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(54) Title: MULTIUSER OFDM OR DMT COMMUNICATIONS SYSTEM FOR USERS TRANSMITTING AT DIFFERENT DATA RATES

(57) Abstract: A multi-user OFDM or DMT communication system has nodes which are allowed to transmit continuously on one or just a few of the system's frequency sub-channels, while the other nodes avoid putting any signal into those sub-channels. Simple low data rate nodes are allowed to use a small number of sub-channels while more complicated nodes use the remainder, and preferably functionality is provided to ensure that adjacent sub-channels are reliably spaced apart in frequency so that they do not bleed over into one another; to ensure that signals from all nodes arrive at the base station with well-aligned symbol transitions (symbol synchronization); and to ensure that signals from the various nodes arrive at the base station with similar power levels (power control). Frequency assignment strategies at a base station range from one fixed sub-channel per node to a hopped group of sub-channels per node.

**INTERNATIONAL SEARCH REPORT**

International Application No

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**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04L5/02

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 7 H04L

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)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	VAN DE BEEK JAN-JAAP ET AL: "A TIME AND FREQUENCY SYNCHRONIZATION SCHEME FOR MULTIUSER OFDM" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, IEEE INC. NEW YORK, US, vol. 17, no. 11, November 1999 (1999-11), pages 1900-1913, XP000880706 ISSN: 0733-8716 page 1900, left-hand column -page 1903, right-hand column, paragraph B.; figures 1-3 page 1907, right-hand column -page 1908, left-hand column; table II	1, 4, 5, 10-12, 14, 18, 20, 22, 26, 27, 29-31
Y	---	13, 28
Y	WO 99 50985 A (TELIA AB) 7 October 1999 (1999-10-07) page 2, line 20 -page 6, line 7; figure 1 ---	13, 28
	-/--	

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

° Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

7 September 2001

Date of mailing of the international search report

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/34651

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>CHEN Q ET AL: "MULTICARRIER CDMA WITH ADAPTIVE FREQUENCY HOPPING FOR MOBILE RADIO SYSTEMS" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS,US,IEEE INC. NEW YORK, vol. 14, no. 9, 1 December 1996 (1996-12-01), pages 1852-1858, XP000639647 ISSN: 0733-8716 page 1852 -page 1853 ----</p>	1,4,5, 18,20-22
X	<p>EP 0 874 494 A (AT &amp; T CORP) 28 October 1998 (1998-10-28) column 1 -column 6; figures 1-4 ----</p>	1,4,5, 18,20-22
X	<p>US 5 726 978 A (FRODIGH CARL MAGNUS ET AL) 10 March 1998 (1998-03-10) column 1, line 59 -column 5, line 25; figures 4A-7 column 7, line 14 -column 7, line 63 ----</p>	2,14-17, 29-31
A	<p>US 5 828 660 A (KELTON JAMES ROBERT ET AL) 27 October 1998 (1998-10-27) column 1, line 40 -column 2, line 7; figures 3,4 column 2, line 50 -column 2, line 57 column 4, line 39 -column 4, line 66 column 11, line 26 -column 13, line 22 ----</p>	10-13, 26-28
A	<p>WO 99 65155 A (ERICSSON TELEFON AB L M) 16 December 1999 (1999-12-16) page 1, line 6 -page 1, line 27 page 3, line 7 -page 3, line 23 page 6, line 1 -page 9, line 15; figures 3,4 ----</p>	
A	<p>OKHAWA M ET AL: "ORTHOGONAL MULTICARRIER FREQUENCY HOPPING-CODE DIVISION MULTIPLE ACCESS SCHEME FOR FREQUENCY-SELECTIVE FADING" ELECTRONICS &amp; COMMUNICATIONS IN JAPAN, PART I - COMMUNICATIONS,SCRIPTA TECHNICA. NEW YORK,US, vol. 78, no. 8, 1 August 1995 (1995-08-01), pages 86-98, XP000547248 ISSN: 8756-6621 the whole document -----</p>	

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 00/34651

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:  
  
1, 2, 4, 5, 10-17, 18, 20-22, 26-31
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1, 4, 5, 18, 20-22

multiuser, multirate OFDM system

2. Claims: 2,17

multiuser OFDM system in which users are allocated non-adjacent subcarriers

3. Claims: 3,19

multiuser OFDM system with frequency hopping

4. Claims: 6-9,23-25

frequency synchronization in a multiuser OFDM signal

5. Claims: 10-13,26-28

timing synchronization in a multiuser OFDM signal

6. Claims: 14-16,29-31

transmission power control in a multiuser OFDM signal

7. Claims: 32-37

adaptive channel allocation in multiuser OFDM for reducing channel interference

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/34651

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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