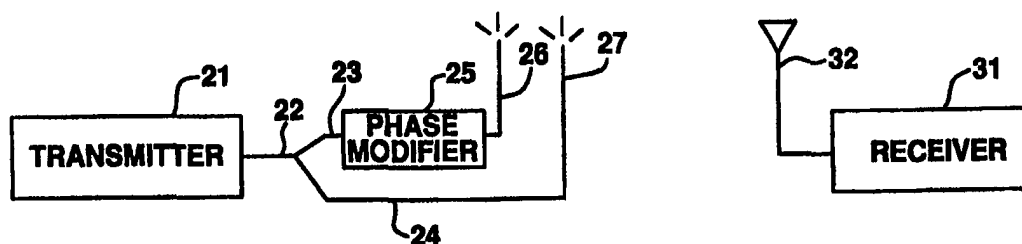




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <p>(51) International Patent Classification <sup>6</sup> :<br/><b>H04B 7/04, 7/06,</b><br/><b>H04L 1/06, 1/08</b></p>   | <p><b>A3</b></p>  | <p>(11) International Publication Number: <b>WO 98/27663</b></p> <p>(43) International Publication Date: 25 June 1998 (25.06.98)</p> |
| <p>(21) International Application Number: PCT/US97/22605</p> <p>(22) International Filing Date: 15 December 1997 (15.12.97)</p> <p>(30) Priority Data:<br/>08/768,319 17 December 1996 (17.12.96) US</p> <p>(71) Applicant: ERICSSON INC. [US/US]; 7001 Development Drive, P.O. Box 13969, Research Triangle Park, NC 27709 (US).</p> <p>(72) Inventors: CHENNAKESHU, Sandeep; 311 Glen Abbey Drive, Cary, NC 27513 (US). BOTTOMLEY, Gregory, E.; 100 Merlot Court, Cary, NC 27511 (US). DENT, Paul, W.; 637 Eagle Point Road, Pittsboro, NC 27312 (US).</p> <p>(74) Agents: MOORE, Stanley, R. et al.; Jenkins &amp; Gilchrist, P.C., Suite 3200, 1445 Ross Avenue, Dallas, TX 75202 (US).</p> | <p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b><br/><i>With international search report.</i><br/><i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p> <p>(88) Date of publication of the international search report:<br/>6 August 1998 (06.08.98)</p> |  |

(54) Title: SYSTEM FOR IMPROVING THE QUALITY OF A RECEIVED RADIO SIGNAL



## (57) Abstract

A delay spread is created in a digital radio signal to reduce the coherence bandwidth and facilitate frequency hopping to reduce the effect of fading losses within an enclosed propagation environment. The delay spread is introduced into the signal in several ways. One technique disclosed employs a transmitter (21) with two separate antennas (26, 27) one of which transmits the digital signal and the other of which transmits the same signal after a phase delay (25) has been introduced into the signal. The carrier frequency of the signals is hopped between at least two frequencies and the receiver processes the resulting signals. In another embodiment, a single transmit antenna (42) is used but the signal is received by two different antennas (43, 44) with the output signal from one of those antennas being phase delayed (45) before combining (46) it with the other prior to processing by the receiver circuitry (47). Phase delay (115) is also introduced at baseband into the signals to be transmitted by rotating the I and Q components of the waveforms before modulation.

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# INTERNATIONAL SEARCH REPORT

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**A. CLASSIFICATION OF SUBJECT MATTER**

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According to International Patent Classification(IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04L H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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| X  | <p>MOGENSEN P E ET AL: "On antenna- and frequency diversity in GSM related systems (GSM-900, DCS-1800, and PCS1900)" SEVENTH IEEE INTERNATIONAL SYMPOSIUM ON PERSONAL, INDOOR AND MOBILE RADIO COMMUNICATIONS. PIMRC '96 (CAT. NO.96TH8240), PROCEEDINGS OF PIMRC '96 - 7TH INTERNATIONAL SYMPOSIUM ON PERSONAL, INDOOR, AND MOBILE COMMUNICATIONS, TAIPEI, TAIWAN, October 1996, ISBN 0-7803-3692-5, 1996, NEW YORK, NY, USA, IEEE, USA, pages 1272-1276 vol.3, XP002067203<br/>see page 1272, left-hand column, line 27 - line 35<br/>see page 1274, right-hand column, line 7 - line 19<br/>see page 1275, left-hand column, line 1 - line 8<br/>see tables 2,3</p> | <p>1,2,9,<br/>10,17,<br/>27,35,36</p>                               |
| Y  | <p style="text-align: center;">---</p>   | <p>4-6,8,<br/>12-14,<br/>16,21,<br/>22,24,<br/>25,28,<br/>32,33</p> |
| Y  | <p style="text-align: center;">---</p> <p>YOSHIDA S ET AL: "Artificial delay insertion diversity to extend anti-multipath capability of DSK in mobile radio" IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS '86. ICC '86: 'INTEGRATING THE WORLD THROUGH COMMUNICATIONS'. CONFERENCE RECORD (CAT. NO.86CH2314-3), TORONTO, ONT., CANADA, June 1986, 1986, NEW YORK, NY, USA, IEEE, USA, pages 60-64 vol.1, XP002067204<br/>see page 60, left-hand column, line 19 - page 61, left-hand column, line 47<br/>see page 61, right-hand column, line 50 - page 62, left-hand column, line 19<br/>see page 62, right-hand column, line 12 - line 41<br/>see figures 1,2</p> | <p>4-6,8,<br/>12-14,<br/>16,21,<br/>22,24,<br/>25,28,<br/>32,33</p> |
| A  | <p style="text-align: center;">---</p> <p style="text-align: center;">-/--</p>   | <p>1,9</p>  |

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|----------|---|---|
| A        | <p>HOOK M ET AL: "Frequency diversity gain in indoor GSM systems"<br/>                     1996 IEEE 46TH VEHICULAR TECHNOLOGY CONFERENCE. MOBILE TECHNOLOGY FOR THE HUMAN RACE (CAT. NO.96CH35894), PROCEEDINGS OF VEHICULAR TECHNOLOGY CONFERENCE - VTC, ATLANTA, GA, USA, April 1996, ISBN 0-7803-3157-5, 1996, NEW YORK, NY, USA, IEEE, USA, pages 316-320 vol.1, XP002067205<br/>                     see page 316, left-hand column, line 1 -<br/>                     page 317, left-hand column, line 17<br/>                     -----</p> | <p>1,5,9,<br/>                     13,17,<br/>                     21,24,<br/>                     27,32,35</p> |