, the concept of a “**cell**” in which a base station and mobile devices operate was well-known in the field of wireless communication, and specifically in IEEE 802.16-based networks, prior to the Critical Date of the ’450 patent. Ex-1003, 189.

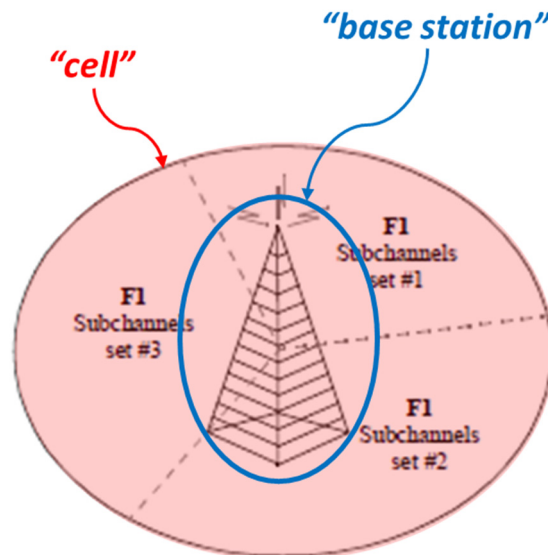


Figure B.6—Reuse of 1 configuration, 3 sectors per cell

Ex-1008, Figure B.6 (annotated)

[7.2] receive a signal containing information from the base station over a segment of time-frequency resource,

See [1.2].

[7.3] the segment having a starting time-frequency coordinate and

See [1.3].

[7.4] the segment comprising N time-frequency resource units within a time interval,

See [1.4].

[7.5] each unit containing a set of frequency subcarriers in a group of OFDM symbols,

See [1.5].

[7.6] where $N=2, 4$, or 8 ; and

See [1.6].

[7.7] recover the information from the received signal using the starting time-frequency coordinate and N in conjunction with the received identifier.

See [1.7] and [1.8].

7. Claims 8-12

[8.0] The mobile device of claim 7, wherein the starting time-frequency coordinate indicates a starting OFDM symbol of the segment of time-frequency resource.

See [2.0].

[9.0] The mobile device of claim 7, wherein the starting time-frequency coordinate indicates a starting subcarrier of the segment of time-frequency resource.

See [3.0].

[10.0] The mobile device of claim 7, wherein the starting time-frequency coordinate indicates a starting group of subcarriers of the segment of time-frequency resource.

See [4.0].

[11.0] The mobile device of claim 7, wherein modular coding is applied to the time-frequency resource units in the segment of time-frequency resource.

See [5.0].

[12.0] The mobile device of claim 11, wherein a repetition coding is further applied to the time-frequency [sic] resource units.

See [6.0].

8. Claim 13

[13.P1] A base station in a wireless packet system

See [1.P1] and [7.P1].

[13.P2] using a frame structure of multiple frames for transmission,

See [1.P2].

[13.P3] each frame comprising a plurality of time intervals,

See [1.P3].

[13.P4] each time interval comprising a plurality of orthogonal frequency division multiplexing (OFDM) symbols, and

See [1.P4].

[13.P5] each OFDM symbol containing a plurality of frequency subcarriers, the base station configured to:

See [1.P5].

[13.1] provide an identifier to a mobile device in the cell;

See [1.1] and [7.1].

[13.2] allocate a segment of time-frequency resource for carrying information to the mobile device,

See [1.2].

[13.3] the segment having a starting time-frequency coordinate and

See [1.3].

[13.4] the segment comprising N time-frequency resource units within a time interval,

See [1.4].

[13.5] each unit containing a set of frequency subcarriers in a group of OFDM symbols,

See [1.5].

[13.6] where $N=2, 4, \text{ or } 8$; and

See [1.6].

[13.7] transmit a signal containing the information to the mobile device in a manner that allows the mobile device to recover the information using the starting time-frequency coordinate and N in conjunction with the provided identifier.

See [1.7] and [1.8].

9. Claims 14-18

[14.0] The base station of claim 13, wherein the starting time-frequency coordinate indicates a starting OFDM symbol of the segment of time-frequency resource.

See [2.0].

[15.0] The base station of claim 13, wherein the starting time-frequency coordinate indicates a starting subcarrier of the segment of time-frequency resource.

See [3.0].

[16.0] The base station of claim 13, wherein the starting time-frequency coordinate indicates a starting group of subcarriers of the segment of time-frequency resource.

See [4.0].

[17.0] The base station of claim 13, wherein modular coding is applied to the time-frequency resource units in the segment of time-frequency resource.

See [5.0].

[18.0] The base station of claim 17, wherein a repetition coding is further applied to the time-frequency [sic] resource units.

See [6.0].

IV. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

A. The *Fintiv* Factors favor institution—§ 314(a)

Consistent with Congressional intent and goals of *NHK/Fintiv*, Petitioner asks the Board alone to consider challenges raised in this Petition. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 6 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”). For this and other reasons addressed below, *Fintiv* favors institution. *Id.*; *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019 Paper 12 at 20-21 (PTAB Dec. 1, 2020) (precedential); *Snap, Inc. v. SRK Technology LLC*, IPR2020-00820 Paper 15 at 19 (PTAB Oct. 21, 2020) (precedential).

1. Factor 1: Either Party May Request Stay

Factor 1 is neutral because neither party in the co-pending litigation has, as of yet, requested a stay pending the result of IPR. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 15 at 12 (PTAB May 13, 2020); *Sand Revolution II, LLC v. Cont'l Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) (“*Sand Revolution*”) (informative).

2. Factor 2: Proximity of the Trial Date

The parties submitted a joint proposed scheduling order on August 6, 2021, asking the court to begin jury selection on January 17, 2023. Ex-1015, 5. In the proposal, referencing, among others, the trial date, the parties jointly note that the “Court expects to set these dates at the conclusion of the *Markman* Hearing,” which, according to the proposed schedule, is set for January 13, 2022. Ex-1015, 3 (emphasis added). Petitioner has filed a motion for intra-district transfer. Ex-1016. In this motion, Petitioner moves that the case be transferred from the Waco Division to the Austin Division. The Court has granted a similar motion filed by Petitioner to transfer an action from the Waco Division to the Austin Division in the past. *See Datascape, Ltd. v. Dell Techs., Inc., et al.*, No. 6:19-CV-00129-ADA, 2019 WL 4254069 *2-3 (W.D. Tex. June 7, 2019) (transferring case involving Petitioner as a defendant from the Waco Division to the Austin Division, holding that

“the relevant convenience weighs heavily in favor of transfer” and that Dell (Petitioner) demonstrated that “the transferee venue is *clearly more convenient*”) (emphasis in original).

Moreover, even if a trial occurs in January 2023, such a trial date would precede the Final Written Decision (FWD) date by at most two months. The Board has previously granted institution in cases in which a FWD was issued three to five months after the scheduled trial date. *See e.g., Sand Revolution*, IPR2019-01393, Paper 24 at 8-10. The Board has relied on various justifications when granting institution, e.g., Petitioners exercised diligence in filing the petition, the petition was accompanied with a stipulation not to pursue IPR grounds in litigation, minimal investment had been made in litigation (fact and expert discovery not started, petition was filed even before the serving of preliminary invalidity contentions), and the merits of the invalidity challenge were strong. *Verizon Business Network Services, Inc. v. Huawei Techs. Co.*, IPR2020-01141, Paper 12 (Jan. 14, 2021); *HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 (Jan. 14, 2021). The same factors weigh even more heavily in favor of institution here. For instance, Petitioner has exercised diligence and filed this petition well in advance of the one-year bar date. As noted under Factor 4 below, Petitioner has additionally served Patent Owner’s counsel a conditional stipulation (Ex-1014) broader than the stipulation

accepted by the Board in *Sand Revolution* and *HP Inc. v. Slingshot* and has stipulated not to assert any of the primary or secondary references used in the IPR grounds in litigation. See *Tide International (USA), Inv. V. UPL NA, Inc.*, case (IPR2020-01113). Moreover, fact and expert discovery have not started and no depositions have occurred. The *Markman* hearing has not yet been held. And, in view of the grounds asserted in this petition, the merits of the invalidity challenge are strong.

Therefore, *Fintiv* Factor 2 weighs against discretionary denial

3. Factor 3: Petitioner’s Diligence and Investment in the IPR Outweighs the Parties’ Minimal Investment in Litigation

This petition was filed more than four months before the one-year statutory bar date. *Mylan*, IPR2018-01680, Paper 22 at 18 (finding that petition filed two months before bar date is “well within the timeframe allowed by statute, weighing heavily in [petitioner’s] favor”).

Moreover, Petitioner filed this petition at a very early stage of the litigation—a fact that “has weighed against exercising the authority to deny institution under *NHK*.” *Seven Networks*, IPR2020-00156, Paper 10 at 11-12 (June 15, 2020). In particular, Petitioner filed this petition even before a schedule has been issued for litigation. No substantive orders have been issued by the court, no depositions have been taken, and fact and expert discovery have not begun.

Overall, Factor 3 weighs against discretionary denial.

4. Factor 4: The Petition's Grounds Are Materially Different From Any That Might Be Raised in Litigation

As noted above, the co-pending litigation is in an early stage. At present, there is no overlap in issues between the litigation and any IPR resulting from this petition.

Moreover, consistent with *Fintiv*, Petitioner asks the Board alone to consider the unique challenges raised in the Petition. Petitioner has further eliminated any risk of duplicated effort by voluntarily stipulating to counsel for Patent Owner that, if the Board institutes an IPR based on this Petition, Petitioner will not pursue district court invalidity challenges based on the primary or secondary references asserted in this Petition. Ex-1014; *see Tide International (USA), Inv. V. UPL NA, Inc.* case (IPR2020-01113). A lack of overlap between the petition and the district court proceeding “has tended to weigh against exercising discretion to deny institution.” *Fintiv*, IPR2020-00019, Paper 11 at 12-14.

For at least these reasons, Factor 4 weighs against discretionary denial. See, *e.g.*, *Fintiv* at 12-13; *Snap* at 13-16; *Sand Revolution* at 11-12.

5. Factor 5: Institution Would Promote Judicial Efficiency

Petitioner and Patent Owner are parties to the co-pending litigation. Petitioner has stipulated not to assert any of the primary or secondary references in this

petition (and therefore any instituted grounds) in the co-pending litigation if the PTAB institutes an IPR, a fact that favors institution and promotes judicial efficiency. *See Sand Revolution* at 11-12. At worst, where the parties are the same such as in this case, Factor 5 is neutral. *Cisco Sys., Inc. v. Ramot at Tel Aviv Univ. Ltd.*, IPR2020-00122, Paper 15 at *10 (PTAB May 15, 2020) (APJ Crumbley, dissenting).

6. Factor 6: The Merits of this Petition Strongly Favor Institution

The merits of this Petition are particularly strong. As demonstrated in the Petition with reference to Dr. Ding's testimony and additional evidence, institution would result in a finding of unpatentability of the Challenged Claims, which are obvious based on prior art references that materially differ from those considered by the Examiner during prosecution. The strength of the merits alone is enough to outweigh any inefficiencies born of parallel litigation (and as explained above, institution of this petition would actually promote efficiency). *See Fintiv* at 14-15. Accordingly, *Fintiv* Factor 6 favors institution. *See Snap* at 16-19.

V. CONCLUSION

Petitioner respectfully requests institution of an IPR for the Challenged Claims.

VI. PAYMENT OF FEES

Petitioner authorizes charges of fees to Deposit Account No. 06-1050.

VII. 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)

Dell Inc., and Dell Technologies Inc. (collectively “Petitioner”) are the real parties-in-interest.

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

Petitioner is not aware of any disclaimers, reexamination certificates, or IPR petitions for the ’450 patent. The ’450 patent is subject of the following civil action *Neo Wireless LLC v. Dell Technologies Inc. and Dell Inc.*, Case No. 6:21-cv-0024 (W.D. Tex.) (Ex-1011).

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
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D. Service Information

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

Petitioner consents to electronic service by email at IPR00035-0021IP1@fr.com

(referencing No. 00035-0021IP1 and cc'ing PTABInbound@fr.com, axf-ptab@fr.com, monaldo@fr.com, and yoona@fr.com).

Respectfully submitted,

Dated: September 16, 2021

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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 13,292 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: September 16, 2021

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on September 16, 2021, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided, via FedEx, to the Patent Owner by serving the correspondence address of record as follows:

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