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11/066,915 25 February 2005 (25.02.2005) US(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).(71) Applicant (*for all designated States except US*): **INTER-DIGITAL TECHNOLOGY CORPORATION** [US/US];
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(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **MARINIER, Paul** [CA/CA]; 1805 Stravinski, Brossard, Québec J4X 2J7 (CA). **CHANDRA, Arty** [IN/US]; 31 Jeffrey Place, Manhasset Hills, NY 11040 (US). **CHA, Inhyok** [US/US]; 3600 Manassas Avenue, Melbourne, FL 32934 (US). **ROY, Vincent** [CA/CA]; 6254 De La Roche, Montreal, Québec H2S 2E1 (CA).(88) Date of publication of the international search report:
13 July 2006*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: IMPLEMENTING A SMART ANTENNA IN A WIRELESS LOCAL AREA NETWORK

200	202	204	206	208	210	212	214	216	218	220	222	224	226	228	230	232	234
FRAME CONTROL	DURATION	DA	SA	BSSID	SEQUENCE CONTROL	TIME- STAMP FIELD	BEACON INFORMATION FIELD	CAPABILITY INFORMATION FIELD	SSID IE	SUPPORTED RATES IE	FH/SS PARAMETER SET IE	CF PARAMETER SET IE (OPTIONAL)	IBSS PARAMETER SET IE (OPTIONAL)	TIM IE (OPTIONAL)	TOTAL NUMBER OF BEAMS	CURRENT BEA IDENTIFIER	

(57) Abstract: A method for implementing a smart antenna in establishing association between a station (STA) and an access point (AP) in a wireless local area network begins by transmitting a beacon frame by the AP on one antenna beam. The beacon frame is received at the STA, which measures the signal quality of the beacon frame. The AP switches to a different antenna beam and repeats the method until the beacon frame has been transmitted on all antenna beams. The STA associates to the AP that transmits the beacon frame with the highest signal quality on one of its antenna beams. A similar method may be used in which the STA sends a probe request frame to the AP, which then responds with probe response frames sent on multiple antenna beams.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/31641

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8): H04B 1/38 (2006.02)

US: 455/562.1

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)

US: 370/332, 335, 342; 455/562.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

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

MicroPatent; IP.com; Ei Compendex, INSPEC, NTIS; National Technical Information Service, JICST-EPlus - Japanese Science & Technology, PASCAL, Current Contents Search, Inside Conferences; IEEE Xplore

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 6,438,389 B1 (SANDHU et al) 20 August 2002 (20.08.2002), abstract; column 1 lines 25-28, 57; column 2 line 45; column 3 lines 41-57; column 4 lines 30-34, 50-60; column 5 lines 41-44; column 6 lines 2-6, 20-25, 33-36.	1 ----- 2-5, 11
Y	WO 2004/042983 A2 (BRENNAN et al) 21 May 2004 (21.05.2004), page 12 lines 12-25.	2, 3, 11
Y	US 2004/0100936 A1 (LIU et al) 27 May 2004 (27.05.2004) abstract; paragraphs 0011, 0017, 0041-0043, 0051; Figure 4.	4, 5
Y	US 2004/0090938 A1 (HSU) 13 May 2004 (13.05.2004), paragraph 0025.	15
X ----- Y	US 2004/0114535 A1 (HOFFMANN et al) 17 June 2004 (17.06.2004), abstract; paragraphs 0028-0029, 0050, 0052.	6-9, 12 ----- 10, 14, 22
Y	US 2004/0100936 A1 (LIU et al) 27 May 2004 (27.05.2004), paragraphs 0041-0043, 0051; Figure 4.	10
Y	US 2002/0181492 A1 (KASAMI et al) 05 December 2002 (05.12.2002), paragraphs 0002, 0005, 0061, 0090, 0123, 0156; Figures 1, 6-7.	13-23, 26-30, 33, 36
Y	US 2004/0157604 A1 (SHARONY et al) 12 August 2004 (12.08.2004), Figure 1; paragraph 0014.	13-23, 26-30

☒ Further documents are listed in the continuation of Box C.☐ See patent family 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 application or patent 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

17 February 2006 (17.02.2006)

Date of mailing of the international search report

17 APR 2006

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Authorized officer:

Blaine R. Copenheaver

Telephone No. 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/31641

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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.: 38
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 No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

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

Group I, claims 1-5 and 11, drawn to transmitting beacon frames from an access point (AP) to a station (STA).

Group II, claims 6-10 and 12, drawn to transmitting probe requests from a station (STA) to an access point (AP).

Group III, claims 13-31, drawn to transmitting packets containing selected beam information between access point and station indicating a specific beam for transmission.

Group IV, claims 32-59, drawn to communicating antenna capability information between stations.

The inventions listed as Groups I, II, III and IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention includes using beacon frame sent by the AP to the STA to determine the best quality beam, the special technical feature of the Group II invention involves using probe request frames sent by the STA to the AP to determine the best quality beam, the special technical feature of the Group III invention is communicating selected beam information between access point and station wherein the information indicates a specific beam to use and the special technical feature of the Group IV invention is communicating the capabilities of the antenna beams of each station with each other.

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 additional fees, this Authority did not invite payment of additional fees.
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.:

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 and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/31641

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- X	US 2003/0169769 A1 (HO et al) 11 September 2003 (11.09.2003), abstract; paragraphs 0004, 0008, 0015, 0036, 0051, 0059.	32, 42, 43, 52-55 16, 17, 26-30, 33-41, 44, 45, 48, 50, 51, 56, 57
Y	US 2004/0103282 A1 (MEIER et al) 27 May 2004 (27.05.2004), paragraph 0907.	21, 22
Y	US 6,754,501 B1 (MCRAE et al) 22 June 2004 (22.06.2004), column 4, lines 29-37.	18, 27
Y	US 2004/0120292 A1 (TRAININ) 24 June 2004 (24.06.2004), abstract; paragraphs 41-42.	37-39, 41
Y	US 6,721,302 B1 (ALASTALO) 13 April 2004 (13.04.2004), column 1, lines 6-9; column 1, lines 20-25; column 6, lines 10-12.	34-35
Y	US 2004/0160930 A1 (CHOI et al) 19 August 2004 (19.08.2004), paragraph 0075.	40
Y	US 2003/0033394 A1 (STINE) 13 February 2003 (13.02.2003), paragraph 0036.	45, 48
Y	US 6,768,747 B1 (DOGAN) 27 July 2004 (27.07.2004), column 1, lines 34-37.	56
Y	US 2003/0123576 A1 (CLEVELAND et al) 03 July 2003 (03.07.2003), paragraph 0048.	57
Y	US 6,751,206 B1 (PADOVANI et al) 15 June 2004 (15.06.2004), column 7, lines 16-19.	44, 45, 48, 50, 51
Y	US 2004/0143428 A1 (RAPPAPORT et al) 22 July 2004 (22.07.2004), paragraphs 0045, 0151.	44, 45, 48, 50, 51
A	US 2004/0152458 A1 (HOTTINEN) 05 August 2004 (05.08.2004), see entire document.	1-59
A	US 2004/0004951 A1 (ZUNIGA et al) 08 January 2004 (08.01.2004), see entire document.	1-59
A	US 2004/0157637 A1 (STEER et al) 12 August 2004 (12.08.2004), see entire document.	1-59
A	US 2004/0170153 A1 (STEWART et al) 02 September 2004 (02.09.2004), see entire document.	1-59
A	US 2004/0170140 A1 (BACKES et al) 02 September 2004 (02.09.2004), see entire document.	1-59