DECLARATION UNDER 37 CFR 1.131(a)

Application Serial Number: 16/916,901
Patent Number: 11,223,508
Filing Date: 6/30/2020
Inventor: Steve Shattil
Attorney Docket Number:

I, Steve Shattil, declare as follows:

1. I am the inventor of Patent No. 11,223,508 ('508).

2. This Declaration establishes constructive reduction to practice (and thus, invention) of the subject matter of each rejected claim prior to the effective date (under 35 U.S.C. 102(e)) of references on which the rejection is based.

3. I completed my invention as described and claimed in the subject patent 11,223,508 ('508) as evidenced by the following:

4. The subject matter of each of the rejected claims is disclosed in U.S. Patent appl. no. **10/131,163 ('163), filed April 24, 2002**.

5. The features of claim 1 (with emphasis) and corresponding support in '163, by way of example, but without limitation, are shown as follows:

Claim 1 (and claims 9 and 17 recite similar features). A method of communicating in a mobile radio communications network, comprising:

6. Written support in '163 includes the following: (emphasis added)

Page 11, sixth Par.:

> "Some of the many **wireless** applications of the invention include local-area networks, **cellular communications**, personal communication systems, broadband wireless services, data link, voice radio, satellite links, tagging and identification, wireless optical links, campus-area communications, wide-area networks, last-mile communication links, and broadcast systems."

7. A person of ordinary skill in the art (POSITA) would recognize "cellular communications" as a type of wireless network.

provisioning a consecutive series of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers for uplink or downlink communications;

8. Written support in '163 includes the following: (emphasis added)

Page 35, fourth Par.:

> "If the frequency separation between any two **adjacent frequencies** is made equal to the reciprocal of the effective symbol period for multicarrier transmission, the nil point of the frequency spectrum of each modulated wave coincides with the center frequency of the adjacent modulated waves. CI signals can include **orthogonal**, overlapping signals."

Page 54, fourth Par.:

> "FIG. 11 shows a CI-OFDM signal architecture for a plurality *M* of users. **Each user is provided with a unique set of carriers**."

Page 203, second Par.:

> "In accordance with yet other embodiments of the scaleable CI modulation system, scaleable transmission rates permit asymmetric data rates between mobile units and base stations. For example, the mobile units can have lower data rates than the base stations by allocating only a fraction of the total number of carriers to each mobile, while the base stations transmit on all carriers simultaneously. Additionally, during data downloading,

for example, **a mobile unit could have a larger downlink data rate than uplink data rate**. In accordance with other aspects of a scaleable CI system, mobile units and base stations using the same antennas for both transmit and receive operations can benefit from adaptive antennas without any additional processing requirements at the base station, thereby keeping the mobile units as simple as possible. The scaleable CI modulation system can use an adaptive antenna at the base by sending feedback through the uplink when **uplink and downlink** channel characteristics are not identical."

9. A POSITA would recognize "CI-OFDM" as a type of OFDM, which typically provisions blocks of consecutive subcarriers to users. The POSITA would recognize that adjacent frequencies are consecutive subcarrier frequencies. The POSITA would understand that a mobile unit provided with a particular downlink data rate and an uplink data rate would necessarily be provisioned with OFDM subcarriers.

provisioning a plurality of different selectable subcarrier spacings for the consecutive series of OFDM subcarriers;

10. Written support in '163 includes the following: (emphasis added)

Page 52, third Par.:

> "The symbol duration T_s is equal to the inverse of the carrier-frequency spacing f_s. **Carrier-frequency spacing in each carrier set may be selected** to reduce correlated fading between adjacent carrier frequencies."

Page 202, third Par.:

> "The control circuitry 9901 may scale a transmitted bit rate by **scaling** the CI symbol duration, the number of carriers, **the carrier spacing**, and/or the number of bits per symbol per carrier. This permits the scaleable CI system to operate in various **communications environments** requiring various operating parameters and/or characteristics. By scaling the operating parameters and/or characteristics of the CI system when control circuitry **9901** determines that different operating parameters and/or

characteristics are necessary or advantageous, the control circuitry **9901** can dynamically change the operating parameters and/or characteristics, thereby providing compatibility or the desired performance. For example, dynamically scaling the bit rate enables widely varying signal bandwidths, **adjustment of delay-spread tolerances**, and adaptability to different SNR requirements. A scaleable CI system is particularly suitable for applications in mobile wireless communications, as well as other applications that support a variety of services in a variety of environments."

11. The POSITA finds explicit instruction and motivation in the above examples to provision different subcarrier spacings.

performing discrete Fourier transform (DFT) coding on a plurality of data symbols to produce coded symbols;

12. Written support in '163 includes the following: (emphasis added)

Page 117, third Par.:

"CI symbols may be values derived from at least one **invertible transform function**, such as a **Fourier transform**"

13. The POSITA understands that a discrete Fourier transform is a type of Fourier transform.

performing an inverse-DFT on the coded symbols to produce a single-carrier frequency division multiple access signal that comprises a sum of the consecutive series of OFDM subcarriers; and

14. Written support in '163 includes the following: (emphasis added)

Page 73, third Par.:

"The carrier generator 1606 is illustrated as an **inverse Fourier Transform** (IFT)."

Page 67, second Par.:

> "The matrix elements shown in FIG. 15B illustrate basic mathematical relationships between carrier frequencies f_n and phase spaces $Ps(n')$ that can simplify transforms between frequency-domain and time-domain signals. For example, given a set of symbol values $s_{n'}$, these mathematical relationships provide carrier-frequency weights that produce a **superposition signal** with time-domain characteristics corresponding to the symbol values $s_{n'}$."

15. The POSITA understands that an inverse discrete Fourier transform is a type of inverse Fourier transform that is commonly used in OFDM modulation. The output of such an inverse discrete Fourier transform is naturally a sum (e.g., superposition) of subcarriers.

transmitting the single-carrier frequency division multiple access signal in the mobile radio communications network;

16. Written support in '163 includes the following: (emphasis added)

Page 117, last Par. – Page 118, first Par.:

> "FIG. 41A illustrates general steps of a **transmitting** method of the present invention. An information signal $s(t)$ is optionally encoded and/or interleaved 4101. Encoding may include code puncturing. Preferably, coding includes CI or CI-based coding. The coding/interleaving step 4101 may include generating or otherwise acquiring symbol values to be impressed onto multiple carriers. The information signal may be provided with predetermined training symbols in a training symbol injection step 4102. Training symbols may be used for channel estimation, signal-quality estimations, synchronization, etc. An IFFT 4103 or equivalent process impresses the coded data symbols onto a plurality of carriers. Optionally, a cyclic prefix may be added to the coded data symbols. An FIR filtering and interpolation step 4104 is performed prior to preparing the resulting signal for **transmission into a communication channel** (not shown)."

Page 139, second Par.:

"The output of the frequency spreader 5512 is processed by an RF modulator 5514 that provides an RF transmit signal that is optionally processed and coupled into a communication channel by a transmitter 5516."

Page 201, second Par.:

"Time-domain signals generated by the IFFT 9809 are provided to a transmission system adapted to prepare the time-domain signals for **transmission into a communication channel**."

17. The POSITA recognizes explicit instructions to transmit the signal in a mobile communications network.

wherein provisioning the plurality of different selectable subcarrier spacings comprises providing the single-carrier frequency division multiple access signal with a particular one of a set of different symbol periods by selecting one of the plurality of different selectable subcarrier spacings.

18. Written support in '163 includes the following: (emphasis added)

Page 52, third Par.:

"The **symbol duration T_s is equal to the inverse of the carrier-frequency spacing f_s**. **Carrier-frequency spacing** in each carrier set may be **selected** to reduce correlated fading between adjacent carrier frequencies."

19. The POSITA is taught that selecting the subcarrier spacing effects a selection of the symbol duration (i.e., symbol period) according to an inverse relationship.

Claim 2 (and claims 10, 18) The method of claim 1, wherein at least one of the plurality of different selectable subcarrier spacings equals at least one other of the plurality of different selectable subcarrier spacings multiplied by a scaling factor that is a power of two.

20. Written support in ’163 includes the following: (emphasis added)

Page 202, first Par.:

> “The number of wavelets representing each chip depends on the **duration** of the particular wavelet compared to the duration of the chip. Orthogonal wavelets may be provided wherein the **wavelet scales are related by multipliers that are powers of two**.”

21. The POSITA is taught that a wavelet is a CI pulse shape comprising a superposition of CI-coded subcarriers, and the duration of different wavelets may be related by factors that are powers of two.

Claim 3 (and claims 11, 19) The method of claim 1, further comprising adding a cyclic prefix to the single-carrier frequency division multiple access signal prior to transmitting.

22. Written support in ’163 includes the following: (emphasis added)

Page 165, fourth Par.:

> “FIG. 70 shows three orthogonal waveforms 7001, 7002, and 7003 separated in frequency by integer multiples of a separation frequency f_s. In some cases, the waveforms 7001, 7002, and 7003 may be sub-carrier modulations. Similarly, the waveforms 7001, 7002, and 7003 may be characterized by orthogonal circular (or elliptical) polarization spin frequencies. Data symbols may be impressed onto each waveform within a symbol interval $T_s = 1/f_s$. The symbol interval and/or adjacent intervals may include guard intervals and/or **cyclic prefixes**, which are well known in the art.”

23. The POSITA finds explicit instruction to add a cyclic prefix.

Claim 4 (and claims 12, 20) The method of claim 1, wherein the plurality of different selectable subcarrier spacings are integer multiples of a first subcarrier spacing.

24. Written support in ’163 includes the following: (emphasis added)

Page 202, first Par.:

> “The number of wavelets representing each chip depends on the duration of the particular wavelet compared to the duration of the chip. Orthogonal wavelets may be provided wherein the **wavelet scales are related by multipliers that are powers of two**.”

25. The POSITA understands that multiples that are powers of two include integer multiples, and integer multiples are conventionally employed due to their convenience in digital and fixed-point implementations.

Claim 5 (and claims 13, 21) The method of claim 1, wherein the provisioning the plurality of different selectable subcarrier spacings is configured for different deployment scenarios comprising different system requirements or different channel conditions.

26. Written support in ’163 includes the following: (emphasis added)

Page 202, second Par.:

> “The present invention increases flexibility and adaptability by providing scaling of operating parameters and/or signal characteristics in a CI system. FIG. 99 illustrates a control circuit 9901 adapted to process one or more **system requirements** 9911 and, optionally, one or more **channel characteristics** 9912.”

27. The POSITA finds explicit instruction to select signal characteristics, which includes frequency spacing, according to system requirements and/or channel characteristics.

Claim 6 (and claims 14, 22) The method of claim 1, wherein each of the plurality of different subcarrier spacings provides a different number of symbols per frame.

28. Written support in ’163 includes the following: (emphasis added)

Page 52, third Par.:

> "The **symbol duration *T_s* is equal to the inverse of the carrier-frequency spacing *f_s***. **Carrier-frequency spacing** in each carrier set may be **selected** to reduce correlated fading between adjacent carrier frequencies."

Page 161, last Par. – Page 162, first Par.:

> "**Framing can involve providing a predetermined number of symbols in a fixed time interval**. In CI systems, framing can be performed by selecting a number of CI carriers that is related to the number of symbols in a frame. The frequency separation between carriers may be related to the inverse of the frame duration. Data symbols are positioned in the frame via carrier weighting, which may be adjusted at frame-duration intervals."

29. The POSITA is taught that a frame is a fixed time interval, so the number of symbols in a frame depends on the symbol duration depends (inversely) on the carrier-frequency spacing.

Claim 7 (and claims 15, 23) The method of claim 1, wherein the performing the inverse-DFT employs a discrete Fourier transform with a plurality of sampling rates that comprise harmonic frequencies.

30. Written support in '163 includes the following: (emphasis added)

Page 153, first Par.:

> "Optionally, **A/D conversion** 6509 and frequency conversion 6510 may be performed via **harmonic** and/or sub-harmonic processes 6515. A/D conversion 6509 may be integrated into frequency conversion 6510 and/or **Fourier processes** 6514."

Page 182, second Par.:

> "Thus, OFFT and **CI sampling may utilize harmonic** and/or sub-harmonic frequencies relative to at least one frequency component of a sampled signal."

31. The POSITA understands that A/D conversion employs sampling.

Claim 8 (and claims 16, 24) The method of claim 1, further comprising determining a delay spread in the mobile radio communication network; and based on the delay spread, employing a first numerology or a second numerology; wherein the first numerology comprises a first one of the plurality of different selectable subcarrier spacings, and the second numerology comprises a second one of the plurality of different selectable subcarrier spacings.

32. Written support in ’163 includes the following: (emphasis added)

Page 202, third Par.:

> “The control circuitry **9901** may scale a transmitted bit rate by **scaling the CI symbol duration**, the number of carriers, **the carrier spacing**, and/or the number of bits per symbol per carrier. This permits the scaleable CI system to operate in various **communications environments** requiring various operating parameters and/or characteristics. By scaling the operating parameters and/or characteristics of the CI system when control circuitry **9901** determines that different operating parameters and/or characteristics are necessary or advantageous, the control circuitry **9901** can dynamically change the operating parameters and/or characteristics, thereby providing compatibility or the desired performance. For example, dynamically scaling the bit rate enables widely varying signal bandwidths, **adjustment of delay-spread tolerances**, and adaptability to different SNR requirements. A scaleable CI system is particularly suitable for applications in mobile wireless communications, as well as other applications that support a variety of services in a variety of environments.”

33. The POSITA is taught that the signal bandwidth is a function of the carrier-frequency spacing, and that scaling such enables adjustment of the delay-spread tolerance.

Claim 9 An apparatus for communicating in a mobile radio communications network, comprising:

> **a non-transitory computer-readable memory storing one or more instructions; and at least one processor in communication with the non-transitory computer-readable**

memory; wherein the one or more instructions, when executed by the at least one processor, cause the at least one processor to:

34. Written support in ’163 includes the following: (emphasis added)

Page 80, last Par.:

> “For example, the A/D converter 1848 may include a filter bank, such as a **signal processor** adapted to perform a Fourier transform, wavelet transform, or an equivalent operation.”

Page 146, fourth Par.:

> “The filter 6012 may include a filter bank. The filter 6012 may include any type of **signal processor** adapted to perform a Fourier transform operation. For example, the filter 6012 may perform one or more FFTs, DFTs, and/or OFFTs.”

Page 202, second Par. – third Par.

> “FIG. 99 illustrates a **control circuit** 9901 adapted to process one or more system requirements 9911 and, optionally, one or more channel characteristics 9912. The control circuit 9901 provides adjustment to one or more CI parameters 9902 in a CI transceiver 9903. CI parameter adjustment and/or selection affects one or more transceiver operating parameters 9921.
>
> The **control circuitry** 9901 may scale a transmitted bit rate by scaling the CI symbol duration, the number of carriers, the carrier spacing, and/or the number of bits per symbol per carrier. This permits the scaleable CI system to operate in various communications environments requiring various operating parameters and/or characteristics. By scaling the operating parameters and/or characteristics of the CI system when control circuitry 9901 determines that different operating parameters and/or characteristics are necessary or advantageous, the control circuitry 9901 can dynamically change the operating parameters and/or characteristics, thereby providing compatibility or the desired performance. For example, dynamically scaling the bit rate enables widely varying signal

bandwidths, adjustment of delay-spread tolerances, and adaptability to different SNR requirements. A scaleable CI system is particularly suitable for applications in mobile wireless communications, as well as other applications that support a variety of services in a variety of environments."

35. The POSITA understands that a signal processor can include a variety of different processors, including a processor with computer-readable memory. The POSITA understands that control circuitry in a transceiver can include chips and other processors that are regarded as a processor in communication with the non-transitory computer-readable memory.

Claim 17 An apparatus for communicating in a mobile radio communications network, comprising:

a transceiver-control circuitry configured for:

36. Written support in '163 includes the following: (emphasis added)

Page 202, second Par.:

"The present invention increases flexibility and adaptability by providing scaling of operating parameters and/or signal characteristics in a CI system. FIG. 99 illustrates a **control circuit** 9901 adapted to process one or more system requirements 9911 and, optionally, one or more channel characteristics 9912. The **control circuit** 9901 provides adjustment to one or more CI parameters 9902 **in a CI transceiver** 9903. CI parameter adjustment and/or selection affects one or more transceiver operating parameters 9921."

37. The POSITA understands that a signal processor can include a variety of different processors, including a processor with computer-readable memory. The POSITA understands that control circuitry in a transceiver can include chips and other processors that are regarded as a processor in communication with the non-transitory computer-readable memory.

DECLARATION

The declarant acknowledges that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon. The declarant attests that all statements made of the declarant's own knowledge are true and that all statements made on information and belief are believed to be true.

Date: May 9, 2025

Steve Shattil