UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WASHINGTON
AT SEATTLE

MALIKIE INNOVATIONS LTD., KEY PATENT INNOVATIONS LTD., **Plaintiffs,** **v.** **NINTENDO CO., LTD., NINTENDO OF AMERICA INC.,** **Defendants.**	**NO. 2:24-cv-01490-JLR**

Report of Matthew B. Shoemake, Ph.D., Regarding Claim Construction

I. Introduction

1. I have been retained by Malikie Innovations Ltd. and Key Patent Innovations Ltd., Plaintiffs in Case No. 24-cv-01490 against Defendants Nintendo Co. Ltd. and Nintendo of America, Inc., currently pending in the U.S. Federal Court for the Western District of Washington.

2. I have been asked by Plaintiffs to give my opinion on the proper construction of certain claim terms in the patents they have asserted against Defendants.

3. I am being compensated at a rate of $805 per hour for all work performed for Plaintiffs. My compensation is not contingent on the outcome of this matter.

II. Qualifications

4. I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My full curriculum vitae is attached as Exhibit 1 to this report.

A. Educational Background

5. I received Bachelor of Science degrees in Electrical Engineering and Computer Science with honors from Texas A&M University, College Station, Texas in 1994. I received a Master of Science degree in Electrical Engineering from Cornell University, Ithaca, New York in 1997. I received a Ph.D. in Electrical Engineering from Cornell University, Ithaca, New York in 1999. My doctoral studies focused on communication and information theory with specific focus on error correction codes. My M.S. thesis and

Ph.D. dissertation at Cornell both related to advanced error correction coding including turbo codes.

B. Career

6. From 1991 to 1995, I worked as an intern in the Digital Signal Processing Group at Texas Instruments, Inc. in Stafford, Texas. I worked on both product engineering and applications engineering projects. Processors that I worked on at Texas Instruments were used in a variety of applications, including, e.g., voice processing, image processing, fax machines, voiceband modems, wireless communications, digital radio receivers and anti-lock brakes on cars and aircraft. As further example, these processors were used for OFDM-based communications systems such as the Harris RF-5000 military wireless communication systems developed in the late 1980s and early 1990s.

7. From 1997 to 2000, I was a Manager at Alantro Communications, Inc. in Santa Rosa, California. I managed the baseband systems team where I developed 802.11b compliant physical layer technology. I also lead the first development of 802.11a OFDM technology at Alantro. Amongst other things, I was responsible for building and designing error correction encoders and decoders at Alantro. Alantro Communications was later acquired by Texas Instruments. The 802.11 solutions that I built at Alantro and Texas Instruments shipped in numerous products, including Intel's Centrino brand of Wi-Fi products, and in Dell, D-Link, Linksys, Nokia, and many other products. The descendants of those products are still sold by Texas Instruments today.

8. From 2000 to 2003, I was the Director of Advanced Technology at Texas Instruments in Dallas, Texas. I worked in the Wireless Networking Business Unit where I led the development of Bluetooth and Wi-Fi coexistence technology. I also led efforts at Texas Instruments to enhance the IEEE 802.11 standard with quality-of-service extensions and to develop a very low power Wi-Fi technology for mobile phones. During my time at Alantro and Texas Instruments, I also worked on error correction coding for 802.11 systems including but not limited to CCK, BCC, concatenated Reed Solomon codes, turbo codes and LDPCs.

9. Further, while at Texas Instruments and through my expert consulting, I worked on and managed a team of engineers that worked on MAC-layer Wi-Fi technologies such as quality-of-service and data unit aggregation technologies.

10. Additionally, while at Alantro, Texas Instruments, and through my expert consulting, I have worked on, studied, and managed activity related to MIMO, space-time-block codes and beamforming.

11. From 2003 to 2008, I was the CEO and Founder of WiQuest Communications, Inc. in Allen, Texas. I developed the world's first 1 Gbps ultra-wideband chipset. I also developed the world's first wireless VGA/DVI system for notebook computers. This technology was incorporated into products developed by several major computer and electronics manufacturers such as Dell, Toshiba, Lenovo, Belkin, D-Link, and

Kensington. I built the company from inception to 120 employees. I managed a diverse group of employees who were located in Texas, India, California, Taiwan, and Japan.

12. In 2008, I founded and became the CEO of Biscotti, Inc. At Biscotti, I develop high-definition, Wi-Fi-based video calling systems for the home and office. During my time at Biscotti, I evaluated numerous Wi-Fi chip offerings for range, rate and robustness capabilities. Wi-Fi products that I evaluated were made by manufacturers such as Broadcom, Atheros (now Qualcomm), Marvell and Texas Instruments. At Biscotti, we used Wi-Fi chips from Broadcom and Marvell based on our range, rate and performance testing. As with many applications, range, rate and robustness were important to Biscotti due to our need to operate reliably across the entire home, tolerate interference from other products operating in the unlicensed bands used by Wi-Fi and achieve speeds that were sufficient to move high-definition video.

13. In about 2008, large companies began calling on me to serve as an expert and testifying witness in patent litigation cases. Thus, for 17 years, I have served in an expert capacity in trials where my expertise in communication systems and standards was needed by judges and juries. Clients that have used my services include Apple, AT&T, Blackberry, Broadcom, Caltech, Canon, Cisco, Dell, FujiFilm, Google, Harmon, Honda, HTC, Intel, Kia, Mercedes-Benz, Mitsubishi, NXP, Qualcomm, Realtek, Salesforce.com, Samsung, Sharp, Sprint, T-Mobile, Texas Instruments, Toyota, Verizon, and Wistron. After working in this capacity as a sole proprietor for many years, I incorporated Peritum LLC in 2015. Today, I continue providing expert engineering, consulting and technical services via Peritum.

C. Patents and Publications

14. I am a named inventor on over thirty patents, including patents related to wireless communications systems and various aspects of data communications systems including encoding, decoding, and transmission of information.

15. I have authored, co-authored, and contributed to many academic papers and publications, most in the area of data communications.

D. Other Relevant Qualifications

16. I have been a member of the Institute of Electrical and Electronic Engineers ("IEEE") since 1991. In 1999, I was the Chairperson of the IEEE 802.11g Study Group where I led a committee of twenty engineers to set project requirements for IEEE 802.11g. Subsequently, from 2000 to 2003, I was the Chairperson of the IEEE 802.11g Task Group where I led a committee of over 200 engineers to set standards for 54 Mbps data rates in the 2.4 GHz band in a way that was backward compatible with the IEEE 802.11b standard. From 2003 to 2004, I was the Chairperson of the IEEE 802.11n Task Group where I led a committee of over 300 engineers through the initial stages of standardization of data rate enhancements in excess of 100 Mbps.

17. I joined the external advisory board of the Department of Electrical and Computer Engineering at Texas A&M University in 2008. I currently hold emeritus status.

III. Opinions

18. I have been asked to provide my opinion as to what the credentials of a person of ordinary skill in the art would have been in the 2000-2001 timeframe (the time of the inventions of U.S. Patent Nos. 9,313,065 (the ’065 Patent) and 7,529,305 (the ’305 Patent)) and also how such a person would have understood the claims at issue. Specifically, I was asked to provide my opinions on the following terms:

    a. “wherein the pilot symbols for the first antenna correspond to a first code and the pilot symbols for the second antenna correspond to a second code” from claims 1, 9, 17, 25, 31, and 37 of the ’065 Patent

    b. “a delay arrangement, arranged such that for each symbol of the M symbol substreams a time of representation of the symbol in the M space-time coded streams is different for each of the M space-time coded streams” from claim 1 of the ’305 Patent

    c. “delay elements adapted to insert a delay in time in at least one of the M substreams” from claim 6 of the ’305 Patent

    d. “mth” and “m–1” from claim 6 of the ’305 Patent

19. In my opinion, a person of ordinary skill in the art of the ’065 patent would have had a Bachelor of Science degree in electrical engineering or computer engineering and two years of experience in the field of wireless communication with focus on the physical layer, or the equivalent thereof. Additional education, such as a Master’s degree in a relevant field, could compensate for less work experience.

20. In my opinion, a person of ordinary skill in the art of the ’305 patent would have had credentials and experiences equivalent to those listed above for the ’065 patent.

21. I possess at least the level of skill necessary to qualify as a person of ordinary skill with respect to these two patents and to provide the following opinions as a person of ordinary skill in the art at the relevant times would have understood them.

A. The ’065 Patent

22. The ’065 Patent, which claims priority to an application filed October 17, 2001, claims a method of transmitting symbols using Orthogonal Frequency Division Multiplexing, or OFDM.

23. At a high level, now and at the time of the ’065 Patent, wireless communication is achieved by transmitting electromagnetic signals and modifying certain parameters or characteristics of those signals—such as amplitude, phase, and frequency—to encode information. These transmissions can occur within designated frequency bands (such as the 5 GHz band), which can be further subdivided into narrower frequency channels (e.g., a 20 MHz channel).

24. As relates to the ’065 Patent, Orthogonal Frequency Division Multiplexing (OFDM) is a technique in which each of those channels is further divided into multiple subcarriers. Each subcarrier can be individually modulated. For example, a subcarrier may be multiplied by +1 or –1, corresponding to binary values of 0 or 1. An OFDM symbol is comprised of several of these subcarriers, and a frame is typically formed from a sequence of OFDM symbols. Increasing the number of subcarriers enables higher transmission rates.

25. Also as relates to the ’065 Patent, Multiple Input Multiple Output (MIMO) is a technique in which multiple antennas are used by both the transmitter and receiver to send and receive multiple data streams simultaneously over the same frequency channel. The antennas are placed at different physical locations where each can experience distinct channel conditions due to differences in propagation paths, reflections, or scattering in the environment. These differing channel conditions make it possible to transmit multiple spatial streams—independent data streams sent simultaneously based on the spatial separation of the antennas—thereby significantly increasing the achievable data rate.

26. At the time of the ’065 Patent, it was known that accurate data reception in OFDM systems could be significantly impaired by factors such as clock offset between the transmitter and receiver and Doppler shift caused by relative motion. These timing and frequency mismatches were known to accumulate throughout the duration of a packet, leading to substantial errors in data recovery. The challenge became even more complex in systems that combined MIMO and OFDM.

27. The ’065 Patent addresses, among other things, methods for the insertion of pilot symbols specifically tailored for MIMO systems, where precise synchronization and channel estimation are critical. See, e.g., ’065 Patent at Abstract, Figs. 10-11, 8:17-36 (“The first received signal is a combination of the two signals transmitted by the two transmitting antennae …, although each of the two signals will have been ***altered by a respective channel*** between the respective transmitting antenna and receiving antenna. … The four channels (between each of the two transmitting antennae and each of the two receiving antennae) may ***vary with time and with frequency***…,” 10:43-66 (“***The goal*** of channel estimation ***is to estimate the channel characteristics*** for each sub-carrier and at each time ***for each possible transmit antenna, receive antenna combination***”) (emphasis added).

28. To address these challenges, the ’065 Patent describes using certain subcarriers as pilot subcarriers. See, e.g., id. at 7:19-22 (“some sub-carriers are used as pilot sub-carriers to carry pilot symbols”), Figs. 4-5, 7. These pilot subcarriers are modulated in a known and predictable manner, allowing the receiver to compare the received pilot values with the expected ones. See, e.g., id. at 61-66 (“The channel estimator compares the received pilot symbols with what the channel estimator knows to be the values of the pilot symbols as transmitted by the OFDM transmitter….”). By doing so, the receiver can estimate and compensate for channel effects—thereby maintaining accurate synchronization and channel estimation throughout a packet. See, e.g., id. at 8:63-9:2 (“The channel estimator … generates an estimated channel response for each frequency and time within the OFDM symbol. The estimated channel responses are passed to decoder 78.”), Fig. 3 showing Channel Estimator 72 output connected to Decoder 78; 9:1-2 (“The estimated

channel responses are passed to decoder 78”). The ’065 patent further teaches that pilot symbols can be advantageously scattered among the subcarriers to enhance the receiver’s ability to perform these corrections across the entire channel and for all antennas in a MIMO system. See, e.g., id. at 2:32-35 (“Since the channel response can vary with time and frequency, the pilot symbols are scattered …”), 4:24-27 (“Channel estimation methods ... are based on ... a scattered pilot ...”), (“The methods allow fewer pilot symbols to be placed within each symbol …. The data rate of a MIMO-OFDM system is thereby improved.”), 7:14-17 (“The following sections describe MIMO-OFDM transmitter/receiver and scattered pilot insertion”).

29. However, there is an inherent tradeoff in the allocation of pilot subcarriers: assigning too many subcarriers to pilots reduces the number of subcarriers available for transmitting user data, thus lowering the system’s data rate. See, e.g., id. at 2:30-33 (“The pilot symbols are overhead, and should be as few in number as possible in order to maximize the transmission rate of data symbols.”). Conversely, too few pilot subcarriers can make it difficult for the receiver to reliably estimate channel conditions, especially if the pilots themselves are degraded due to signal fading or interference, ultimately jeopardizing successful data recovery. See, e.g. id. at 3:12-15 (“To interpolate and reconstruct the channel response function from the limited pilots to achieve reliable channel estimation with the minimum overhead is a challenging task.”).

30. The ’065 Patent teaches that pilot symbols can be advantageously scattered in a variety of ways—including across frequency, time, and/or transmit antennas—to optimize channel estimation and synchronization in OFDM and MIMO systems. See, e.g., id. at 2:32-35 (“[T]he pilot symbols are scattered … over frequency and time”), 4:51-55 (“a scattered pattern in time-frequency”), 6:24-34 (“sets of N pilot symbols transmitted from N antennas in a scattered pattern in time-frequency”), 4:56-60. Figure 5 of the ’065 Patent provides an exemplary illustration: each row corresponds to an OFDM symbol (with time progressing downward), and each column represents a subcarrier across the frequency axis. See, id. at 10:6-23. The circles represent subcarriers, where the shaded circles indicate pilot subcarriers and the open circles are used for data. Id. Thus, Figure 5 is an example of how pilot symbols may be scattered both across different frequency subcarriers within a single OFDM symbol and across multiple OFDM symbols over time.

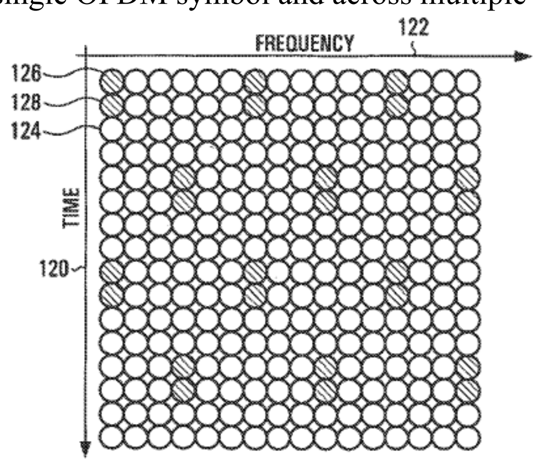

FIG. 5

i. "wherein the pilot symbols for the … antenna correspond to a … code"

31. I understand that the parties have proposed the following constructions:

Term	Plaintiffs' Proposed Construction	Defendants' Proposed Construction
"wherein the pilot symbols for the first antenna correspond to **a first code** and the pilot symbols for the second antenna correspond to **a second code**"	No construction required.	"wherein the pilot symbols for the first antenna correspond to **a first row of a space time block code** and the pilot symbols for the second antenna correspond to **a second row of the space time block code**"

32. In the context of wireless communication systems – and particularly in the context of pilot symbols – a "code" is, and was, at the time of the invention of the '065 Patent, commonly understood by persons of ordinary skill in the art to mean a predefined sequence of values or symbols—typically comprising +1s and –1s or complex-valued elements, that is used to modulate a signal for a specific purpose. Such codes may be applied, for instance, to modulate pilot subcarriers within an OFDM symbol, to differentiate transmissions from multiple antennas, or to facilitate signal separation and identification. A code can define the relative phase or amplitude for each subcarrier or time instance and is typically known a priori by both transmitter and receiver. For example, a sequence such as [–1, –1, +1, –1] could be employed as a code to modulate a set of pilot subcarriers, enabling a receiver to determine parameters such as time and frequency offset between the transmitter and receiver.

33. A space-time block code (STBC) can be used in wireless communication systems that transmit symbols across multiple transmit antennas and multiple time instances according to a predefined encoding matrix, having, in some instances rows and columns which specify the transmission of symbols, their complex conjugates, or negated versions from each antenna over successive time instances. The relationship between the columns and rows of certain STBC designs are subject to constraints such as orthogonality or quasi-orthogonality, which are not necessary or inherent to other coding schemes used for pilot symbols or other purposes. Thus, rows of an STBC can have constraints that are not applicable to other types of codes.

34. It is my opinion that the defendants' proposed construction, which narrows the term "code" to a "row of a space-time block code (STBC)," is incorrect and unsupported. This interpretation is neither consistent with the specification of the '065 Patent nor aligned with the understanding of a person of ordinary skill in the art at the time of the invention.

35. Within the context of the '065 Patent, a "space-time block code," on the other hand, represents a specific subset of coding schemes, characterized by a function that maps symbols to a matrix comprising the symbols, their complex conjugates, and/or negated versions. See, e.g., '065 Patent at 8:1-8 ("The STBC block 23 takes two pilot symbols at

a time for example P_1 and P_2 … and generates an STBC block consisting of a two by two matrix having (P_1, P_2) in the first row and having ($-P_2^*$, P_1^*) in the second row"). The defendants' construction would exclude other well-established coding schemes applicable to pilot symbols, such as Walsh codes and complementary codes, which are (and were at the time of the '065 Patent) widely used in wireless standards for modulation, channel estimation, or signal differentiation, yet do not conform to the STBC matrix structure or its row-specific goals like orthogonality. Accordingly, there is no basis to restrict the broader term "code" exclusively to the STBC framework or to limit it to the rows of such a matrix, which impose additional constraints not inherent to the claimed invention.

36. The term "code," as used in the claims, would have been understood by such a person of ordinary skill to encompass any predefined sequence of values or symbols—such as relative phases and/or amplitudes—employed to modulate pilot symbols for each antenna. The term would have been reasonably understood without further definition, especially not the one proposed by the defendants.

B. The '305 Patent

37. The '305 Patent, titled *Combination of Space-Time Coding and Spatial Multiplexing, and the Use of Orthogonal Transformation in Space-Time Coding*, claims priority to October 27, 2000, and addresses techniques for transmitting multiple symbol substreams across multiple antennas using space-time coding and spatial multiplexing to achieve coding gain and improved robustness to fading. In particular, the patent describes applying an orthogonal transformation to the symbol substreams and introducing relative delays so that each symbol is represented across all transmit antennas at different times. See, e.g., Abstract, 2:51-57, 3:7-16, 13:60-63. This has the benefit of introducing a coding gain and making symbols more immune to fading. See, e.g., id. at 2:51-3:6.

i. "a delay arrangement, arranged such that for each symbol of the M symbol substreams a time of representation of the symbol in the M space-time coded streams is different for each of the M space-time coded streams"

38. I understand that the parties have proposed the following constructions:

Term	Plaintiffs' Proposed Construction	Defendants' Proposed Construction
a delay arrangement, arranged such that for each symbol of the M symbol substreams a time of representation of the symbol in the M space-time coded streams is different for each of the M space-time coded streams	No construction required.	a **time** delay arrangement, arranged such that for each symbol of the M symbol substreams a time of representation of the symbol in the M space-time coded streams is different for each of the M space-time coded streams

39. In my opinion, a person of ordinary skill in the art would reasonably understand "delay arrangement" in the context of the '305 Patent, and therefore no construction is necessary. Moreover, delay can take forms other than time delay, such as phase delay. Because phase delay and time delay can directly correspond, narrowing the claim to "time delay" could have unintended consequences—such as effectively excluding delays expressed in other ways, e.g., via time or phase shifts.

40. I further note that certain embodiments described in the specification of the '305 Patent disclose delay arrangements in which not all symbols are delayed in time. Accordingly, a person of ordinary skill in the art would not understand a delay arrangement to require that all symbols be subject to a time delay. For example, figure 5 presents a preferred embodiment of the '305 Patent. I have annotated it below in color.

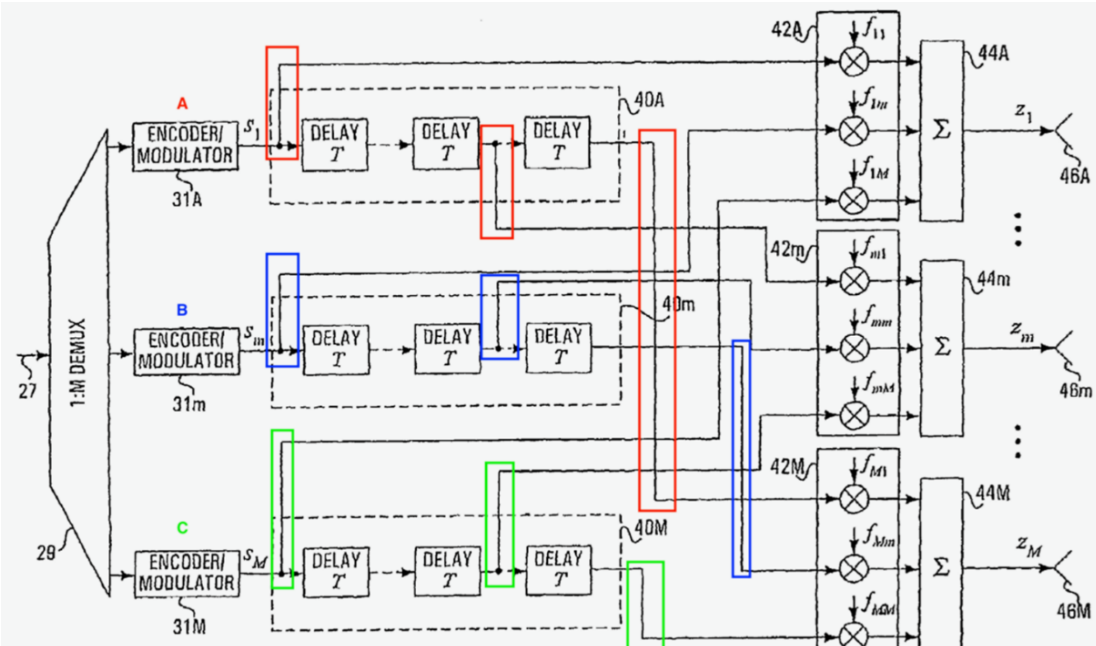

FIG. 5

41. Figure 5 includes a delay arrangement in which certain symbols are *not* delayed at all to achieve different times of representation. There are M symbol sub-streams (here, three of them) as input, which I have labeled A, B, and C. Each of those streams travels through delay elements (labeled "DELAY" in original). The red boxes identify how A contributes to the space-time code streams (the outputs on the right), the blue does so for B, and the green does so for C. Importantly, as can be seen in the figure for each of these, there is a path that ***does not use delay***. The first of each of the red, blue and green boxes on the left do *not* go through any delay elements, yet they are still part of a "delay arrangement" that results in the time of presentation being different in different symbols of the space-time coded symbols. See '035 Patent at Fig. 6 and 5:1-17 ("The ***undelayed bits*** u_1, …, u_M, … are fed to respective symbol mapping functions…" (emphasis added)).

42. In summary: (a) a person of ordinary skill in the art would readily understand the term "delay arrangement" in the context of the '305 Patent without modification or further

definition; (b) such a person would recognize that delays can be expressed in different ways, including but not limited to time delay and phase delay, and thus injecting "time" into the construction is unnecessarily limiting; and (c) the specification discloses embodiments in which, even when measured in time, some symbols are not delayed at all. For these reasons, narrowing the claim term to require a "time delay" would improperly exclude legitimate forms of delay arrangements and preferred embodiments described in the patent. A person of ordinary skill would not have needed further definition of "delay arrangement" to understand the scope of the claims, and certainly not the definition proposed by the defendants.

ii. "delay elements adapted to insert a delay in time in at least one of the M substreams"

43. I understand that the parties have proposed the following constructions:

Term	Plaintiffs' Proposed Construction	Defendants' Proposed Construction
delay elements adapted to insert a delay in at least one of the M substreams	No construction required.	delay elements adapted to insert a **time** delay in at least one of the M symbol substreams

44. It is my opinion that a person of ordinary skill in the art of the '305 Patent at the time of the invention would have understood the "delay" in at least one of the substreams as not limited to a delay *in time*." In fact, at the time of the invention, it was well understood that delay elements could be adapted to insert a *phase* delay.

45. Consider a basic sinusoid, such as would for the signal of the symbol sub-streams:

$$x(t) = \cos(\omega t + \phi)$$

Time delay is commonly expressed by the following equation:

$$\tau = \phi / \omega$$

where ϕ is the phase shift (also referred to as phase *delay*), and τ time is the equivalent time delay. Therefore, in an oscillating signal, delay can be expressed in different ways, e.g. time delay or phase delay.

46. In fact, the body of the specification uses such notation for phase delays. For example, at 4:30-34 a matrix is provided for a Hadamard transform which uses phase shift notation of $e^{j\pi/4}$ (phase advance 45 degrees) and $-e^{j\pi/4}$ (phase delay by 45 degrees). Each such phase delay or advance has a corresponding time delay or advance depending on the frequency of the subcarrier to which it is applied.

47. Thus, adopting Defendants' proposal would not be in accord with the claim's plain and ordinary meaning to one that excludes certain types of delay, including those that are equivalent to a time delay. Therefore, in my opinion, a person of ordinary skill in the art

at the time of the '305 Patent would not have understood "delay" to exclude all non-time delays as Defendants' proposed construction appears to do.

iii. "mth" and "m-1"

48. I understand that the parties have proposed the following constructions:

Term	Plaintiffs' Proposed Construction	Defendants' Proposed Construction
mth	(m=1, …,M)th	*No construction required.*
m-1	((m=1, …,M) – 1)	*No construction required.*

49. Claim 6 of the '305 Patent includes: "an orthogonal transform adapted to produce M orthogonal outputs, with the mth orthogonal output being a function of the M substreams delayed in said delay elements by m−1 symbol periods" Here, both "m" and "M" represent integer numbers.

50. The specification describes "m" in this context at 3:14-16: "For example, the delay elements can be adapted to introduce a delay of m-1 symbol periods in the mth orthogonal output, where m=1, …, M." This is standard mathematical notation that a person of ordinary skill in the art would readily understand to indicate that *m* is an index ranging from 1 to *M*, corresponding to the orthogonal outputs. In this usage, "mth" simply refers to the orthogonal output associated with the index *m* (for example, the 1st output, 2nd output, …, Mth output).

51. It is my opinion that a person of ordinary skill in the art of the '305 Patent would readily understand from claim 6 and the specification that there are M orthogonal outputs of the space-time coding function, and that "mth orthogonal output" refers to one of those outputs, where *m* is an index from 1 to *M*. Thus, "mth" necessarily identifies the specific orthogonal output corresponding to the index *m* (for example, the 1st, 2nd, …, Mth output). A person of ordinary skill in the art would understand that *m* can take on any integer value in the range 1 to M, consistent with standard notation in the field.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge and belief.

Executed August 6, 2025 at Carmel, Indiana.

Matthew B. Shoemake, Ph.D.