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Shimomura et al.

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(54) **SPREAD CODE ALLOCATING METHOD, DESPREADING METHOD, TRANSMITTING DEVICE, RECEIVING DEVICE, COMMUNICATING DEVICE, WIRELESS BASE STATION DEVICE, AND MOBILE TERMINAL DEVICE**

(75) Inventors: **Tsuyoshi Shimomura**, Kawasaki (JP); **Dai Kimura**, Kawasaki (JP); **Tetsuya Yano**, Kawasaki (JP)

(73) Assignee: **Fujitsu Limited**, Kawasaki (JP)

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(51) **Int. Cl.**
H04J 4/00 (2006.01)
H04B 1/707 (2011.01)

(52) **U.S. Cl.** **370/478**; 370/464; 375/146

(58) **Field of Classification Search** 370/478, 370/203–209, 310, 328, 329, 335, 342; 375/141, 375/146, 147, 259, 260
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,324,206 B1 * 11/2001 Rotstein et al. 375/140
6,496,474 B1 * 12/2002 Nagatani et al. 370/208
6,507,576 B1 * 1/2003 Suzuki et al. 370/342
6,512,753 B1 * 1/2003 Kim et al. 370/335
6,532,250 B1 * 3/2003 Palenius et al. 375/141
6,999,467 B2 * 2/2006 Krauss et al. 370/441
7,092,431 B2 * 8/2006 Maeda et al. 375/144
7,161,895 B1 * 1/2007 Sudo 370/204
7,242,722 B2 * 7/2007 Krauss et al. 375/260
7,302,238 B2 * 11/2007 Fujil 455/101
7,386,029 B2 * 6/2008 Hoshino et al. 375/142
7,420,915 B2 * 9/2008 Murakami et al. 370/204
7,436,758 B2 * 10/2008 Suh et al. 370/203
7,551,546 B2 * 6/2009 Ma et al. 370/208
7,620,420 B2 * 11/2009 Higuchi et al. 455/562.1

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1267966 A 9/2000

(Continued)

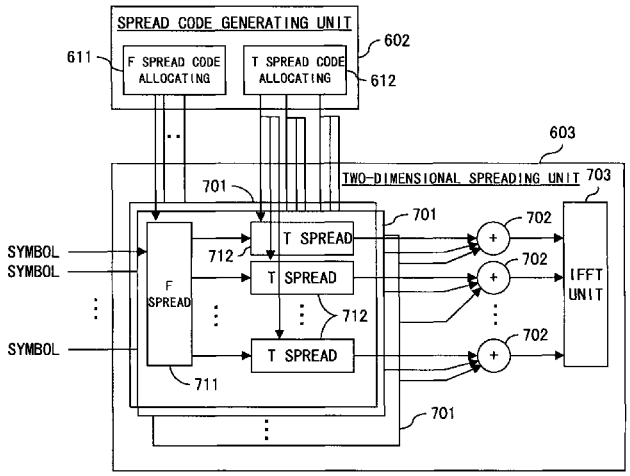
OTHER PUBLICATIONS

Y. Kishiyama, et al., "Investigation of Pilot Channel Structure for VSF-OFCDM Broadband Wireless Access," *Technical Report of IEICE*, vol. 102, No. 373, RCS2002-169.

(Continued)

Primary Examiner — Chi Pham
Assistant Examiner — Robert Lopata
(74) *Attorney, Agent, or Firm* — Myers Wolin, LLC

(57) **ABSTRACT**

When a two-dimensional spread code, with which spreading is made in time and frequency directions, is allocated to each channel, spread codes at least one of time and frequency directions of which are mutually orthogonal, and with which despreading can be made with spreading factors that are smaller than the original spreading factors in the respective directions are recognized as selection targets, and a spread code to be allocated to each channel is determined from among the spread codes recognized as the selection targets.

35 Claims, 27 Drawing Sheets