DECLARATION UNDER 37 CFR 1.131(a)

Application Serial Number: 17/183,114
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Inventor: Steve Shattil
Attorney Docket Number:

I, Steve Shattil, declare as follows:

1. I am the inventor of Patent No. 11,424,792 ('792).

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 11,424,792 ('792) 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 8 and 15 recite similar features). A method of enabling a flexible channel bandwidth for mobile radio communications, comprising:

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

Page 202, second Par. – third 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.
>
> 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.”

7. A person of ordinary skill in the art (POSITA) finds explicit instruction to provide for flexible channel bandwidth for mobile wireless communications, which includes can include selecting frequency spacing.

provisioning a set of Orthogonal Frequency Division Multiplexing (OFDM) subcarriers for mobile radio communications;

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

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. The POSITA recognizes from the disclosure that CI-OFDM is a type of OFDM in which each user is provisioned a unique set of carriers for mobile communications.

encoding data symbols with polyphase codes derived from a discrete Fourier transform to produce encoded data symbols; and

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

Page 39, third Par.:

> "An offset in the time domain corresponds to **linearly increasing phase offsets** in the frequency domain. A CI signal with a time offset $\tau = k/Nf_s$ is equivalent to a CI carrier set with carriers 1 to N having phase offsets:
>
> $$\{\phi_1, \phi_2, \ldots, \phi_N\} = \{0, 2\pi k/N, 2 \cdot 2\pi k/N, \ldots, (N\text{-}1) \cdot 2\pi k/N\}.$$

Orthogonality between CI signals can be understood as an appropriate time separation $\tau \in \{k/f_s,\ k = 1, 2, \ldots, N\text{-}1\}$ between superposition signals or as carriers of each carrier set coded with a different **polyphase spreading sequence**:

$$f(\phi) = \{e^{j\theta 1}, e^{j\theta 2}, \ldots, e^{j\theta N}\} = \{e^{j0}, e^{j2\pi k/N}, \ldots, e^{j(N-1)\cdot 2\pi k/N}\}$$

with respect to values of $k=0, 1, \ldots, N\text{-}1$."

Page 201, fifth Par.:

"A code may be provided as a set of phase shifts (e.g., a **polyphase CI code** or a binary-phase direct-sequence code) or some other diversity-parameter values applied to the wavelets."

Page 117, third Par.:

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

11. The POSITA finds explicit teaching of polyphase codes that comprise linearly increasing phase offsets, which for certain sets of phase offsets, the POSITA recognizes as columns of a DFT matrix.

modulating the encoded data symbols onto the OFDM subcarriers to produce a superposition signal that resembles a single-carrier signal and has one of a plurality of different symbol durations;

12. 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 94, last Par. – Page 95, first Par.:

"In one set of embodiments, the aggregate bandwidth of the CI frequency components equals the bandwidth of a corresponding conventional single-carrier signal."

Page 163, second Par.:

"A CI superposition signal **has similar time-domain characteristics as a conventional single-carrier signal**."

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."

13. 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. The POSITA is taught that a superposition of the CI-coded subcarriers has similarities to a single-carrier signal.

wherein provisioning comprises selecting one of a plurality of different selectable subcarrier spacings, to provide for the one of the plurality of different symbol durations.

14. 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."

15. 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 9, 16). 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.

16. 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**."

17. 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 10, 17). The method of claim 1, wherein the superposition signal is provided with a cyclic prefix.

18. 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.”

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

Claim 4 (and claims 11, 18) The method of claim 1, wherein the provisioning comprises receiving at least one of a system requirement and a channel characteristic, and the selecting is responsive to the at least one of the system requirement and the channel characteristic to provide at least one of a predetermined transmission rate, a predetermined bandwidth, a predetermined signal-to-noise ratio, or a predetermined delay-spread tolerance.

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

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."

21. The POSITA finds explicit instruction for selecting subcarrier spacing based on system requirements and/or channel conditions to effect a predetermined transmission rate, bandwidth, delay-spread tolerance, or SNR.

Claim 5 (and claims 12, 19). The method of claim 1, wherein the provisioning is performed by a user device or a base station.

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

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."

Page 206, third Par.:

"Base-station functionality may be controlled by individual access points or subscriber transceivers assigned to act as base stations."

23. The POSITA understands that base stations typically provision resources. The POSITA finds explicit instructions in the disclosure that a user device might perform base-station functionality.

Claim 6 (and claims 13, 20). The method of claim 1, wherein the modulating employs a discrete Fourier transform with a plurality of sampling rates that comprise harmonic frequencies.

24. 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."

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 A/D conversion employs sampling. The POSITA understands that the disclosed wavelet scales being related by multipliers that are powers of two indicates harmonic sampling rates.

Claim 7 (and claims 14, 21). The method of claim 1, further comprising determining a delay spread in a mobile radio communication network; and based on the delay spread, the selecting being performed according to a first numerology or a second numerology; wherein the first numerology is a first one of the plurality of different selectable subcarrier spacings, and the second numerology is a second one of the plurality of different selectable subcarrier spacings.

26. 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.”

27. 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. The POSITA

would understand, it's practically useful to limit spacing choices (symbol durations) to a finite subset.

Claim 8. An apparatus for providing flexible channel bandwidth in mobile radio communications, comprising:

at least one processor; and

at least one non-transitory computer-readable memory in electronic communication with the at least one processor, and instructions stored in the at least one memory, the instructions executable by the at least one processor for:

28. 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."

29. 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 15. A computer program product, comprising a non-transitory computer-readable memory having computer readable program code stored therein, the program code containing instructions executable by one or more processors of a computer system for:

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

Page 154, fourth Par.:

"The hardware component(s) 6603.1 to 6603.j typically include a transmitter and/or receiver system, and a **storage medium** (e.g., disk drive, tape drive, CR Rom, DVD, flash memory, or any other storage device) **for storing application programs** and data. Hardware and/or the software may perform A/D conversion, as necessary. In some applications, modulation and/or demodulation may be performed digitally with any combination of software 6601.1 to 6601.i and hardware 6603.1 to 6603.j components."

31. The POSITA understands that a storage medium can include 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