I, Joseph C. McAlexander III, P.E., declare as follows:

1. I have personal knowledge of the facts set forth herein, and, if called upon to do so, I could and would testify competently to them.

2. I have been asked to supplement my November 25, 2016 declaration (the "Original Declaration") regarding the Petition for Inter Partes Review of U.S. Patent No. 9,282,396 (the "'396 patent") in IPR2016-01639, and in particular, to evaluate (1) whether the '892 patent and the 1998 paper disclose a transmitter, receiver or headphone that includes a DPSK implementation, (2) whether the '892 patent and the 1998 paper disclose a transmitter, receiver or headphone that includes a direct conversion module, and (3) whether the '892 patent and the 1998 paper disclose a direct conversion module configured to capture uniquely coded packets. As I explain in detail below, I conclude that the '892 patent and the 1998 paper do not disclose these items in these arrangements.

3. I have also been asked to consider (1) whether a direct conversion module or DPSK is necessary for making or operating the invention in the '892 patent, and (2) whether a direct conversion module or DPSK is necessary to implement or operate a system in accordance with the Bluetooth specifications described in the 1998 paper. As I confirm below, neither DPSK nor a direct conversion module is necessary in either of those two cases.

4. In preparing this supplemental declaration, I further reviewed and considered the following references:

- U.S. Patent No. 9,282,396 to Woolfork (the "'396 patent");
- U.S. Patent No. 6,563,892 to Haartsen et al. (the "'892 patent"); and
- Haartsen, J., "Bluetooth—The Universal Radio Interface for Ad Hoc, Wireless Connectivity," Ericsson Review, Telecommunications Technology Journal No. 3, 1998, pp. 110–117 ("the 1998 paper").

5. I am being compensated at my customary hourly rate for my time spent on this opinion. I have no personal interest in the outcome of this or any related proceeding.

6. My qualifications are stated in my Original Declaration.

Level of Ordinary Skill in the Art

7. Consistent with my Original Declaration, I have assumed that a person has ordinary skill in the art if the person has a Bachelor of Science degree in electrical engineering or a related field and around two years of experience in the design or implementation of wireless communications systems, or the equivalent, or six years of experience in the design or implementation of wireless communications systems, or the equivalent. I am very familiar with the level of knowledge meeting this standard. My own experience and education exceeds those levels, and did so throughout the time of the applications. Additional details are shown in my Curriculum Vitae attached to my Original Declaration.

Claim term constructions, U.S. Patent No. 9,282,396

8. I have applied the following claim constructions in this analysis:

Claim Term	Petitioner's Requested Construction
"reduced intersymbol interference coding" (cl. 1, 2, 6, 9, 14, 16)	"coding that reduces intersymbol interference"
"configured for independent code division multiple access (CDMA) communication operation" (cl. 1, 2, 6, 9, 14, 16)	"configured for code division multiple access (CDMA) communication operation performed independent of any central control"
"unique user code" / "unique user code bit sequence" (cl. 1, 2, 6, 9, 14, 16)	"fixed code (bit sequence) specifically associated with one user of a device(s)"
"direct conversion module" (cl. 1, 2, 6, 9, 14, 16)	"a module for converting radio frequency to baseband or very near baseband in a single frequency conversion without an intermediate frequency"

The ’892 Patent’s Reference to DPSK

9. I have further reviewed the ’892 patent. In particular, I have considered the following paragraphs beginning at column 4, line 65 and running through column 5, line 54, which I have lettered below for convenient reference:

(a) Despite these types of variations and disturbances experienced by the signal, the threshold for the bit value determination has conventionally remained fixed (assuming no a priori knowledge about the interference present, which would allow an adaptation of the threshold). As a result, bit errors are introduced since the fixed threshold does not remain located at the optimal position midway between the signal values. However, since the amplitude of the binary signal is fixed (e.g., as in binary FM signals, wherein the modulation index represents the amplitude of the final detection signal at the output of the FM detector and is fixed), the separation Δ between the signal symbols remains fixed regardless of the disturbance superimposed on the signal.

(b) Therefore, a better detection technique for binary signals disturbed by slowly varying signals is to abandon the threshold technique, and instead use the difference Δ between the two possible symbols. To be able to use this technique, the signal separation between the two symbols must be fixed. Therefore, this difference technique can only be used in systems where this separation is constant and is not affected by propagation effects. Such difference techniques include, for example, binary phase or frequency modulation schemes (e.g. continuous phase frequency shift keying, CPFSK) which are widely used in wireless communication because of the property that the signal variation is hardly affected by propagation effects.

(c) A known technique that uses the difference between two adjacent symbols is differential keying. In differential keying, a one is represented by a change between two adjacent symbols, whereas a zero is represented by no change between adjacent symbols (or the other way around). Differential keying is primarily found in phase modulation schemes (DPSK) but can be used in other modulation schemes as well. For example, frequency modulation could also be implemented in this manner, e.g., a DFSK scheme (Differential Frequency Shift Keying) wherein for a binary one, two adjacent symbols use $f_o+\Delta f$ and $f_o-\Delta f$, whereas for a binary zero, the symbols use both $f_o+\Delta f$ or both $f_o-\Delta f$. The original signal d(k) at time instant k is retrieved in the detector by sampling the input signal at the symbol rate and comparing two adjacent samples. This can be achieved by subtracting the previous symbol x(k−1) from the current symbol x(k):

$$d(k)=x(k)-x(k-1) \qquad (1)$$

(d) It will be appreciated by those skilled in the art that this type of differential modulation scheme removes all DC offset. In addition, some low-frequency signals can be removed as long as the difference in the disturbance level between adjacent samples is less than Δ/2. DFSK modulation is, however, not used much in practice since its signal-to-noise (SNR) performance is degraded compared to FSK. This degradation occurs because, for the determination of a single bit, the noise of two samples is taken into account in the differential process. Therefore, the performance

in white Gaussian noise of DFSK modulation is more than 3 dB worse than that of FSK modulation.

10. A person of ordinary skill in the art ("POSITA"), reading the above paragraphs, would understand that, in these patents, the '892 patent discusses bit detection techniques.

11. A POSITA would understand that, in paragraph (a), the '892 patent discusses the conventional use of a fixed threshold for bit detection and points out that, in a binary signal having a fixed amplitude, the separation delta between symbols remains fixed regardless of disturbances.

12. A POSITA would understand that in paragraph (b), the '892 patent makes the point that, when binary signals are experiencing disturbance by slowly varying signals, then it would be better for detection to use the difference delta between two symbols, rather than to use the threshold technique. A POSITA would further understand paragraph (b) to explain that the use of the difference technique is only applicable to systems where signal separation is constant and not affected by propagation effects. A POSITA would understand that paragraph (b) then provides well known examples of difference techniques, namely binary phase or frequency modulation schemes, and also CPFSK (continuous phase frequency shift keying). Paragraph (b) informs a POSITA that, in these schemes, signal variation is hardly affected by propagation effects.

13. A POSITA would understand that, in paragraph (c), the '892 patent introduces differential keying as a technique that uses the difference between two adjacent symbols. A POSITA would understand that paragraph (c) explains, in differential keying, a zero could be represented by no change between adjacent symbols, and a one could be represented by a change between adjacent symbols (or the other way around). After this explanation of the basic nature of differential keying, paragraph (c) then points out a known example by stating, "Differential keying is primarily found in phase modulation schemes (DPSK) but can be used in other modulation schemes as well." A POSITA would understand that the mention of DPSK in that sentence is to identify an example of a phase modulation scheme that implements differential keying. A POSITA would understand that the remainder of paragraph (c) is devoted to discussing how differential keying can be implemented with frequency modulation, including providing difference equations for such implementation with frequency modulation. A POSITA would understand that paragraph (c) provides the basic equations for a differential frequency shift keying (DFSK) technique.

14. A POSITA would understand that, in paragraph (d), the ’892 patent explains some properties of differential modulation and compares the use of DFSK to FSK (frequency shift keying).

15. Considering the remainder of the ’892 patent, a POSITA would understand that the ’892 patent describes the invention of the ’892 patent with periodic comparison to conventional DFSK. (*See* ’892 patent 5:55-62; 6:8-34; 7:20-28).

16. Considering again the mention of DPSK in paragraph (c) above (’892 patent 5:29-31), and considering the context in which DPSK was mentioned, a person of ordinary skill in the art would understand that the mention of DPSK was made solely to identify an example of a phase modulation scheme that implements differential keying. No other reference to DPSK appears in the ’892 patent. A person of ordinary skill in the art would understand that the ’892 patent does not disclose DPSK as being used by the invention of the ’892 patent, does not disclose DPSK as being used by any embodiment of the ’892 patent, and does not disclose any transmitter, receiver or other product or component as being configured to use DPSK or to have a DPSK implementation.

17. A person of ordinary skill in the art would also understand that use of the invention of the ’892 patent does not require DPSK. In fact, the first paragraph of the ’892 patent states that “The techniques described herein are particularly well-suited for the detection of binary FM or binary FSK modulated signals . . ..” (*See* ‘’892 patent 1: 13-15). Thus, one of ordinary skill in the art would understand that, to the extent any modulation scheme is suited for use with the invention of the ’892 patent, it would be a frequency-based modulation scheme, and not a phase-based modulation scheme like DPSK.

18. A person of ordinary skill in the art, having reviewed the entire ’892 patent, would understand that the ’892 patent does not suggest or recommend the use of DPSK, but rather emphasizes that the invention of the ’892 patent be used with frequency-based modulation, in particularly DFSK.

The ’892 Patent and the 1998 Paper do not Disclose Any Transmitter, Headphone or Receiver as Including DPSK

19. Claims 3, 7, 12 of the ’396 patent each recite a digital audio spread spectrum transmitter that is specifically required to include a “differential phase shift keying (DPSK) implementation.” Claim 9 similarly recites a digital audio spread spectrum transmitter that is specifically required to include a “differential phase shift keying (DPSK) modulator.” The ’892 patent fails to disclose any transmitter as comprising a differential phase shift keying implementation or as comprising a differential phase shift keying modulator.

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