

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 199742105 B2**
(10) Patent No. **723996**

(54) Title
Data transmission method, and radio system

(51)⁶ International Patent Classification(s)
H04J 003/16

(21) Application No: **199742105** (22) Application Date: **1997 .09 .05**

(87) WIPO No: **WO98/10540**

(30) Priority Data

(31) Number	(32) Date	(33) Country
963518	1996 .09 .06	FI

(43) Publication Date : **1998 .03 .26**

(43) Publication Journal Date : **1998 .05 .21**

(44) Accepted Journal Date : **2000 .09 .07**

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(56) Related Art
WO 95/32566
WO 90/08436
WO 96/10875

OPI DATE 26/03/98 APPLN. ID 42105/97
AOJP DATE 21/05/98 PCT NUMBER PCT/FI97/00524



AU9742105

(51) International Patent Classification ⁶ : H04J 3/16		A2	(11) International Publication Number: WO 98/10540
			(43) International Publication Date: 12 March 1998 (12.03.98)
(21) International Application Number: PCT/FI97/00524		(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, 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, US, UZ, VN, YU, ZW, ARIPO patent (GH, 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).	
(22) International Filing Date: 5 September 1997 (05.09.97)			
(30) Priority Data: 963518 6 September 1996 (06.09.96) FI			
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(54) Title: DATA TRANSMISSION METHOD, AND RADIO SYSTEM			
The diagram illustrates a frame structure with time slots. The frame is divided into two main sections, 300 and 302, separated by a vertical line. Section 300 contains slots 0, 1, and k-2. Section 302 contains slots k-1, k, n-2, and n-1. The total duration of the frame is indicated by a horizontal line at the top labeled t_F.			
(57) Abstract			
A radio system and a data transmission method in a digital radio system where data between two transceivers is transmitted in both directions on the same frequency band in frames consisting of time slots, and where time slots (300, 302) assigned to different directions of transmission are separated from one another in the time domain. To allow effective use of the frequency band available, the number of time slots (300, 302) assigned to the different directions of transmission is varied dynamically.			

DATA TRANSMISSION METHOD, AND RADIO SYSTEM**FIELD OF INVENTION**

The invention relates to a data transmission method in a digital radio system where data between two transceivers is transmitted in both directions on the same frequency band in frames consisting of time slots, and where time slots assigned to different directions of transmission are separated from one another in the time domain.

BACKGROUND OF INVENTION

In present mobile systems, an equal amount of transmission capacity is assigned to a user in both directions of transmission. In connection with normal transmission of speech, this is not a problem. When new data transmission services are introduced, more flexible use of transmission capacity is, however, important. In several data transmission services, for example, short search requests, for which little capacity is needed, are sent in one direction. In the other direction the data requested is transferred to the user, and so more capacity is needed. Since the bandwidth has to be defined in view of the maximum need, bandwidth is wasted.

A previously known solution to the above problem is to form a data transmission frame comprising time slots of different length. A user needing more transmission capacity is assigned a longer time slot in both directions of transmission, whereas a user needing less transmission capacity is assigned a shorter time slot in both directions of transmission. The drawback of the method is that the time slots of the frame are of a predefined length, and if not much data transmission capacity is needed, bandwidth is unnecessarily wasted in long time slots.

BRIEF DESCRIPTION OF INVENTION

The object of the present invention is to provide a data transmission method and system in which a bandwidth assigned to the system can be divided according to the need flexibly and more effectively than before. Another object of the invention is to allow effective use of many-sided data transmission services in radio systems without that bandwidth is wasted.

The object is achieved by a method as described in the introduction, the method being characterized in that the number of time slots

assigned to the different directions of transmission is varied dynamically according to the capacity needed in the different directions of transmission.

Yet another object of the invention is to provide a digital radio system which comprises at least one base station and a number of terminal equipments, and in which data between the base station and the terminal equipments is transmitted in both directions on the same frequency band in frames consisting of time slots, and in which the time slots assigned to the different directions of transmission are separated from one another in the time domain. The radio system according to the invention is characterized in that the number of time slots assigned to the different directions of transmission on each frequency band can be varied dynamically according to the capacity needed in the different directions of transmission.

The solution of the invention has several advantages. In the solution, the number of time slots is varied according to the amount of capacity needed in the different directions of transmission. Consequently, the bandwidth available can be used as effectively and flexibly as possible. Also, the solution allows the use of high data transmission capacity requiring services (e.g. video calls) in systems where the bandwidth is limited.

DESCRIPTION OF DRAWINGS

In the following the invention will be described in greater detail with reference to the examples illustrated in the attached drawings, in which
fig. 1 shows a radio system in which the invention can be applied,
fig. 2 shows a frame of the DECT system,
fig. 3a shows a solution according to the invention for dividing the frame between different directions of transmission, and
fig. 3b shows a solution according to the invention in connection with the DECT system.

DESCRIPTION OF PREFERRED EMBODIMENTS

The method and receiver according to the invention can be applied in any digital radio system whatsoever where the directions of transmission are on the same frequency band and are separate from one another in the time domain. This kind of multiple access method is called a FDMA-TDD method (Frequency Division Multiple Access - Time Division Duplex). The essential parts of a structure of a typical radio system are described, by way of an example, in fig. 1. The system comprises a base station 100, and a number of

usually mobile subscriber terminals 102-104 with a both-way connection 106, 108 and 110, 112 to the base station 100. Here data is transmitted 106 from the base station to e.g. terminal equipment 102 at the same frequency as from terminal equipment 102 to the base station 108, but the transmissions are not simultaneous. The terminal equipments 102-104 communicate with the other parts of the system and with the fixed network via the base station 100. An example of a system like this is the DECT system. In the following we shall describe the invention as applied in the DECT, but without limiting the invention thereto.

10 In FDMA-TDD systems, such as the DECT, traffic between a terminal equipment and a base station is transferred in frames. Fig. 2 shows an example of a DECT frame, which structurally is a frame typically used in the FDMA-TDD systems. The overall length of the frame is t_f , which in connection with the DECT is 10 ms. The frame is divided into two parts 200, 202 of an equal size, where communication in different directions of transmission 106, 108 takes place. In the case of the DECT, both halves of the frame 200, 202 comprise 12 time slots, each one of which is used in a normal situation for transmitting one signal. Time slots 1 and 13, for example, carry information of one connection in both directions.

20 In prior art solutions there is an equal number of time slots assigned to the different directions of transmission, and the division cannot be changed. In the DECT, for example, there are 12 time slots per each direction of transmission. In the solution of the invention, the number of time slots assigned to the different directions of transmission can be changed dynamically according to the need. Fig. 3a shows an example of a solution according to the invention for dividing a frame between the different directions of transmission. The overall length of the frame is t_f , the number of time slots is n , and the frame is further divided into two parts 300, 302, which are used for transmitting traffic in the different directions of transmission 106, 108.

30 In the solution of the invention, the number of time slots assigned to the different directions of transmission is varied dynamically. The size of parts 300, 302 is thus adjusted according to the need. In the example of fig. 3a, part 300 comprises k time slots $0 \dots k-1$, and part 302 comprises $n-k$ time slots $k \dots n-1$. When an equal number of time slots are assigned to both directions of transmission, then $k=n/2$. In a preferred embodiment of the invention, the number of time slots can be varied with the capacity needed in the different

directions of transmission. The base station monitors the capacity needed in the different directions of transmission and, if necessary, changes the number of time slots assigned to the different directions of transmission. The base station naturally has to signal the current division of the frame structure to the terminal equipments.

The invention can also be applied in situations where more than one time slot is assigned to a connection between two transceivers. Since the different directions of transmission are assigned a different number of time slots, the number of time slots assigned for a connection in the different directions of transmission can be defined to be different according to the data transmission capacity needed.

Let us now examine a solution of the invention as applied in the DECT system. Fig. 3b shows an example of a DECT frame, where the number of time slots is $n=24$. In a prior art solution, there are 12 time slots in both directions, whereas in the solution of the invention the number can be adjusted. In the example of fig. 3b, time slots 0...8 - i.e. 9 time slots - are assigned to one direction of transmission 304, and time slots 9...23 - i.e. 15 time slots - to the other direction of transmission 306.

Let us then turn to fig. 1, which shows a structure of a radio system according to the invention. In a solution of the invention, the radio system comprises at least one base station 100 and a number of terminal equipments 102-104. Data between the base station and the terminal equipments is transmitted in both directions 106, 108 on the same frequency band in frames comprising time slots. Time slots 300, 302 assigned to the different directions of transmission are separated from one another in the time domain. The number of time slots 300, 302 assigned to the different directions of transmission on each frequency band can be varied dynamically. In a preferred embodiment, the frame structure can be adjusted at the base station 100.

Although the invention is described above with reference to an example illustrated in the attached drawings, it is to be understood that the invention is not limited thereto but can be varied in many ways within the scope of the inventive idea presented in the attached claims.

The claims defining the invention are as follows:

1. A data transmission method in a digital radio system where data between two transceivers is transmitted in both directions on the same frequency band in frames consisting of time slots, and where time slots assigned to different directions of transmission are separated from one another in the time domain, the method comprising the steps of:

5 varying the number of time slots assigned to the different directions of transmission dynamically according to the capacity needed in the different directions of transmission.

2. A method according to claim 1, wherein the radio system comprises one or more base stations and a number of terminal equipments, whereby the number of time slots is adjusted at the base station.

3. A method according to claim 1, whereby the time slots assigned to a particular direction of transmission are successive.

4. A method according to claim 1, whereby more than one time slot is assigned for a connection between two transceivers.

5. A method according to claim 4, whereby the numbers of time slots assigned for a connection in the different directions of transmission are not equal.

6. A digital radio system comprising at least one base station and a number of terminal equipments, data between the base station and the terminal equipments being transmitted in both directions on the same frequency band in frames consisting of time slots, and time slots assigned to the different directions of transmission being separated from one another in the time domain, wherein the number of time slots assigned to the different directions of transmission on each frequency band can be varied dynamically according to the capacity needed in the different directions of transmission.



7. A radio system according to claim 6, wherein more than one time slot is assigned for a connection between a base station and a terminal equipment of the system.

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8. A radio system according to claim 7, wherein the numbers of time slots assigned for a connection in the different directions of transmission are not equal.

9. A data transmission method substantially as described herein with reference to any one of the embodiments, as that embodiment is shown in the accompanying drawings.

10. A digital radio system substantially as described herein with reference to any one of the embodiments, as that embodiment is shown in the accompanying drawings.

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DATED this Thirty-first Day of March 1999

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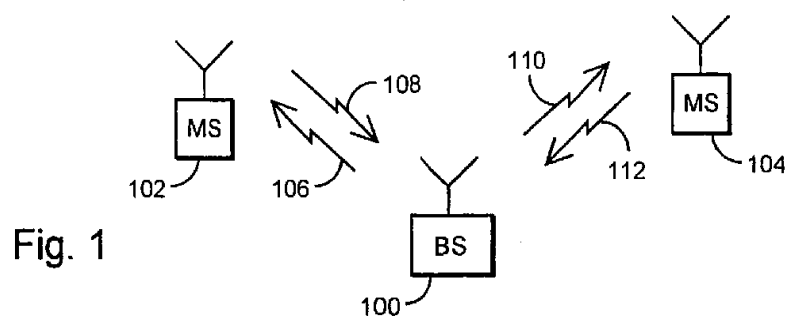


Fig. 1

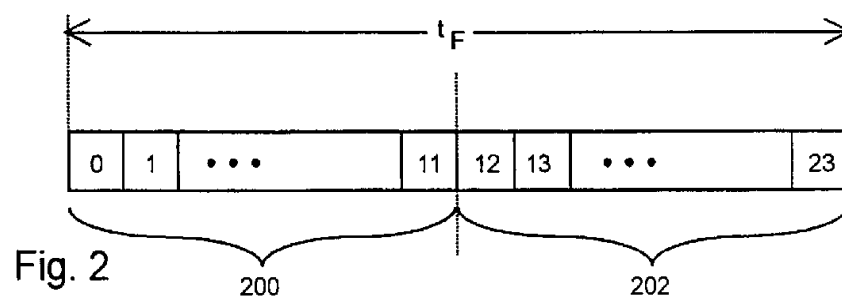


Fig. 2

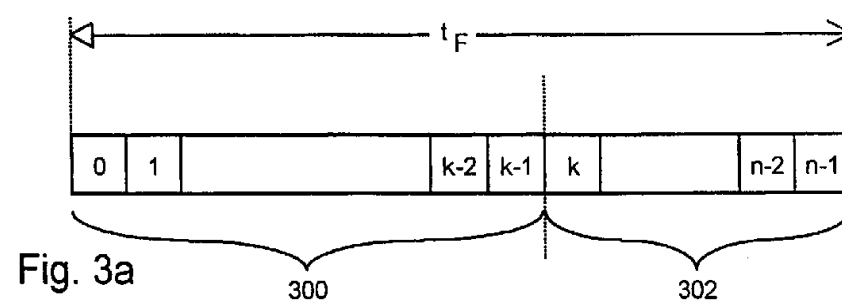


Fig. 3a

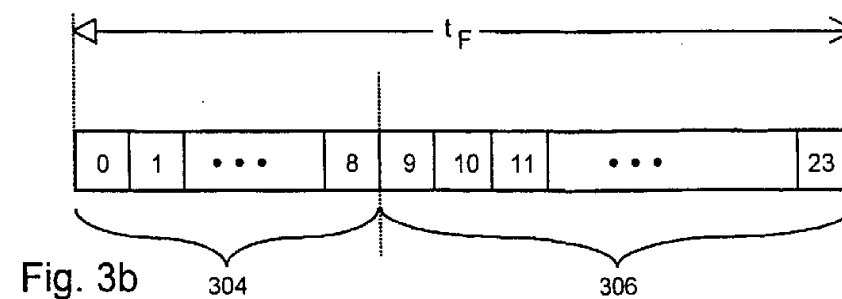


Fig. 3b