(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 April 2004 (01.04.2004)

PCT

(10) International Publication Number
WO 2004/028086 A2

(51) International Patent Classification[7]: H04L 12/28

(21) International Application Number: PCT/EP2003/010461

(22) International Filing Date: 19 September 2003 (19.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/412.244	20 September 2002 (20.09.2002)	US
60/419.151	17 October 2002 (17.10.2002)	US
60/419.152	17 October 2002 (17.10.2002)	US
Not furnished	17 September 2003 (17.09.2003)	US

(71) Applicant *(for all designated States except US)*: **ERICSSON TECHNOLOGY LICENSING AB** [SE/SE]; Scheelevägen 15, SE-223 63 Lund (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **HAARTSEN, Jacobus** [NL/NL]; Bruchterweg 81, NL-7772 BG Hardenberg (NL).

(74) Agent: **ERICSSON MOBILE PLATFORMS AB**; IPR & Legal support, S-221 83 Lund (SE).

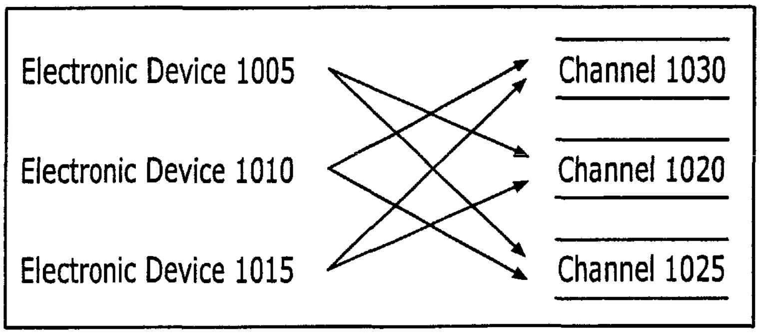
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHODS AND ELECTRONIC DEVICES FOR WIRELESS AD-HOC NETWORK COMMUNICATIONS USING RECEIVER DETERMINED CHANNELS AND TRANSMITTED REFERENCE SIGNALS



(57) Abstract: Electronic devices for communicating in wireless ad-hoc networks and multiple access systems (such as mobile radio telephone communications systems) are disclosed. For example, a disclosed transmitter can transmit data to a first receiver in an ad-hoc wireless network (or multiple access system) over a first channel and can, further, transmit data to a second receiver in the ad-hoc wireless network (or multiple access system) over a second channel that is separate from the first channel, where the first and second channels are determined by the respective receivers which will receive the first and second transmitted data. Accordingly, communications between transmitters and different receivers in the ad-hoc wireless network (or multiple access system) can be carried on simultaneously. Related receivers as well as methods, computer program products, and systems for communicating are also disclosed.

WO 2004/028086 A2

METHODS AND ELECTRONIC DEVICES FOR WIRELESS AD-HOC NETWORK COMMUNICATIONS USING RECEIVER DETERMINED CHANNELS AND TRANSMITTED REFERENCE SIGNALS

CLAIM FOR PRIORITYAND CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application No. 60/412,244, filed September 20, 2002, entitled *Method and Apparatus for Chaotic Radio Communication*; and to U.S. Provisional Application No. 60/419,151, filed October 17, 2002, entitled *Ultra-large processing gain system applying time offset;* and to U.S. Provisional Application No. 60/419,152, filed October 17, 2002, entitled *Ultra-large processing gain system applying frequency offset*, the entire disclosures of which are incorporated herein by reference.

TECHNICAL FIELD OF THE INVENTION

The invention relates to the field of communications in general, and more particularly, to wireless communications.

DESCRIPTION OF THE RELATED ART

Many existing communications systems may be considered to be highly structured. For example, in cellular phone systems, such as GSM, UMTS, or CDMA2000, radio base stations control the transmissions between mobile radios and a wired backbone. The infrastructure used to control such systems can reside in a Public Land Mobile Network (PLMN), which can include sub-systems such as base station controllers (BSC) and mobile switching centers (MSC). The communications with the mobile radios can be provided over control channels defined by the system. Connection setup, channel allocation, handover, and other types of support functions can be controlled by the BSCs and the MSCs.

Figure 1 shows an example of a conventional system, wherein the operations of several base stations in close proximity of each other, can be coordinated to reduce interference between mobile radios and to provide handover when the mobile radio moves from one coverage area to another. In particular, the system can be responsible for handling mobility issues that may arise while using the system, such as the radio interface, roaming, authentication, and so on. The system can be separated from a conventional wire-line backbone, such as a Public Switched Telephone Network (PSTN), but may interface to the backbone via a gateway (GMSC). As shown in Figure 1, typically only the connection between the radio and the base station (*i.e.,* the last segment of a call) is wireless.

Figure 2 shows wireless extensions to a wire-line backbone, such as the PSTN discussed above. In these types of systems, the BSC and MSC sub-systems shown in Figure 1 may be absent as the wire-line backbones may not support mobility. Some examples of wireless extensions to wire-line backbones include DECT (a wireless extension of PSTN/ISDN) and IEEE 802.11, which is a wireless extension of Ethernet.

Many of the above systems can provide multiple users with access to the system essentially simultaneously. Access can be provided to the multiple users by, for example, dividing the radio band into multiple channels. These types of systems are sometimes referred to as multiple access systems, which can be provided using various approaches illustrated in Figures 3-5 .

Figure 3 illustrates an analog type multiple access approach that is commonly referred to as Frequency Division Multiple Access (FDMA) wherein access for N users is provided by N different frequencies ω_i. According to Figure 3, N separate channels are provided at the different frequencies indicated by evenly spaced carriers at the different frequencies ω_i. The information signal (TX signal i) generated by the respective user modulates a respective carrier ω_i to provide a respective transmitted signal. The transmitted signal can be received by a receiver by demodulating the transmitted signal using the same carrier frequency ω_i and processed by a low pass filter (LP Filter) to provide a received signal (RX signal i). The bandwidth of the transmitted signal combined with the carrier spacing can determine interference between adjacent channels. The Advanced Mobile Phone System (AMPS), the Nordic Mobile Telephone (NMT) system, and the Extended Total Access System (ETACS), are examples of systems based on FDMA.

In FDMA, channels may be confined to an intended channel, for example to reduce interference, by spacing adjacent carriers adequately (referred to as orthogonality). The relative positions of the carriers should remain in a fixed relationship to one another (*i.e.,* the channels should not drift toward or away from one another). One way to reduce drift is to use a stable crystal oscillator as a reference for the frequency synthesizer in the radio.

Digital communications systems, such as the Global System for Mobile communications (GSM) and D-AMPS, can allow multiple users to access the medium on the basis of time. Such systems are commonly referred to as Time Division Multiple Access (TDMA) systems, an example of which is shown in Figure 4. As shown in Figure 4, each of the N users can be assigned one of the N time slots t_i. The transmitters transmit the respective signal (TX signal i) during the respective assigned time. Similarly, the receivers receive the signals (RX signal i) during the assigned time slot. In some TDMA systems, such as those illustrated in Figure 4, the channel provided by the carrier is divided into eight time slots. The channel can be defined by the carrier frequency and a time slot. Different users can be supported by different channels (*i.e.,* a combination of the particular frequency and the assigned time slot). It is also known to combine aspects of TDMA and FDMA, wherein multiple carrier frequencies are divided into multiple time slots. The channels can, therefore, be specified by one of the frequencies in combination with one of the time slots.

In TDMA, channel orthogonality can be provided by preventing consecutive time slots from overlapping one another, which can be provided using stable clocks in the transceivers. In addition to a particular transmitter and receiver pair being synchronized in the system, the different receivers can be also be synchronized to one another to prevent the time slot assigned to one radio from drifting into another time slot assigned to another radio. Usually, this can be accomplished by synchronizing all radios to a central controller, such as a base station.

It is also known to provide multiple access communications using a technique that is commonly referred to as Code Division Multiple Access (CDMA), such as systems using Direct Sequence CDMA (DS-CDMA) or Direct Sequence Spread Spectrum (DSSS). As shown in Figure 5, in DS-CDMA, the transmitted information (TX signal i) is spread with a high-rate spreading code (or signature) S_i that is associated with the particular transmitter i. In the receiver, a correlation can be applied to the signal using the same spreading code S_i to despread the signal to its original format (RX signal i). Typically, the spreading codes assigned to the transmitters are orthogonal relative to one another. If the spreading code used by the receiver does not match the spreading code used by the transmitter, the received signal will not be despread correctly and, therefore, may not be decoded. DS-CDMA techniques are used, for example, in IS-95, UMTS and CDMA2000. Conventional Spread Spectrum processing is discussed further, for example, in *Spread spectrum communications handbook*, pp. 7-117, by Marvin K. Simon et al., published 1994 by McGraw-Hill, In. ISBN 0-07-057629-7.

It is also known to provide multiple access communications using a technique that is commonly referred to as Frequency-Hopping CDMA (FH-CDMA), as shown in Figure 6A. According to Figure 6A, each of the N transmitters in the multiple access system separates the information to be transmitted into different segments and transmits each of the different segments at a carrier frequency that changes over time. A "hop pattern" defines which carrier frequency is used at which time for data transmission. In particular, as time elapses each transmitter hops (or changes) from one carrier to another according to a pseudo-random hop code, $C_i(\Omega,t)$, that is essentially unique to the particular transmitter.

Only the receiver that applies the same hop code C_i applied during transmission can remain in synchronization with the transmitter that transmitted the data and, therefore, is the only receiver that can decode the information. An exemplary table in Figure 6B shows an example of a hop pattern wherein the N transmitters change from one frequency to another frequency as a function of the hop codes applied by the different transmitters (and receivers) as a function of time.

One type of problem that may be encountered in both DS-CDMA and FH-CDMA type systems is the acquisition or initial code synchronization. If the spreading code is not synchronized to the signal at the receiver, the correct despreading may not be provided. Synchronization may be particularly difficult to obtain in low Signal-to-Noise Ratio (SNR) conditions. As a result, synchronization can be a lengthy process. This may pose a problem for asynchronous services where the transmissions are "bursty" and a synchronization phase may be needed for each new transmission.

Moreover, the acquisition delay may become an obstacle when large immunity against interference is desired. The Processing Gain (PG) in direct-sequence spread spectrum systems can be defined as the ratio between the Signal to Noise Ratio (SNR) after and before de-spreading:

$$PG = SNR_{despread}/SNR_{spread}$$

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

WHAT WILL YOU BUILD? | **sales@docketalarm.com** | **1-866-77-FASTCASE**

fastcase

Smarter legal research.