

- [54] **METHOD FOR FREQUENCY DIVISION DUPLEX COMMUNICATIONS**
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0 653 859 5/1995 European Pat. Off. .  
 0 653 973 12/1995 European Pat. Off. .  
 94/19877 9/1994 WIPO .  
 97/01256 1/1997 WIPO .

**OTHER PUBLICATIONS**

Ojanpera et al., "Frames-hybrid multiple access technology," 1996 IEEE 4th Int'l Symposium on Spread Spectrum Techniques, vol. 1, Sep. 22-25, 1996, pp. 320-324.

Rohling H et al, "Performance of an OFDM-TDMA mobile communication system," 1996 IEEE 46th. Vehicular Technology Conference, Apr. 28-May 1, 1996, vol. 3, No. 46, pp. 1589-1593, XP000595799.

Giner, V.C., "An Approximate Analysis of TDMA Out-of-Slot Random Access Protocols for Microcellular Mobile Communications" Int'l Jour. of Wireless Information Networks, vol. 3, No. 1, Jan. 1996, pp. 41-53, XP002077581.

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- [22] Filed: **Feb. 6, 1997**
- [51] **Int. Cl.<sup>6</sup>** ..... **H04Q 7/00**
- [52] **U.S. Cl.** ..... **370/330; 370/203; 370/281**
- [58] **Field of Search** ..... **370/203, 206, 370/329, 330, 337, 336, 343, 344, 321, 280, 281; 375/267, 347, 299**

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[57] **ABSTRACT**

The high quality PCS communications are enabled in environments where adjacent PCS service bands operate with out-of-band harmonics that would otherwise interfere with the system's operation. The highly bandwidth-efficient communications method combines a form of time division duplex (TDD), frequency division duplex (FDD), time division multiple access (TDMA), orthogonal frequency division multiplexing (OFDM), spatial diversity, and polarization diversity in various unique combinations. The method provides excellent fade resistance. The method enables changing a user's available bandwidth on demand by assigning additional TDMA slots during the user's session.

[56] **References Cited**

**U.S. PATENT DOCUMENTS**

- 4,381,562 4/1983 Acampora .
- 4,644,562 2/1987 Kavehrad .
- 4,723,321 2/1988 Saleh .
- 4,726,040 2/1988 Acampora .
- 5,056,112 10/1991 Wei .
- 5,289,464 2/1994 Wang .
- 5,367,539 11/1994 Copley .
- 5,689,502 11/1997 Scott ..... 370/281

**FOREIGN PATENT DOCUMENTS**

- 0 641 096 3/1995 European Pat. Off. .

**41 Claims, 15 Drawing Sheets**

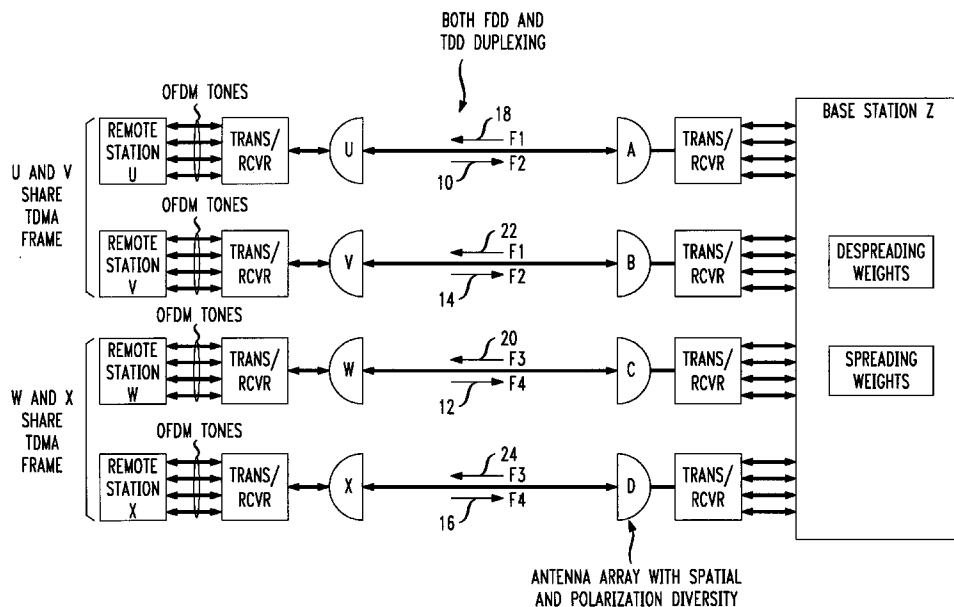


FIG. 1

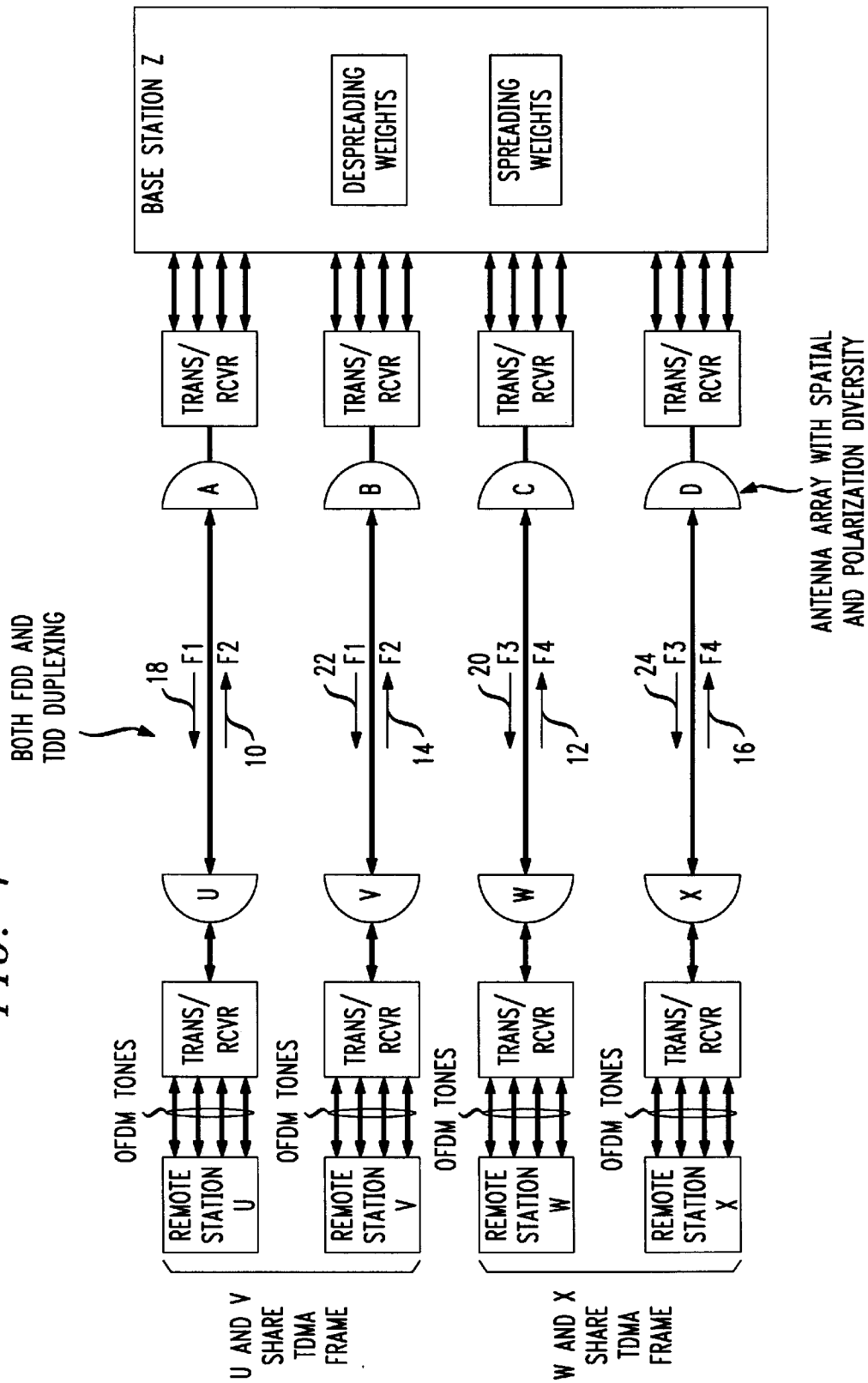


FIG. 1.1

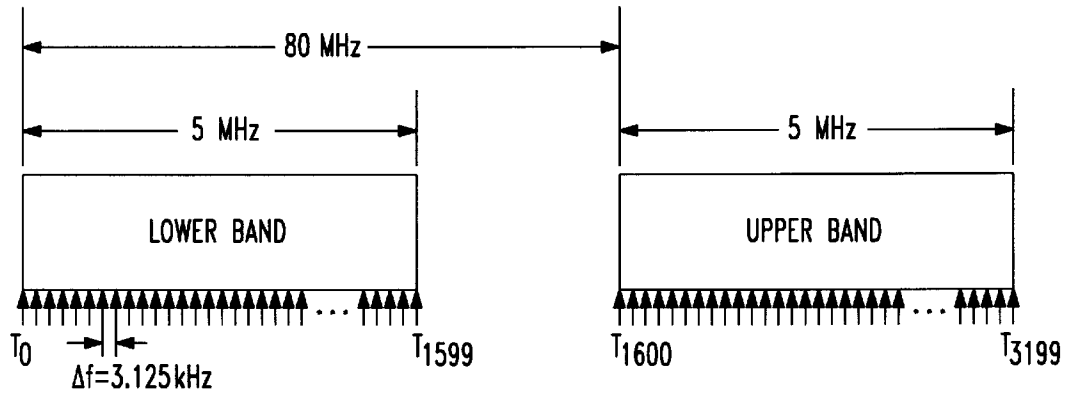


FIG. 1.2

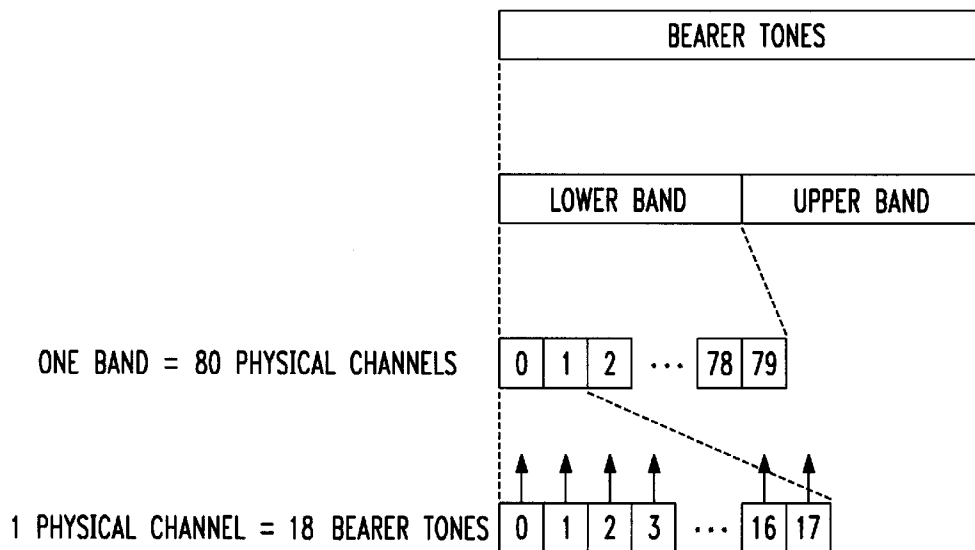


FIG. 1.3

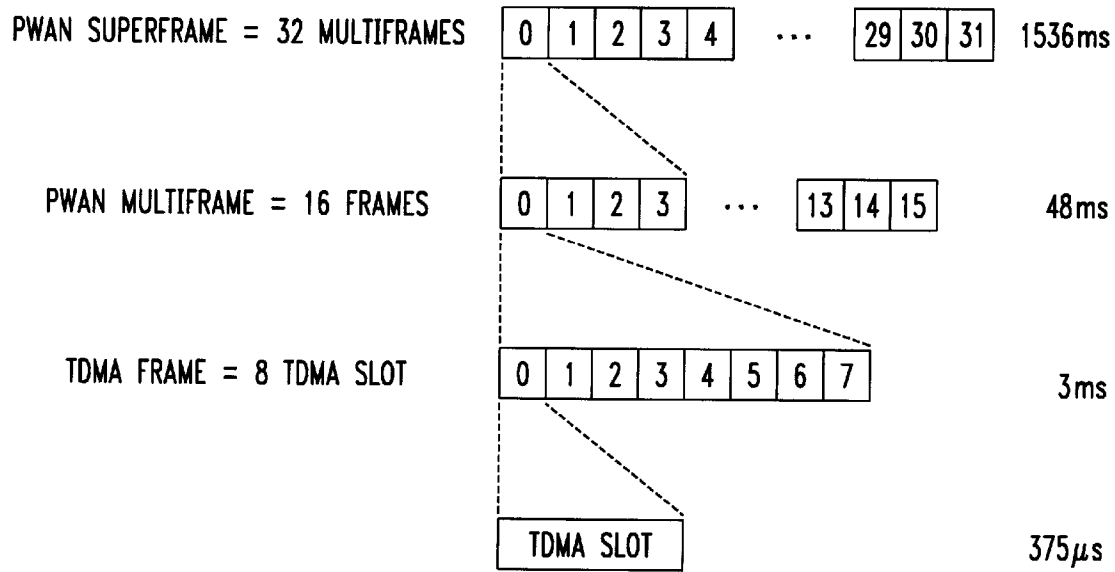


FIG. 1.4

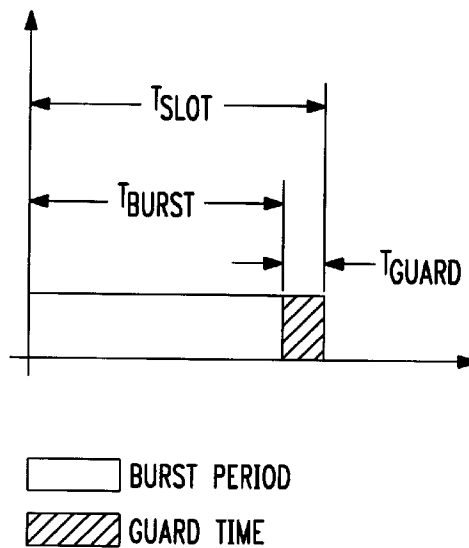
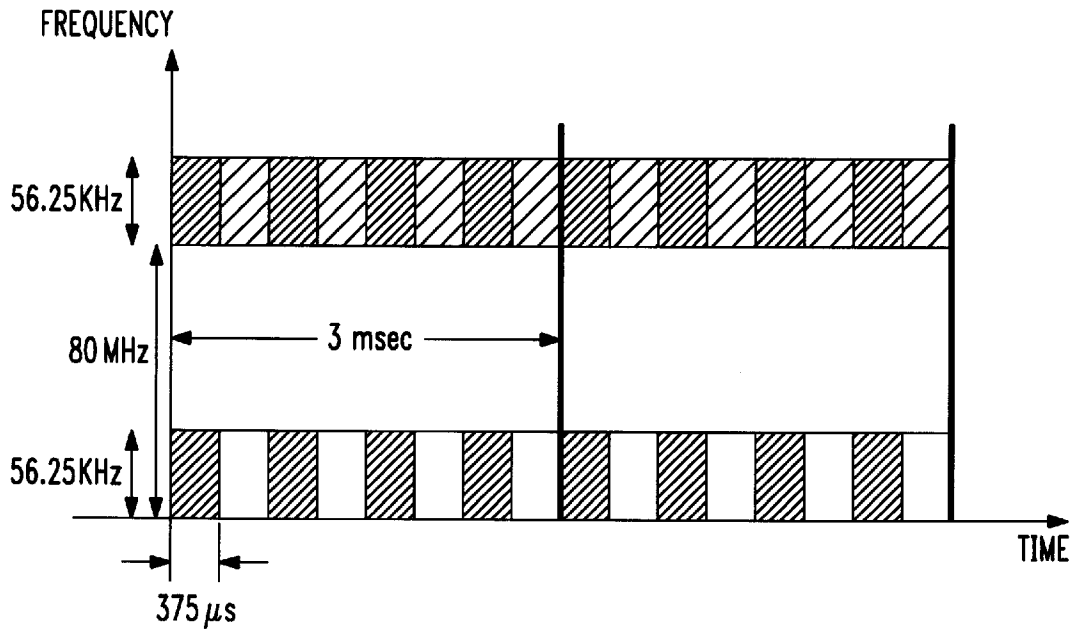






FIG. 1.5



- |  |  |
|--|--|
|  RU1 Rx<br>BASE Tx TO RU1 |  RU1 Tx<br>BASE Rx TO RU1 |
|  RU2 Rx<br>BASE Tx TO RU2 |  RU2 Tx<br>BASE Rx TO RU2 |

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